CS 1555 – Database Management Systems (Fall 2019)
Dept. of Computer Science, University of Pittsburgh

Assignment #7: Database Design - Normalization and ER Model

Release: Oct. 31, 2019 Due: 8:00 PM, Wednesday, Nov. 13, 2019

Goal

This is a **group** assignment and your group is the same as your term project team. The goal of this assignment is to understand and gain familiarity with conceptual database design. You will practice using normalization techniques. Then you will design a database using the E-R Model and then translate it into a relational schema.

Questions [100 points total]

1. Consider the following set of functional dependencies:

   AB → E

   ABE → ED

   B → DE

   C → DE

   C → F

   DC → A

   DF → A

   E → D

   (a) [15 points] Using synthesis approach, construct a set of 3NF/BCNF relations from the above functional dependency. Indicate the primary keys for these relations and whether or not are in 3NF or BCNF.

   (b) [5 points] Using the table method, check whether the constructed set of relations is lossless or not. If not correct them.

2. Assume the following functional dependency set to be:

   FD1: MedicineID → Ingredients, Uses, Warnings, Directions
   FD2: OrderID → OrderDate, PatientID, TotalPrice
   FD3: PatientID → Address, City, State, ZipCode, PhoneNumber
   FD4: MedicineID, OrderID → MedicineQuantity

   [20 points] Using universal relational approach, construct a set of 3NF/BCNF relations from the above functional dependencies. Indicate the primary keys for these relations.

3. Consider a database system that facilitates the operations for an electronic auctioning system, similar to "ebay.com". The system needs to keep track of information of registered users, products that have been put for auction by registered users, bidding history and selling history of each product on auction.

   Some of the intended uses of the database system include:

   - For each registered user, record his/her name, address, email, a unique login-name and password.
   - For each product put for auction, record its name, an (optional) description, one or several categories that it belongs to (e.g., 'books-and-records', 'software', 'automobiles', 'appliances', etc). Each product should have a unique auction-id.
   - Keep track of information about a product for auction such as who is selling it, the minimum acceptable price, auction starting date and its status (i.e., 'under auction', 'sold', 'withdrawn').
   - Keep track of every bid made by registered users, such as the bidder's name, the date when the bid was made, and the amount of the bid, etc.
   - If a product was sold successfully, we want to know who bought the product with what bidding price, and when it was sold.
   - For each product category, record its (unique) name. We want to organize the categories into a hierarchical structure such that one category can contain 0 or more subcategories.

   Please state all assumptions explicitly, as well as any constraints that need to be specified in the database schema.

   (a) [40 points] Produce a conceptual design of the schema using the E-R Model and express it using E-R diagrams from the above natural language description. In order to enhance the readability of your E-R diagrams, you may specify only the key attributes for each entity/relationship type and the constraints on relationships. You are also asked to provide separately the complete diagram of every entity type with complex attributes.

   (b) [20 points] Translate your E-R diagram of conceptual schema into a relational model schema using the algorithm provided on the class web page and in the textbook.

How to submit your assignment

1. For the E-R diagrams, your are required to use a graph editor (such as dia, MS-Word, MS-powerpoint MacDraw, idraw, xfig) to generate your diagrams.
   Handwritten diagrams, even if they are scanned and submitted electronically, will not be accepted/graded.
2. Create a single file named `hw7-team<team_number>` in PDF (.pdf) or Microsoft Word (.doc) format, containing your answers to all questions.
   Do not forget to include your names and usernames (account names) in the file.
3. Submit your assignments through the Web-base submission interface (go to the class web page http://db.cs.pitt.edu/courses/cs1555/current_term/ and click the Submit button). Only one student of each group should submit the assignment. The student who should submit the assignment is the student whose username appears first in alphabetical ordering.
   It is your responsibility to make sure the assignment was properly submitted.
4. Submit your assignment by **8:00 PM, Wednesday, Nov. 13, 2019**. There is no late submission.

Academic Honesty

The work in this assignment is to be done *independently* by each group. Discussions with other students not in your group on the assignment should be limited to understanding the statement of the problem. Cheating in any way, including giving your work to someone else will result in an F for the course and a report to the appropriate University authority.