Exam I
Computer Science 420
Dr. St. John
Lehman College
City University of New York
12 March 2002

NAME (Printed) _____

NAME (Signed) _____

E-mail _____

Exam Rules

- **Show all your work. Your grade will be based on the work shown.**

- **The exam is closed book and closed notes.**

- **When taking the exam, you may have with you pens or pencils, and an 8 1/2" x 11" piece of paper filled with notes, programs, etc.**

- **You may not use a computer or calculator.**

- **All books and bags must be left at the front of the classroom during this exam.**

- **Do not open this exams until instructed to do so.**

Question 1	
Question 2	
Question 3	
Question 4	
Question 5	
Question 6	
Question 7	
Question 8	
Question 9	
Question 10	
TOTAL	

1. True or False:

   (a) ____ All database management systems are relational.

   (b) ____ Only relationships can have attributes in E/R diagrams.

   (c) ____ Every bag is a set.

   (d) ____ Every key is a superkey.

   (e) ____ Every superkey is a key.

   (f) ____ Attributes that are keys cannot appear in functional dependencies.

   (g) ____ If for a relation R, $X \rightarrow$ all attributes, then X is a key for the relation R.

   (h) ____ Every functional dependency is a multivalued dependency.

   (i) ____ You cannot embed a query inside another query.

   (j) ____ Views can queried as if they were tables.

2. Answer the following in two sentences or less:

   (a) What is a constraint?

   (b) What is the difference between a bag and a set?

3. Consider the relation $R(A, B, C, D)$ with the function dependencies:

$$B \rightarrow C \text{ and } B \rightarrow D$$

   (a) What are the keys of R?

   (b) How many superkeys are there of R? Justify your answer.

4. (a) Draw an E/R diagram for the following situations. Indicate any keys, weak entity sets, or subclasses:

Entity sets *Teams*, *Players* and *Fans*. A team has its name, its players, its team captain (one its players), and the colors of its uniform. For each player, you should keep track of his/her name. And, for each fan, we have his/her name, favorite teams, favorite players, and favorite color.

(b) Translate your E/R diagram into a relation schema. Indicate keys for each relation as well as any functional dependencies that hold about each relation.

5. For each of the following types of situations, give an example **and** draws its E/R diagram:

   (a) a weak entity set:

   (b) a relationship with roles:

6. (a) Consider a relation $R(A, B)$ with two tuples: $R = \{(1, 2), (2, 3)\}$.

      i. Does $A \rightarrow B$ hold for this instance of R?
         Circle one: YES   NO

      ii. Does $A \twoheadrightarrow B$ hold for this instance of R?
          Circle one: YES   NO

   (b) Now consider a relation $R(A, B, C)$ with two tuples: $R = \{(5, 2, 1), (7, 2, 6)\}$.

      i. Does $A \rightarrow B$ hold for this instance of R?
         Circle one: YES   NO

      ii. Does $B \rightarrow C$ hold for this instance of R?
          Circle one: YES   NO

      iii. Does $AB \twoheadrightarrow C$ hold for this instance of R?
           Circle one: YES   NO

7. Given the relation schema:

   `Movie(title, year, length, inColor, studioName)`

   (a) Write a query that lists all movies made after 1990:

   (b) Write a query that lists all movies with "Star" in the title:

8. Given the relation schema $R(A, B, C, D)$ with the functional dependencies

$$A \rightarrow B$$
$$B \rightarrow C$$
$$C \rightarrow A$$
$$A \rightarrow D$$

(a) Indicate all the Boyce Codd Normal Form violations. Do not forget to consider dependencies that are not in the given set, but follow from them. However, it is not necessary to give violations that have more than one attribute on the right side.

(b) Indicate all the Third Normal Form violations. Do not forget to consider dependencies that are not in the given set, but follow from them. However, it is not necessary to give violations that have more than one attribute on the right side.

(c) Decompose the relations, as necessary, into a collection of relations that are in **Third Normal Form**.

9. Given the relation schema:

   `Employee(ID, Name, Address, Phone, YearHired)`

   where `ID` is the employee's company identification number and the key for relation. `Name`, `Address`, and `Phone` are the employee's name, address, and phone number. The year the employee was hired is stored in `YearHired`.

   (a) Write the SQL statement that will create the table above. Remember to include the types of the data as well as any keys. Include the constraints that the `Name` must not be `NULL` and the default value for `Address` is ``1600 Pennsylvania Avenue''.

   (b) Write the SQL statements that will add the following employees to the table:

   ```
   Abraham Lincoln, employee number 16, no known phone, hired: 1861
   George W. Bush, employee number 42, 202-456-1414, hired: 2001
   Bill Clinton, employee number 43, address: 55 W 125 Street, NY, NY,
                   hired: 1993
   ```

   [You do not need to worry about information not provided above. You only need to insert into the table the data provided.]

   (c) What is the result of the following query on your database:

   ```
   SELECT name, address, phone
   FROM Employee;
   ```

10. (a) Define Boyce-Codd Normal Form (BCNF):

(b) Define Third Normal Form (3NF):

(c) Define Fourth Normal Form (4NF):

(d) Is every relation in Third Normal Form also in Fourth Normal Form? If yes, explain why. If no, give an example that shows why this is not true.

(e) Is every relation in Fourth Normal Form also in Boyce Codd Normal Form? If yes, explain why. If no, give an example that shows why this is not true.