CS430/630 – Midterm

November 9, 2020

30 points, 75 minutes

For both questions, you are given the following relational schema.

```
Dishes(did:integer, dname:string, origin:string, popularity:integer)
Recipes(did:integer, iid:integer, quantity:integer)
Ingredients(iid:integer, iname:string, unitprice:integer)
```

You must manage a database of recipes for your favorite food show.

There is a table of dishes, with a unique identifier, dish name, origin of the dish (e.g., 'Italy' or 'SouthEast Asia') and popularity (this is a numerical score calculated based on how many "likes" each dish obtains).

There is also a table of ingredients: each ingredient has a unique identifier, a name, and price per unit (in dollars). Finally, the recipes table stores how much of each ingredient is needed for each dish (assume that the quantity given in recipes is of the same unit as the unit price is measured in for table ingredients).

Question 1 (10 points)

Write **relational algebra** expressions for the following queries:

   (a) Find the dish names that do NOT contain any of the following ingredients: sugar, butter, starch.
   (b) Find the ingredient names that cost at least $10 per unit and that appear in at least one dish with popularity higher than 10,000.
   (c) Find the origin of dishes that use at least one unit of an ingredient called 'saffron'.
   (d) List the popularity of "exclusive" dishes, defined as dishes that contain only ingredients costing at least $50 per unit.
   (e) [630 only] Find the name and unit price of rare ingredients, i.e., those that appear in a single dish.

Note: for this question, you are NOT ALLOWED to use SQL, answers in SQL will not receive any marks. Derive relational algebra expressions only.

Question 2 (20 points)

Write **SQL queries** for the following:

   (a) Write a statement to create the table `Recipes`. You do NOT need to provide create table statements for the other tables. Include necessary key constraints.
   (b) Find the names of ingredients that appear in all dishes with origin 'Scandinavia'.
   (c) Find the name of ingredients that appear ONLY in dishes with origin 'Caribbean'.
   (d) Find the origin of dishes that contain at least three units of an ingredient that contains the string 'sour'.
   (e) Find the id and name of dishes that cost at least $200 to prepare (i.e., cost of all ingredients), and at the same time they include at least one ingredient costing no more than $10 per unit price.
   (f) Find the origin(s) of the dish(es) that contain the most expensive ingredient.
   (g) [630 only] Find the name(s) of the most appealing ingredient(s), defined as the ingredients with the highest average popularity score, where the average is computed over all dishes that contain that ingredient.