Group Assignment 4 - Functional Dependencies and Normalization

CS4.301: Data and Applications
Course Instructor: Kamal Karlapalem

Due:11:59 PM, September tbd, 2021
Released: September 25, 2021

1 The Task

For Group Assignment 4, you are required to solve the following questions. The questions test your understanding and application of functional dependencies and the four normal forms.

2 Questions

2.1 Question 1

Consider $R(A_1, A_2, ..., A_n)$ to be a relation with functional dependencies defined as follows:

$$A_1 \rightarrow A_2A_3...A_n (i = 1)$$
$$A_2A_3 \rightarrow A_4A_5...A_nA_1 (i = 2)$$
$$A_4A_5A_6 \rightarrow A_7A_8...A_nA_1A_2A_3 (i = 3)$$

Functional dependencies of the sequence,

$$A_{\frac{(i-1)(i)}{2}+1}A_{\frac{(i-1)(i)}{2}+2}....A_{\frac{(i-1)(i)}{2}+i} \rightarrow A_{\frac{(i-1)(i)}{2}+i+1}....A_nA_1....A_{\frac{i(i-1)}{2}}$$

For i>3 and till $\frac{(i-1)(i)}{2} + i = n$.

Given the premise, answer the following questions.

Question 1.1 For what values of n is the above set of functional dependencies possible?
Question 1.2 How many keys does the relation R have and what are they?
Question 1.3 State the normal form of the above relation and normalize it to $BCNF$ (if valid) using decomposition rules.
Question 1.4 Find the minimal cover of the above relation and use it to normalize it to $BCNF$ (if valid).

2.2 Question 2

Consider $R(A_1, A_2, ...A_n)$ be a relation R with functional dependencies as follows:

$$A_i \rightarrow A_j \; \forall \; 1 \leq i < j \leq n$$

and,

$$A_i \rightarrow A_j \; \forall \; 1 \leq i > j \leq n$$

Given the premise, answer the following questions.

Question 2.1 How many keys does the relation R have and what are they?
Question 2.2 State the normal form of the above relation and normalize it to $BCNF$ (if valid) using decomposition rules.
Question 2.3 Find the minimal cover of the above relation and use it to normalize it to $BCNF$ (if valid).

3 Submission Instructions

Please submit a single PDF from the team named as <teamname>.pdf (without the <and >). All the best!