CS145 Fall 2021 Homework 4

20 November 2021

HW4 is due on 12/03 at 11:59AM (No Late Days Allowed)

Question 1 [12 points] - Functional Dependencies

Consider a relation R(A, B, C, D, E) which satisfies the following functional dependencies:

- $\{A\} \rightarrow C$
- $\{D\} \rightarrow E$
- $\{B, E\} \rightarrow A$

Question 1.1 [8 points] - Closures

Calculate the closures of the following sets of attributes:

a) $\{D\}$

b) $\{A, D\}$

c) $\{A, E\}$

d) $\{B, D\}$

e) $\{C, E\}$

f) $\{A, B, E\}$

g) $\{B, C, D\}$

h) $\{A, B, C, D\}$

Question 1.2 [4 points] - Keys/Superkeys

Identify all the keys and superkeys of the relation.

Question 2 [10 points] - More FDs

Question 2.1 [2 points] - Keys

Consider a relation R(A, B, C, D, E, F, G, H, I, J) which satisfies the following functional dependencies:

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

What are the key(s) in R?

Question 2.2 [4 points]

Consider the relation *R(A, B, C)* below with the following values.

A	**B**	**C**
a_1	b_1	c_1
a_1	b_1	c_2
a_2	b_1	c_2
a_2	b_1	c_2

List all the non-trivial **functional dependencies** that the above relation satisfies.

Question 2.3 [4 points]

Consider the same relation as in part 2.2. Assume that the value of attribute C of the second record (a_1, b_1, c_2) is changed from c_2 to c_1. What are the non-trivial **functional dependencies** satisfied by the relation now?

Question 3 [5 points] - Anomalies

Consider a table with schema defined as Player(player name, team name, stadium, league, goals, assists).

player name	team name	stadium	league	goals	assists
Lionel Messi	Barcelona	Camp Nou	La Liga	8	4
Luis Suarez	Barcelona	Camp Nou	La Liga	6	0
Cristiano Ronaldo	Juventus	Allianz	Serie A	5	1
...	...	...	...	...	...

Question 3.1 [2 points]

Say Barcelona builds a brand new stadium and we want to update the table to reflect this change. Let's say there are 30 players in our table that have their team name as Barcelona. Describe what could be a potential problem or why this might be inefficient.

Question 3.2 [3 points]

Describe how you might go about fixing the problem you described above.