

Homework 2

Name: YOUR NAME HERE

SID: SID HERE

April 17, 2018

Due 11:59PM May 2, 2018. **READ ALL DIRECTIONS VERY CAREFULLY!** Submit your tex files along with a generated PDF. You **MUST** put each problem on a separate page with 1a on the first page, for example 1a will be on page 1 and 1b will be on page 2 (this template is already setup for this). Try to keep each answer to one page. You **MUST** put your name and student ID in the provided author section above. **FAILURE TO DO SO MAY RESULT IN NO CREDIT!**

Problem 1

For this problem you will consider following relation and set of FDs:

$R(A, B, C, D, E)$

$B \rightarrow C$

$BE \rightarrow D$

$DC \rightarrow E$

$DE \rightarrow A$

- a. What are the keys of R ? (**Show your closures**)

- b. Show that the set of FDs is a minimal basis; if it is not a minimal basis find a minimal basis for the FDs.

- c. What are all of the BCNF violations that follow from the FDs? (**Don't just consider the listed FDs, but all that follow.**)

- d. Decompose R into BCNF. For each relation, list the keys, and make sure the set of FDs for each is a minimal basis.

- e. What are all of the 3NF violations that follow from the FDs? (**Don't just consider the listed FDs, but all that follow.**)

- f. Decompose R into 3NF. For each relation, list the keys, and make sure the set of FDs for each is a minimal basis.

g. What are all of the 4NF MVD violations that follow from the FDs?

- h. Decompose R into 4NF. For each relation, list the keys, FDs and MVDs.

- i. If you project the relation R onto $S(A, B, C)$ what nontrivial FDs and MVDs hold in S ?

Problem 2

For this problem you will consider following relation and set of FDs:

$Courses(C, T, I, H, R, S, G)$

$CT \rightarrow I$

$TIH \rightarrow R$

$THR \rightarrow C$

$THS \rightarrow R$

$CTS \rightarrow G$

Where C, T, I, H, R, S , and G are the course, term, instructor, hour, room, student, and grade respectively.

- a. Use the chase test to prove/disprove that $CTH \rightarrow G$ holds in Courses.

- b. Use the chase test to prove/disprove that $CTH \rightarrow R$ holds in Courses.

- c. Use the chase test to prove/disprove that the proposed decomposition has a lossless join.

 $R_1(C, T, I, H)$ $R_2(C, T, H, R, S)$ $R_3(C, T, S, G)$

- d. Decompose Courses into 3NF.

- e. Which of your relations in 3NF are not in BCNF?

- f. Which of your relations in 3NF are not in 4NF?

Problem 3

Design a academic genealogy database with one entity set: Academics. An academic's academic parent is their doctoral advisor, their grandparent is their doctoral advisor's advisor, etc. There are at least two other signators on a disertation other than the doctoral advisor. The information to record about academics includes their birth name, date of birth, date of death (if deceased), field, dissertation title, institution, doctoral advisor, second signer, third signer and any academic children.