Database Systems, CSCI 4380-01
Homework # 2
Due Friday February 2, 2018 at 2:00:00 PM

Homework Statement. This homework is worth 4.5% of your total grade. If you choose to skip it, Midterm #1 will be worth 4.5% more. Remember, practice is extremely important to do well in this class. I recommend that not only you solve this homework, but also work on homeworks from past semesters. Link to those is provided in the Piazza resources page.

This homework targets the normalization theory.

SUBMISSION INSTRUCTIONS. Submit a PDF document for this homework using Gradescope. No other format and no hand written homeworks please. No late submissions will be allowed. Please put answer for each question on a separate page for easiest grading!

Question 1 (10 points). Given a relation $R(A, B, C, D, E, F)$, are the following two sets of functional dependencies equivalent or not? Please show your work in arguing for or against it Note that you do not need to show the details of closure computation, but you should show which closures you compute and which functional dependencies in each set are and are not implied by the other data set as a result.

$\mathcal{F}_1 = \{AB \rightarrow C, CD \rightarrow E, BE \rightarrow D, D \rightarrow F\}$

$\mathcal{F}_2 = \{ABD \rightarrow EF, BE \rightarrow DEF, AB \rightarrow BC, D \rightarrow F, CDF \rightarrow E\}$

Question 2 (40 points). You are given the following relations and associated set of functional dependencies.

For each part, you must do the following: (1) First, find and list all the keys. (2) Then, assess whether the relation is in Boyce-Codd Normal Form. If it is not, list all functional dependencies that violate it. (3) Finally, assess whether the relation is in Third Normal Form. Discuss why or why not.

(a) $Book(ISBN, Author, Title, Version, Publisher)$, $\mathcal{F} = \{ISBN \rightarrow Title, Publisher\}$

(b) $R1(A, B, C, D, E)$, $\mathcal{F}_1 = \{AB \rightarrow C, AB \rightarrow DE\}$

(c) $R2(A, B, C, D, E)$, $\mathcal{F}_2 = \{AB \rightarrow CD, D \rightarrow E\}$

(d) $R3(A, B, C, D, E, F)$, $\mathcal{F}_3 = \{AB \rightarrow CDEF, F \rightarrow B\}$

Question 3 (20 points). Find the minimal basis for the following set of functional dependencies. Show the changes in each step.

$\mathcal{F}_2 = \{ABD \rightarrow EF, BE \rightarrow DEF, AB \rightarrow B, D \rightarrow F, CDF \rightarrow E\}$

Question 4 (30 points). You are given the following:

$\mathcal{F} = \{AB \rightarrow CD, AE \rightarrow G, GD \rightarrow H, HB \rightarrow ED\}$ for relation $R(A, B, C, D, E, F, G, H)$

and the decomposition: $R1(A, B, C, D, G)$, $R2(B, E, H)$, $R3(A, B, G, H, F)$

(a) Is the above decomposition lossless? Use chase decomposition to show whether it is lossy or lossless?