Homework Assignment #2
Database Systems course (2011)

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 MySQL database as discussed in the first assignment.

Submission

Please print your solution and submit it (hardcopy) to Rubi's mailbox – 370 (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 an online media store. The store sells three main types of media: Songs, Movies and Albums. For each one the store saves a unique id, along with a name, price and the year of production. Each Album contains a set of Songs, along with the corresponding track number of each one, and the genre of the entire album. The store also records the length and the rating (P.G.13, R…) of each movie, and the length and the artists of each song. Note that several artists can be associated with a single song, and thus the system also stores a list of artists (unique id and name) for future search.

To support online transactions via their website, customers can register an account (including user_id, name, password, and registration date). When a customer wishes to buy new media, a new transaction is created (with a unique transaction id) for that session. The user can then select several and different types of media to purchase. (but a user cannot purchased twice the same media). Each such transaction is finally paid by a credit card (the system saves the last 4 digits of the card number and the date of the transaction).

Finally, as the store supports online streaming of the media, it also keeps track of the "play count" (the number of times the media was accessed) of each user for each of her purchased media.

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}

A, B → C

B, C → D

A, E → F, G

a. Find **ALL** minimal keys for this relation
b. What are all the nontrivial functional dependencies that follow 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

B → C, D

D → F, A

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

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 receipt_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 contains all the products (id and name) which were purchased more than once by the same (any) user (in different sales).
b. Write a view which contains all the products (id and name) that were always sold in single quantity.
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    DISTINCT user_id
FROM      purchaseDescription
```

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 > 50
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
```