Final Review
CMSC 362
Marmorstein
Spring 2014

Name: _____

Relational Algebra and Tuple Relational Calculus

Suppose we have a database with the schema:

System(hostname: string, address: inet, last_reboot : date, cost : money)
User(username: string, password: string)
Connections(hostname: string, username: string)

1. **(5 pts)** Write a relational algebra query that lists the last reboot of all systems that cost at least $500, but did not cost more than $2000.

2. **(5 pts)** Write a relational algebra query that lists all of the computers that have been logged into by more than one person.

3. **(5 pts)** Write a relational algebra query which lists the hostname and last reboot_time of all systems which have NOT been connected to by any user.

4. **(5 pts)** Is the relational calculus expression { t | t is in Systems AND t[cost] != 30,000} a safe expression? Justify your answer.

Functional Dependencies

5. **(5 pts)** Suppose that we have the following functional dependencies:
$$\{username\} \rightarrow \{password\}$$
$$\{hostname\} \rightarrow \{address, last\_reboot, cost\}$$

Answer the following with "True" or "False":

a. {password} -> {username} must also hold in this database.

b. {hostname, address} -> {last_reboot} must hold in this database.

c. {hostname} -> {username} must hold in this database.

d. {username, password} -> {username} must hold in this database.

Normal Forms

6. **(5 pts)**

Decompose the table shown below into first normal form.

Name	Location	Phone 1	Phone 2
Smith, Charles	Farmville, VA	434-392-6666	
Smith, Shannon	Anaheim, CA	434-395-1118	434-666-7777

Write the schema for the new database and then draw new the new tables and fill them in with the appropriate values.

7. **(10 pts)** Decompose the following table into a set of equivalent tables in 3NF:

Assume the following non-trivial FDs (as well as all the trivial ones, of course):

{place, date}->{event}
{date} -> {holiday}

Place	Date	Event	Holiday
Times Square	January 31	Ball Dropping	New Year's Eve
Longwood	January 31	Winter Break	New Year's Eve
Los Angeles	December 25	Cast Party	Christmas Day

Write the schema for the new database and then draw new the new tables and fill them in with the appropriate values.

SQL Queries

8. **(10 pts)** Given the schema:

      Boats(name : string, owner_last: string, owner_ first: string, length : integer)
      Owners(last : string, first : string, age: integer)

Write an SQL query that finds the longest boat which is owned by someone older than 60.

9. **(10 pts)** Using the schema from the previous problem, write an SQL query that lists the average age of the boat owners, not counting either the oldest or youngest owners.

10. **(10 pts)** Give MongoDB code for:

1. Creating a record for an employee with name "Jamie", age "20", and paygrade "5".

2. Inserting that record into the collection named "employees".

3. Performing a query against the employees database that lists the names of all employees who are more than 65 years old.

Entity-Relationship Diagrams

11. **(10 pts)** Draw an E-R diagram for the following scenario. Be sure to indicate the cardinality of all relationships, indicate the primary keys of the entities, and properly mark the weak entities.

The college library has a database of all its books and collections. The database represents the following components:

Work(with attributes "title", "author", "ISBN")
Book (with attributes "pages", "publisher", "cover")
Magazine (with attributes "volume", "issue", "month", and "year")
Collection(with attributes "name", "location")

And the following relationships:

A Book "is a" Work.
A Magazine "is a" Work.
Collections "contain" Works with attribute "call_number"

A <u>Work</u> is uniquely identified by its ISBN number. A <u>Collection</u> is uniquely identified by its name, which might be "Fiction" or "Non-fiction". Works belong to exactly one collection.

12. (5 pts) Give SQL code for creating an index on the columns "species" and "genus" of a table named "chordata".

13. (5 pts) Suppose I have the following schema:

Winners(name: text, age: integer, race: text)
Sponsorship(name: text, company: text, amount: integer)

Show how I could use a LEFT OUTER join to list the name, age, race, sponsoring company (if any), and sponsorship amount (if any) of every winner of the "Tour de France".

14. (5 pts) Suppose I have the following schema:

Winners(name: text, age: integer, race: text)
Sponsorship(name: text, company: text, amount: integer)

Give SQL code for creating a materialized view that lists all of the companies that gave at least $1000 to a winner under the age of 18.

15. (5 pts) Why won't the following query work in Cassandra?

SELECT company FROM sponsorship WHERE amount > 2500;