CS-317 Data Management and Information Processing
Spring 2003

Quiz 2 Solutions

Problem 1
There is a problem while decomposing a set of schema, with respect to a given set of functional dependencies, to satisfy BCNF. BCNF sometimes cannot satisfy all the given functional dependencies by decompositions. In other words, sometimes in order to make the set of schemas conform to BCNF one must disregard some of the functional dependencies.

Problem 2
a)
Integrity constraint is the restriction on the values that can appear in the tuples of the database.

b)
Referential integrity constraint is used to ensure that each value of a foreign key attribute refers to an entity that appears in the foreign table. Any attempt to modify the database contents that would cause a foreign key violation must be disallowed. Relational database systems provide enforcement of the referential integrity constraints. The constraint is specified in the database schema, and the database system enforces it.

Consider the following two schemas:
R1 (key-1, a1, a2)
R2 (key-2, b1, b2, b3, key-1)

Following is one policy of enforcing this type of a constraint, whenever a tuple in R1 is deleted; we must delete all the tuples in R2 which have the value of key-1 to be the value of key-1 in the deleted tuple (of R1).

Problem 3
The schema, R, is not in third normal form with respect to any of the functional dependencies, FD_1 or FD_2 or FD_3.

R (A, B, C, D, E, F, G, H) is the given relational schema

We first decompose it with respect to FD_1
We obtain:
R_1 (A, B, C) and R_2 (B, D, E, F, G, H)
We note that this is not in 3NF with respect to FD_2 and FD_3
So we can decompose it with respect toFD_2 to obtain:
R_{21} (B, D, E, H) and R_{22} (H, F, G)
Both of these are in 3NF even for FD_3

Hence the final set of schemas which are in 3NF with respect to all the functional dependencies are:
R_1 (A, B, C)
R_{21} (B, D, E, H)
R_{22} (H, F, G)

An alternative decomposition would be
R (A, B, C, D, E, F, G, H) is the given relational schema

We first decompose it with respect to FD_1

We obtain:

R_1 (<u>A</u>, B, C) and R_2 (<u>B</u>, D, E, F, G, H)

We note that this is not in 3NF with respect to FD_2 and FD_3

So we can decompose it with respect toFD_3 to obtain:

R_{21} (<u>B</u>, D, E, F, G) and R_{22} (<u>E</u>, <u>F</u>, <u>G</u>, H)

Both of these are in 3NF even for FD_2

Hence the final set of schemas which are in 3NF with respect to all the functional dependencies are:
R_1 (<u>A</u>, B, C)
R_{21} (<u>B</u>, D, E, F, G)
R_{22} (<u>E</u>, <u>F</u>, <u>G</u>, H)

Problem 4

(a)

$\sigma_{\text{Street = "Maple Street" or City = "Evanston"}}$ (Employee)

(b)

$\Pi_{\text{Person_name}}$ ($\sigma_{\text{Company_name = "First Bank Corporation" and Salary > 40,000}}$ (Works))

(c)

$\Pi_{\text{Person_name}}$ ($\sigma_{\text{Company_name = "First Bank Corporation"}}$ (Works)) –
$\Pi_{\text{Person_name}}$ ($\sigma_{\text{Manager_name = "Johnson"}}$ (Manages))

(d)

$\Pi_{\text{Person_name}}$ ($\sigma_{\text{Salary > 35,000}}$ (Works)) $\cap$ $\Pi_{\text{Person_name}}$($\sigma_{\text{Manager_name = "Johnson"}}$ (Manages))

(e)

$\Pi_{\text{Person_name}}$ ($\sigma_{\text{ Employee.city = Company.city}}$ (Employee X Company))

(f)

$\Pi_{\text{Person_name}}$ ((Works X Company) - $\sigma_{\text{Company.Company_name = "First Bank Corporation"}}$ (Works X Company))