CSC6341 Database Systems

Assignment for Functional Dependence and Normalization

Objectives

- Be familiar with functional dependence inference rules.
- Be able to prove functional dependence equivalence.
- Be able to normalize a database design into normal forms.

Key Ideas

- Functional dependence
- Normal form

Problems

Reference: Chapters 11 and 12 by C. J. Date and Chapter 12 by Elmasri

1. (10 points) Given two sets of functional dependencies (FDs) for a relational table $R\{A, B, C, D, E\}$.

   Use the inference rules (Armstrong's axioms) to prove that the two sets of FDs are equivalent, that is, one set of FDs can be derived from the other.

   Set 1: $A \to B$ $AB \to C$ $D \to AC$ $D \to E$
   Set 2: $A \to BC$ $D \to AE$

2. (10 points) Consider the following relation with attributes of A, B, and C.

Tuple	A	B	C
1	A1	B1	C1
2	A1	B2	C2
3	A2	B1	C4
4	A3	B4	C3
5	A4	B1	C1
6	A5	B4	C3

   Given the tuples of the relation above, which of the following functional dependencies may hold in the above relation? If any dependencies don't hold, explain why.

   A. $A \to B$

B. $B \rightarrow C$

C. $C \rightarrow B$

D. $C \rightarrow A$

3. (20 points) **Normalization:** Consider a relation called CAR_SALE that is used to keep track of car sales by each salesman in a car dealer. The attributes of the relation CAR_SALE are:

   CAR_ID,
   SALESMAN_ID,
   DATE_SOLD
   COMMISSION%,
   DISCOUNT_AMOUNT.

   The meaning of the attributes is self-explanatory. Assume that a car may be sold by multiple salesmen and the primary key of the relation is {CAR_ID, SALESMAN_ID}. Additional functional dependencies are:

   DATE_SOLD →DISCOUNT_AMOUNT,
   SALESMAN_ID →COMMISSION%
   Based on the given primary key and functional dependencies, is this relation is 1NF, 2NF, or 3NF? Why? If not, how would you successively normalize it completely?

4. (10 points) Discuss database insertion and deletion anomalies with examples and the benefits of database normalization in avoiding those anomalies.