Written Assignment #1
CAS CS 460: Introduction to Database Systems
Summer 2017

Due: Friday, June 2, 2017 in class.

Problem 1. [25pts]
A used-car trading company hires you to design a database. The database will store information about used automobiles for sale.

- Each automobile has a (unique) VIN (vehicle identification number), a model (e.g., Golf), a make (e.g., VW), a year (e.g., 2000), a color (e.g., red), a mileage (e.g., 50,000), and a body style (e.g., coupe).
- For each car we need to store if it was involved in an accident and for each accident we need to keep the location, the date and time, cars involved, the damage, and the insurance report.
- Each automobile has a seller, who has a unique id (seller-id) and may be either a dealer or an individual. For each dealer, the database stores name,company, address, phone number. For each individual, only phone number and email address are recorded.
- In addition, we need to maintain reviews about automobiles. Each review is about one particular model, make, and year. Each review has an author. The same author may write several reviews about the same model, make, and year. The database should be able to connect each car with the reviews about the make, model, and year of that car (that can be used in a Web site that the company plans to develop).
- You can make any additional assumptions that you want.

Complete the following tasks:

1. Create the E-R diagram.
2. List the primary keys, candidate keys, weak entities (if any), discriminators, and cardinalities.
3. Turn the E-R diagram into tables (relational model schema).
4. Indicate the primary and candidate keys in the tables (no need to write the SQL statements here but it is fine if you do it).

Problem 2. [30pts]
Suppose that you need to design a database for an airport. The relevant information that must be stored is:

- Every airplane has a registration number, and each airplane is of specific model.
- The airport accommodates a number of airplane models, and each model is identified by a model number (e.g. A-320, B-767) and has a capacity and a weight.
- A number of technicians work at the airport. You need to store the name, SSN, address, phone number, and salary of each technician.
- Each technician is an expert on one or more plane model(s), and his or her experience may overlap with that of other technicians. This information must also be recorded.
- Traffic controllers must have an annual medical examination. For each traffic controller, you must store the date of the most recent exam.
- All airport employees (including technicians) belong to a union. You must store the union membership number of each employee. You can assume that each employee is uniquely identified by an SSN.

- The airport has a number of tests that are used periodically to ensure that airplanes are still airworthy. Each test has a Federal Aviation Administration (FAA) test number, a name, and a maximum possible score.
- The FAA requires the airport to keep track of each time a given airplane is tested by a given technician using a giving test. For each testing event, the information needed is the date, the number of hours the technician spent doing the test, and the score the airplane received on the test.

1. Give an E/R diagram for this database. Very briefly explain the intuitive meaning of any entity and relationship sets. Make sure to list the primary keys, candidate keys, weak entities (if any), discriminators, and cardinalities.
2. Turn the E-R diagram into tables (relational model schema). Indicate primary and candidate keys. Give the SQL statements to create the corresponding relations in a relational DBMS.

Problem 3. [25pts]
Consider the following relational database that stores information about the performance of credit card companies:

Issuer(bank, card)
Bank_location(bank, location)
Max_limits(card, max_limit)

An instance of the database is the following:

Issuer	
Bank	**Card**
Amex	American Express
First Federal	Visa
First Federal	MasterCard
Chase	Visa
Citizens	Visa
Citizens	American Express
Citizens	MasterCard
Citizens	Discovery
Fleet	Visa

Bank_location	
Bank	**Location**
Amex	Chicago
First Federal	LA
Chase	NY
Citizens	Boston
Fleet	Boston

Max_limits	
Card	**Max_limit**
Visa	$50,000
MasterCard	$100,000
Discovery	$100,000
American Express	$500,000

Write the following queries in **Relational Algebra**:

1. Which credit cards are issued by banks in Boston?
2. Which credit cards *are not* issued in NY?
3. Which banks issue credit cards with a limit less than $100,000?
4. Which banks issue MasterCard and Visa but *no* other cards?
5. Which banks issue all credit cards?

Problem 4. [20pts]
Consider a database with the following schema:

Employee(SSN, name, salary, DNo)
Department(DNo, DeptName, MgrSSN)
Project(PNo, location, ProjName)
HourLog(SSN, PNo, hours)

The Employee relation provides a list of employees with their SSN, name, salary, and department number (DNo). The SSN is unique for each employee. Each employee belongs to only one department. The Department relation contains a list of the departments for the company. Its schema includes a unique department number called DNo. It also includes the name of the department (DeptName) and the social security number of the department's manager (MgrSSN). Each department has only one manager. The Project relation includes a unique project number (PNo), location and the project name (ProjName). An employee can be assigned to any number (including zero) projects. Each project has at least one person assigned to it. Finally, the HourLog relation lists for each project the number of hours of work for each employee who is assigned to that project. The key of this relation is SSN and PNo. Write the following queries in **Relational Algebra**. You may use assignment of intermediate results for long queries.

1) Find the name and the SSN of everyone who works more than 100 hours on a project located in Boston.

2) Find the name and SSN of everyone who works for department number 1 and also works on project number 2.

3) Find the name and the SSN of everyone who works on at least two projects.

4) Find the name and the SSN of everyone who works on all projects.