

Homework 6: Relational Design Theory (75 points)

Due Date: Thursday, May 26, 2016 11:45 PM, on EEE

Submission

All homework assignments should have the student IDs and names of your team members. Remember that all homework assignments should be done in a group. This homework assignment should be submitted on EEE before 11:45 pm on the due date. Only one student in a group should submit the file. Everybody on the team is required to have the finally submitted version. Refer to the following table for the submission guidelines. After the 24-hour grace period, no more submission is allowed on EEE. That is, we will **not** accept assignments after that time. We will publish the solutions at that time for the next assignment. Please get all your work in on time!

Date / Time	Place	Remark
Thursday, May 26, 2016 11:45 PM	EEE dropbox	Due date
Friday, May 27, 2016 11:45 PM	EEE dropbox	24-hour grace period - 10 points will be deducted

Relational Design Theory [75 pts]

1. [20pts] We have a relation $R(A,B,C,D)$ with four attributes. For each of the following sets of FDs, assuming those are the only dependencies that hold for R , do the following: (a) Identify the candidate key(s) for R . (b) Identify the strongest form that R satisfies (1NF, 2NF, 3NF, or BCNF), and point out a single dependency that violates the normal form.

- 1) $C \rightarrow D, C \rightarrow A, B \rightarrow A$
- 2) $A \rightarrow B, B \rightarrow C, D \rightarrow A$
- 3) $AB \rightarrow D, D \rightarrow B$
- 4) $A \rightarrow B, A \rightarrow C, C \rightarrow D$
- 5) $BC \rightarrow A, BC \rightarrow D, A \rightarrow C, D \rightarrow B$

2. [20pts] Answer the following questions:

- (1) Give a set of FDs for the relation schema $R(A,B,C,D)$ with primary key AB under which R is in 1NF but not in 2NF.

- (2) Give a set of FDs for the relation schema $R(A,B,C,D)$ with primary key AB under which R is in 2NF but not in 3NF.

3. [10 pts] Suppose we have a relation R with 6 attributes $ABCDEF$. Part of its instances is listed below:

A	B	C	D	E	F
1	2	4	6	3	6
2	1	5	7	9	7
3	2	4	6	3	8
4	1	4	0	9	9

Try to infer all the function dependencies in relations R , and listed as follow:

4. [25pts] Consider the attribute set $R = ABCDEGH$ and the FD set $F = \{AB \rightarrow CD, AC \rightarrow B, AF \rightarrow E, BD \rightarrow A, B \rightarrow C, E \rightarrow G\}$.

(a) For each of the following attribute sets, do the following: (i) Compute the set of dependencies that hold over the set (ii) Name the strongest normal form that is not violated by the relation containing these attributes.

(1) ABC , (2) $ABCD$, (3) $ABCEG$, (4) $DCEGH$, (5) $ACEH$

(b) Which of the following decompositions of $R = ABCDEG$, with the same set of dependencies F , is dependency-preserving? Explain why.

Decomposition 1: $\{AB, BC, ABDE, EG\}$

Decomposition 2: $\{ABC, ACDE, ADG\}$

Extra Credits

[10pts] Decompose each of the attribute sets in Question 4(a) into a collection of BCNF relations if it is not in BCNF.