

**Purdue University
Computer Science
Department CS44800
Homework 4
Spring 2024**

Reference:

- **Fundamentals of Database Systems by Elmasri & Navathe, 7th Edition**

Total Points: **3 points**

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Provide concise but to the point explanation to support your answers. If possible, use bullets to organize the ideas in your answer.

Question 1. (0.75 points)

Consider the universal relation $R = \{A, B, C, D, E, F, G, H, I, J\}$ and the set of functional dependencies F .

$F =$

$\{\{A, B\} \rightarrow \{C, D\},$
 $\{D\} \rightarrow \{E, F, G\},$
 $\{F, G\} \rightarrow \{H\},$
 $\{A\} \rightarrow \{I\},$
 $\{A, B\} \rightarrow \{E, G\},$
 $\{A, I\} \rightarrow \{I, J\}\}$

- (a) What is the closure of the set $\{A, D\}$?
- (b) What is the key for R ?
- (c) What is the minimum cover for the set of functional dependencies F ?

- (d) Decompose R into 2NF.
- (e) Decompose R into 3NF.

Question 2. (0.75 points)

- (a) What are the possible sources of the information that defines the functional dependencies that hold among the attributes of a relation schema? Discuss two possible sources. Explain your answer.
- (b) What is meant by the closure of a set of functional dependencies? Illustrate with an example.
- (c) What is the lossless (or nonadditive) join property of a decomposition? Why is it important?

Question 3. (0.75 points)

Consider the following four schedules for transactions T1, T2 and T3:

- a. r1(X); r3(X); w1(X); r2(X); w3(X); w2(X)
- b. r1(Y); r3(Y); w3(X); w1(X); r2(X); w2(Y)
- c. w2(X); r1(Y); w2(Y); r2(X); w2(Y); r3(Y)
- d. r3(X); r2(X); w3(X); r1(Y); w1(X); r2(Y)
- e. r3(X); r2(X); r1(X); w3(X); w1(X); w2(X)

- (a) For each schedule, specify whether or not the schedule is conflict serializable and why. To determine if a schedule is conflict serializable you can either use the precedence graph or swap conflicting operations.
- (b) Then, for each serializable schedule, give the equivalent serial schedule.

Question 4. (0.75 points)

Consider the following actions taken by transaction T1 on a database with objects X and Y:

R1(X), W1(X), R1(Y), W1(Y)

Without altering the order of operations of T1, give example schedules with an additional Transactions T2 (with 4 operations accessing both database objects X and Y) that fulfill the following conditions:

- (a) Give an example schedule using two transactions (T1 and T2) which is conflict serializable.
- (b) Give an example schedule using two transactions (T1 and T2) which is not conflict serializable. Explain why the schedule is not conflict serializable.