CS127 Homework #2

Due: September 27th, 2017 2:59 P.M.

Handing In

Upload your homework to Gradescope.
Please write your Banner ID on your submission. Do not write your name on the submission.

Warmup #1

Suppose you have a relational database of Brown professors containing their Brown ID and their salary (integer). Write a tuple relational calculus formula that returns the ID(s) of the professor(s) with the highest salary.

Professors(id, salary)

Warmup #2

Given the following relational database:

Sellers(sid, sname, address)
Products(pid, pname, color)
Catalog(sid, pid, cost)

1. Find the names of sellers who supply one or more green products
2. Find the IDs of sellers who supply every green product
3. Find all pairs of sellers IDs such that the sellers with the first ID charges more for some part than the seller with the second ID.

Warmup #3

Using the relational database schema from problem 2, answer the following questions.

1. Explain why the below query is unsafe.
   \[ \{ s \mid \neg(s \in Sellers) \} \]

2. State what the following queries compute:

   (a) \[ \{ t \mid \exists t_1 \in Catalog(\exists t_2 \in Catalog(t_2[pid] = t_1[pid] \land t_2[sid] \neq t_1[sid]) \land t[pid] = t_1[pid]) \} \]

   (b) \[ \{ t \mid \exists t_1 \in Catalog(\exists x \in Sellers(x[sname] = \text{"Stein"} \land x[sid] = t_1[sid]) \land \neg(\exists s \in Sellers(s[name] = \text{‘Stein’} \land \exists z \in Catalog(z[sid] = s[sid] \land z.cost > t_1.cost)) \land t.pid = t_1.pid) \} \]

   (c) \[ \{ t \mid \exists t_1 \in Catalog(\exists x \in Products(x[color] = \text{‘green’} \land x[pid] = t_1[pid]) \land t[sid] = t_1[sid]) \lor \exists t_2 \in Suppliers(t_2[address] = \text{‘251 Ives Street’} \land t[sid] = t_2[sid]) \} \]
Problem 4 (To Be Graded)

For the following problem, you are going to come up with an entity relationship model diagram for an enterprise. Suppose you are hired by a cell phone company called Jog Wireless, and they want you to design their database architecture. They have given you a list of the requirements and type of functionality that they want an application to support. Your job is to design an ER diagram and relational schema, and then justify how you could support the functionality they need.

1. Given the following constraints and goals of the database, design an ER diagram for their database.

   Requirements
   - Manages customer billing information, allowing automated bills to be sent to the home of the customers.
   - Tracks the current type of phones customers have along with each customer’s phone number and billing plan type.
   - Tracks text messages and phone calls and can determine each individual’s phone and text usage per month.

   Characteristics of Jog Wireless
   - Each customer has an address, a single credit card, a single active phone, and phone number.
   - Supports pay-per-minute and pay-per-text, but also supports a fixed rate unlimited plan.
   - They do not provide cellular data. They believe WiFi is the future.

   Desired Application features
   - Calculate a monthly bill for a given customer based on usage.

2. Explain your diagram and why you selected the entity and relationship sets you did in five or fewer sentences.

3. Given the ER diagram, write out a relational database schema for your database. In this schema indicate primary and foreign keys.

4. Explain how your database model would allow the application programmer to assemble the monthly bills for the customers.

Note: We recognize that there are several correct answers to this question. We will grade you on the consistency between your explanation and actual design. We will give more credit to those who have spent time considering the different database design, so in presenting material make sure to be thorough in the explanation but also keep the data model simple.
Problem 5 (To Be Graded)

After Bob, aka “Mr. Incredible”, turned in your queries, he learned from his boss that the database system actually only speaks tuple relational calculus. Bob does not remember this language. Can you help him translate the following queries to help him keep his job?

Schema:

- Product(maker, model, type)
- PC(model, speed, ram, harddrive, screen, price)
- Laptops(model, speed, ram, harddrive, screen, price)
- Printer(model, color, type, price)

Questions

1. Find the maker and model of all PCs that are less than $1000 but greater than $800.

2. What are the models of PCs that are not made by a company that also makes laptops?

3. List the maker that makes the PC with the fastest processor.

4. Which maker makes at least 2 differently colored printers but does not make a PC with a 13-inch screen?

5. What maker makes neither a red printer nor a laptop under $800?