Homework 1

1. Computer Sciences Department frequent fliers have been complaining to Dane County Airport officials about the poor organization at the airport. As a result, the officials decided that all information related to the airport should be organized using a DBMS, and you have been hired to design the database. Your first task is to organize the information about all the airplanes stationed and maintained at the airport. The relevant information is as follows:

(a) Every airplane has a registration number, and each airplane is of a specific model.

(b) The airport accommodates a number of airplane models, and each model is identified by a model number (e.g., DC-10) and has a capacity and a weight.

(c) A number of technicians work at the airport. You need to store the name, SSN, address, phone number, and salary of each technician.

(d) Each technician is an expert on one or more plane model(s), and his or her expertise may overlap with that of other technicians. This information about technicians must also be recorded.

(e) Traffic controllers must have an annual medical examination. For each traffic controller, you must store the date of the most recent exam.

(f) 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 a social security number.

(g) 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.

(h) The FAA requires the airport to keep track of each time a given airplane is tested by a given technician using a given 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.

Draw an ER diagram for the airport database. Be sure to indicate the various attributes of each entity and relationship set; also specify the key and participation constraints for each relationship set. Specify any necessary overlap and covering constraints as well.

2. Consider the following schema:
Suppliers(sid: integer, sname: string, address: string)
Parts(pid: integer, pname: string, color: string)
Catalog(sid: integer, pid: integer, cost: real)

The Catalog relation lists the prices charged for parts by Suppliers. Write the following queries in SQL:

(1). Find the snames of suppliers who supply every part.

(2). Find the sids of suppliers who charge more for some part than the average cost of that part (averaged over all the suppliers who supply that part).

(3). For each part, find the sids of the supplier who charges the most for that part.

(4). Find the sids of suppliers who supply only red parts.

(5). Find the snames of suppliers who supply a red part or a green part.

(6). For every supplier that supplies a green part and a red part, print the name and price of the most expensive part that she supplies.

3. Consider the following relations:
Student(snum: integer, sname: string, major: string, level: string, age: integer)
Class(name: string, meets_at: time, room: string, fid: integer)
Enrolled(snum: integer, name: string)
Faculty(fid: integer, fname: string, deptid: integer)

The meaning of these relations is straightforward; for example, Enrolled has one record per student-class pair such that the student is enrolled in the class.

(1). Write the SQL statements required to create these relations, including appropriate versions of all primary and foreign key integrity constraints.

(2). Express each of the following integrity constraints in SQL unless it is implied by the primary and foreign key constraint; if so, explain how it is implied. If the constraint cannot be expressed in SQL, say so. For each constraint, state what operations (inserts, deletes, and updates on specific relations) must be monitored to enforce the constraint.

(a) Every class has a minimum enrollment of 5 students and a maximum enrollment of 30 students.

(b) Every faculty member must teach at least two courses.
(c) Only faculty in the department with deptid=33 teach more than three courses.

(d) Two classes cannot meet in the same room at the same time.

(e) No department can have more than 10 faculty members.

(f) The number of CS majors must be more than the number of Mathematics majors.