

DASC 5333 Database Systems for Data Science
CSCI 4333 Design of Database Systems
Spring 2023
Homework #7

Functional Dependency and Normalization Analysis

[1] (25%) Conduct normalization analysis on SCSP (HW #3 and #4) by listing the FDs and the highest normal form of each relation. You must use [h7q1_template.docx](#) (which is based on the suggested solution of HW #4). Complete the task by filling in the rows "Normalization Analysis."

[2] (25%) List the candidate keys and the highest normal forms for the following relations.

- [a] R(A,B,C,D) {A->C, C->A}
- [b] R(A,B,C,D) {A->BD, C->D}
- [c] R(A,B,C,D) {AB ->CD, D->C}
- [d] R(A,B,C,D) {A->BC, BC->D}
- [e] R(A,B,C,D) {A->B, B->C, C->D, C->A}

[3] (25%) Consider the relation StudentDormMeal with the following attributes.

stuId, stuName, dormName, dormRoom, dormFee, mealPlan, planFee, semester

The relation stores information about students being assigned to rooms in dorms.

stuId	stuName	dormName	dormRoom	dormFee	mealPlan	planFee	semester
S1	Lee	Hunter	101	2500	P1	600	Fall 2022
S2	Smith	Hunter	101	2500	P2	750	Fall 2022
S3	Black	Hunter	102	4000	P1	600	Fall 2022
S4	Simons	Hunter	101	2600	P1	600	Spring 2023
S5	Casino	Forest	101	1800	P2	750	Spring 2023

For example, the first two rows indicate that S1 (lname: Lee) and S2 (lname: Smith) are roommates assigned to room 101 of the Hunter dorm in Fall 2022. Their dorm fees must be the same in that semester as they live in the same room of the same dorm: \$2,500. They have different meal plans, which cost differently. Plan P1 costs \$600 and P2 costs \$750 in Fall 2022. The third row stores the information of S3 assigned to a single occupancy room: Hunter 102. Row 4 shows S4 assigned to Hunter 101 with meal plan P1. The dormFee is different in Spring 2023 (blame inflation). Fortunately, the meal plan P1 costs the same in Spring 2023. Row 5 shows an assignment to a different dorm, Forest.

(a) List all applicable functional dependencies. (Make reasonable assumptions if necessary.)

(b) What are the candidate keys?

(c) What is the highest normal form? Why?

(d) If the highest normal form is not BCNF, can you decompose the relation TD losslessly into component relations in BCNF while preserving functional dependencies? If yes, how. If no, why?

[4] (20%) Consider the following relation

$R(A,B,C,D,E) \{B \rightarrow CD, A \rightarrow C, D \rightarrow E\}$

(a) Show all candidate keys.

(b) What is the highest normal form (up to BCNF)? Why?

(c) If it is not in BCNF, can you losslessly decompose R into component relations in BCNF while preserving functional dependencies?

[5] (5%) It is known that for $R(A,B,C,D)$:

1. R has two candidate keys
2. A is a superkey.

How many superkeys can R have?

Your solution filename should be h7_<<Your name>>_<<Your Student ID>>.docx.
Submit your homework through Blackboard.