

CS430/630 – Homework 1

Released Feb 3rd, Due Feb 18th

50 points (5/100 of final grade)

Instructions: The homework is due **AT 17:00 EST on Fri Feb 18th**. The submission must be in a **SINGLE PDF FILE** called **HW1.pdf**. The homework must be **typeset** (handwritten submissions will **NOT** be accepted). The email **MUST BE SENT FROM YOUR @UMB ACCOUNT**, it must have subject formatted **EXACTLY AS BELOW**, and there must be a single attachment (HW1.pdf):

[CS430] HW1 - for CS430 students, and

[CS630] HW1 - for CS630 students.

The timestamp will be considered according to the UMB email server. Submissions received later than the deadline **WILL NOT BE GRADED**. You are only allowed a **SINGLE** submission (i.e., you cannot send multiple emails – only the **first received** will be graded).

Email submissions must be sent to Wenxiu Ye at <Wenxiu.Ye001@umb.edu>

Question 1 (30 points)

Consider a database schema with three relations:

```
Students (sid:integer, sname:string, age:integer)
Enrolled (sid:integer, cid:integer, grade:integer)
Courses (cid:integer, cname:string, credits:integer)
```

The keys are underlined in each relation. Students are identified uniquely by `sid`, and courses by `cid`. Students enroll to take courses, and for each course they obtain a `grade` which is an integer. `sname` is the student name (string), `age` represents the student age and is an integer. `cname` is the course name (string), and `credits` is the number of credits for a particular course (integer).

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

- Find the names of students who got grade 10 in some course.
- Find the ages of students who take some course with 3 credits.
- Find the names of students who take a course named 'Calculus'.
- Find the names of students who obtained grade at least 8 in some course that has less than 4 credits.
- Find the names of students who obtained only grades of 10 (implies that they took at least one course).
- Find the names of students who took a course with three credits or who obtained grade 10 in some course.
- Find the ages of students who attend 'Calculus' but never took any 4-credit course (assume there is a course 'Calculus' with 3 credits).
- Find the names of students who have the lowest grades.
- [630 only] Find the names of students who are enrolled in a **single** course.
- [630 only] Find the grades of students who are enrolled in course(s) with the highest number of credits.

Question 2 (20 points)

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

Dishes(did:integer, dname:string, origin:string, popularity:integer)

Recipes(did:integer, iid:integer, quantity:integer)

Ingredients(iid:integer, iname:string, unitprice:integer)

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).

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.