CSE 4701 Fall 2023
Homework 4: Due 11:59 pm, Dec 6 (Wed), 2023 at HuskyCT
5% penalty per day late submission. No acceptance after Dec 8 (Fri) midnight.
Solution will be uploaded by Dec 9 (Sat) 8:00 am.

Problem 1 (10)
Prove or disprove that the following inference rule for functional dependencies.

If $\{A \rightarrow B, C \rightarrow D\}$, then $\{AC \rightarrow BD\}$

Proof can be made by using inference rules IR1 through IR3. Disproof should be done by showing a relational instance that refutes the rule.

Problem 2 (10)
Show that $AB \rightarrow D$ is in the closure of $\{AB \rightarrow C, CE \rightarrow D, A \rightarrow E\}$

Problem 3 (60)
Consider the relation schema $R = \{A, B, C, D, E, F, G, H, I, J\}$ and the set of functional dependencies $F = \{AB \rightarrow C, A \rightarrow DE, B \rightarrow F, B \rightarrow G, F \rightarrow GH, D \rightarrow IJ\}$ that hold true for R.

(a) Find a minimal cover for F.
(b) Suppose R is decomposed into three tables $R_1 = \{A, B, C, D, E\}$, $R_2 = \{B, F, G, H\}$, and $R_3 = \{D, I, J\}$. Show if this decomposition satisfies the dependency preservation property or not.
(c) Suppose R is decomposed into three tables $R_1 = \{A, B, C, D, E\}$, $R_2 = \{B, F, G, H\}$, and $R_3 = \{D, I, J\}$. Show if this decomposition satisfies the lossless join property or not.
(d) Suppose R is decomposed into three tables $R_1 = \{A, B, C, D, E\}$, $R_2 = \{B, F, G, H\}$, and $R_3 = \{D, I, J\}$. What is the key of R_1 and what best normal form is R_1?
(e) Suppose R is decomposed into three tables $R_1 = \{A, B, C, D, E\}$, $R_2 = \{B, F, G, H\}$, and $R_3 = \{D, I, J\}$. What is the key of R_2 and what best normal form is R_2?
(f) Suppose R is decomposed into three tables $R_1 = \{A, B, C, D, E\}$, $R_2 = \{B, F, G, H\}$, and $R_3 = \{D, I, J\}$. What is the key of R_3 and what best normal form is R_3?

Problem 4 (20)
Consider the schedule given next that involves three transactions T1, T2, and T3. Draw the serializibility (precedence) graph for the schedule and state whether this schedule is serializable or not. If the schedule is serializable, write down the equivalent serial schedule(s).

Transaction T_1	Transaction T_2	Transaction T_3
		read_item(Y);
		read_item(Z);
read_item(X);		
write_item(X);		
	read_item(Z);	
read_item(Y);		
write_item(Y);		
	read_item(Y);	
	write_item(Y);	
	read_item(X);	
	write_item(X);	
		write_item(Y);
		write_item(Z);

Problem 5 (20)
The figure given 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.

(a) Suppose that we use the immediate update protocol with checkpointing. Describe the recovery process from the 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.
(b) What should be the values of A, B, C, D and E once the recovery process is completed.