

Homework Assignment #2

Database Systems course (2009-2010)

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 – 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 know **Facebook**? Good, you are doing something similar.

When a user first enters the system, she needs to provide her details (unique username, first/last name and birth date). The most common operation is "friends with" (i.e. "rubi and itay are friends"), so you should keep track of all these relations.

The second common operation is picture uploading. A user can upload as much pictures as she desired and the systems remembers the uploader and the image (for simplicity, assume it's a string representing a location on disk – i.e. "e:\image1.jpg"). In addition, the user can also tag the picture with the appropriate users (can be more than 1). You should save the location of each user in the picture (assume it's a square identified by X and Y coordinates).

The last option the user can do is add "events" which are identified by a unique id. Note that both event needs to save the date they are created and creator (user). Event can be either a "photo album", which saves also the location entered by the creator, or a "calendar event" which holds the start date, end date and a description. The user can also add a guest list for the calendar event which saves the rsvp status of each guest (attending/maybe/not attending). Finally, the user can add any of the uploaded pictures (i.e. more than 1) to either event (photo/calendar).

Question 2 (Functional Dependencies and BCNF/3NF) [20 Points]

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

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

$A \rightarrow B$

$B, C \rightarrow A, D$

$E, F \rightarrow C$

$A, G \rightarrow F$

- Find **ALL** minimal keys for this relation
- Decompose the relation into a collection of relations that are in BCNF
(don't forget to mark the keys of each new relation (e.g. $\{A, \underline{B}, \underline{C}\}$))
- Now decompose this relation into a collection of relations that are in 3NF.

Question 3 (Function Dependencies and BCNF) [15 Points]

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

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

$A \rightarrow C$

$C \rightarrow D$

$E, D \rightarrow C$

$F \rightarrow A, E$

- Find a minimal key for this relation
- What are all the nontrivial functional dependencies that follows from the given?
- Decompose the relation into a collection of relations that are in BCNF
(don't forget to mark the keys of each new relation (e.g. $\{A, \underline{B}, \underline{C}\}$))

Question 4 (Relationship between BCNF and 3NF) [10 Points]

- 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.
- 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.

- Write a view which returns all products (their ids and names) sold at 2008 but not at 2009.
- Write a view which returns all sold products (their ids and names) and their quantity (from all purchases) at 2009.
- 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
```