Homework Assignment #2

Database Systems course (2008-2009)

Objectives

To understand and be able to manipulate E/R diagrams.
To understand functional dependencies, BCNF and 3NF.
To understand how to use views in queries

Tools

For this assignment, you may need a database to help and validate your answers. For this purpose you can use Oracle database as discussed in the first assignment.

Submission

Please print your solution and submit it (hardcopy) to my mailbox – 372 (on Schreiber's second floor)

Questions 1 (ER Diagram → Schema) [30 Points]

Assume you have been hired to design a database for the following scenario. You may add any necessary attributes, but overall try to keep your design simple. Don't forget to add unique identifier for each relation.

a. Design an E/R schema diagram for this database using as much of the E/R model as appropriate.
b. Map the schema that you designed above to relations. For each relation, give all attributes and keys. For example:
   - Table1(field1, field2)
   - Table2(field3, field4)

The scenario:

You were hired to design a database for a video game store. Each product in the store has a unique product id along with its name, price and year of production. The store sells consoles (Xbox,PS,Wii.. the difference between them is the type of the CPU, GPU and the number of controllers). In addition, they also sell video games (rating, description and console type – xbox,ps…) and peripheral hardware (color and console type).

To support online transaction via their website, customers can register an account (including user_id, name, password, and registration date). Currently, the store supports payment by credit card only (sorry no cash..), but the system should be able to store more than one credit card for each account. For each card the system should save the card number, type (visa, mastercard..) and expire date. When a customer enters the site, a new transaction is created (with a unique transaction id) for all the products she buys. Note that the customer can buy more than one item of the same kind in the same transaction (for example, you would like to buy 3 extra Wii controllers..). Each such transaction is finally paid by a credit card from the system. Note that the manager would need to keep this information (including the date) for future customer service stuff.

Question 2 (Functional Dependencies and BCNF) [20 Points]

Given below is the set F of functional dependencies for the relational schema:

R = {A, B, C, D, E, F, G, H}

A → B

C → D, E

E → A

B, E → F

H → D, A

B → A

a. Find a minimal key for this relation
b. What are all the nontrivial functional dependencies that follows from the given?
c. Decompose the relation into a collection of relations that are in BCNF

Question 3 (Function Dependencies and 3NF) [20 Points]

Given below is the set F of functional dependencies for the relational schema:

R = {A, B, C, D, E, F}

A → B, C

B, D → E

E → F

F → D

a. Find **ALL** minimal keys for this relation
b. What are all the nontrivial functional dependencies that follows from the given?
c. Decompose the relation into a collection of relations that are in BCNF
d. Now decompose this relation into a collection of relations that are in 3NF.

Question 4 (Relationship between BCNF and 3NF) [5 Points]

a. If a schema is in BCNF is it also true that it is in 3NF? Explain why or why not in a sentence or two.
b. If a schema is in 3NF is it also true that it is in BCNF? Explain why or why not in a sentence or two.

(Question 5 is on the next page)

Question 5 (Views in queries) [25 Points]

Consider the following relational schema:

Users(user_id, user_name, password, birthday)
Products(product_id, product_name, product_price)
Receipts(receipt_id, user_id, purchase_date)
PurchaseDescription(receipt_id, product_id, quantity)

This schema describes a simple online store, which has users data (user_id, name, password, birthday) and products data (product_id, name, price). To keep track of sales, the store uses two tables: the Receipts, which stores a unique receipts_id for each sale (with the user purchasing and the date) and the purchase description table which describes the items purchase for each sale.

a. Write a view which returns the users who bought something in 2008
b. Write a view which returns all the products that never been sold
c. For the following 2 queries, consider whether it is possible to use just the view to answer each one. If yes, show the query that uses the view. If not, explain why.

Query 1

```
SELECT    user_id
FROM      users
```

Query 2

```
SELECT    users.user_id
FROM      users, product, receipts, purchasedescription
WHERE     receipts.user_id          =    users.users_id                    AND
          receipts.receipt_id       =    purchasedescription.receipt_id    AND
          products.product_id       =    purchasedescription.product_id    AND
          product.price * purchasedescription.quantity > 100
GROUP BY  user.user_id
```

View

```
SELECT    users.user_id, SUM(product.price * purchasedescription.quantity)
FROM      users, product, receipts, purchasedescription
WHERE     receipts.user_id          =    users.users_id                    AND
          receipts.receipt_id       =    purchasedescription.receipt_id    AND
          products.product_id       =    purchasedescription.product_id
GROUP BY  user.user_id
```