Virginia Tech. **CS 4604 – Introduction to DBMS**
Computer Science **Spring 2013, Prakash**

Homework 3: E/R Diagrams
(due March 6th, 2013, 9:05am, in class—hard-copy please)

Reminders:

a. Out of 100 points.
b. Rough time-estimates: ~3-5 hours.
c. Please type your answers. Illegible handwriting may get no points, at the discretion of the grader. Only drawings may be hand-drawn, as long as they are neat and legible.
d. There could be more than one correct answer. We shall accept them all.
e. Whenever you are making an assumption, please state it clearly.

Important:

f. If there are parts of a problem that E/R diagrams cannot model, state these as "notes". Make sure you follow all the rules and conventions discussed in class and in the textbook to correctly denote all aspects of the E/R diagrams, including keys, multiplicity and referential integrity constraints. Please do not invent your own syntax!
g. Ditto for RA/SQL queries---use only operators and syntax discussed in the class/in the textbook.

Q1: Fans and teams [15 points]

Exercise 4.1.3 on page 139 of the textbook (make sure you have the third edition of the book). Assume that each fan can at have at most one favorite team, at most one favorite player, and at most one favorite color. In addition, indicate appropriate referential integrity constraints.

Q2: Garage Database [20 points]

We want to design a database for a local garage. For each customer, we want to record the (unique) name, the customer address, and the contact phone number. For each vehicle, we want to record the unique vehicle's identification number (VIN), and the vehicle's make, model and year. For each repair job we want to record the description of the job done (maximum 200 chars), the date, and the total dollar cost. A repair job may involve zero or more parts (like, e.g., "windshield wipers", "battery", etc.) For each part we want to record its (unique) part number, the part name and its cost. In addition, note that:

- Each vehicle may have 1 or more repair jobs.
- Each customer may be the primary owner of 1 or more vehicles.
- Every vehicle has only one primary owner (we ignore co-owners).

- No vehicle can have more than one repair job in any given day.

Please answer the following questions:

Q2.1. (10 points) Draw an ER diagram for this database. Make sure to indicate primary keys, cardinality constraints, weak entities (if any), and participation constraints. List any assumptions you make in the process.

Q2.2. (10 points) Translate the ER diagram in Q2.1 into relational database tables (i.e. give the SQL DDL statements). Make sure that the translation captures key constraints (primary keys and foreign keys if applicable) and participation constraints in the ER diagram. Identify constraints, if any, that you are not able to capture.

Q3: Restaurant Database [20 points]

The student administrator of the Mini University wants to design a database for profiling students' preferences for the nearby restaurants and the dishes. For example, the student Jack Smith likes the "rib eye steak" at the "TGI Fridays", not the "rib eye steak" at the "Olive Garden", while the student Nancy Graham likes the Italian spaghetti at "Zeppoli's".

- Each student has his/her SSN, the name, and the department.
- Each restaurant has its name, and the mailing address.
- The name of a restaurant may not be unique, but the mailing address is unique.
- Each dish has the name and the price.
- The price of a dish might differ on different restaurants. For example, "rib eye steak" is $15 at "TGI Fridays", but $20 at the "Olive Garden".
- The name of a dish is unique within a restaurant. Two restaurants may have the same dish name.
- A dish is offered by at least one restaurant, and a restaurant offers at least a dish.

Q3.1. (10 points) Draw an ER diagram for this database. Make sure to indicate primary keys, cardinality constraints, weak entities (if any), and participation constraints. List any assumptions you make in the process.

Q3.2. (10 points) Translate the ER diagram in Q3.1 into relational database tables (i.e. give the SQL DDL statements). Make sure that the translation captures key constraints (primary keys and foreign keys if applicable) and participation constraints in the ER diagram. Identify constraints, if any, that you are not able to capture.

Q4: Reverse Engineering [20 points]

This question tests how well you understand the algorithm for converting E/R diagrams to relational schemas. An E/R diagram when converted to relations (using the mechanical construction that we know and love) gives rise to the following relations:

- R(<u>a</u>, b, c)
- S(<u>a, d</u>)
- T(<u>a, d</u>, f, g)

You may assume that the same symbols refer to the same attribute and different symbols refer to different attributes (e.g., the attributes *a* in the relations R, S and T are the same) i.e. it ultimately comes from a single entity set or relationship in the E/R diagram.

Your task is to *reverse-engineer* the E/R diagram from these relations; in other words, what E/R diagram could have produced these relations. For full credit, give **two different** E/R diagrams that could have produced these (and only these) relations (i.e. 10 points for each correct E/R diagram).

Q5: Doctor Database [25 points]

Design an E/R diagram for the following situation: Doctors prescribe drugs for patients. A given doctor can prescribe many drugs for a certain patient. Sometimes a doctor may not prescribe any drug to a patient. Many doctors can treat a patient. Many doctors can prescribe the same drug to the same patient. A prescription can involve more than one patient (e.g., a mother and her baby) and more than one drug, but is associated with a unique doctor. Furthermore, if a prescription involves multiple patients, the doctor prescribes each drug on the prescription only for one patient. You can assume that any given drug appears only once on a prescription.

Hints

This problem may be trickier than it appears. Carefully consider what the instances of each entity set and relationship in your E/R diagram will look like. Reading all the examples in the textbook may help.