CS430/630 – Homework 1

Released Sep 17, Due Oct 02

50 points (5/100 of final grade)

Instructions: The homework is due **MIDNIGHT (23:59:59)** on Fri Oct 02. Please email a single PDF file to Gabriel.Ghinita@umb.edu with subject "[CS430] HW1" or "[CS630] HW1" (whether you are 430 or 630 student). File must be called HW1.pdf. Your solution must be TYPESET (you can use any text processor you like, then export to PDF).

Question 1 (25 points)

Consider a database schema with three relations:

```
Customers(cid:integer, cname:string, age:integer, zipcode:integer)
Vehicles(vin:integer, manufacturer:string, year:integer, seats:integer)
Sales(cid:integer, vin:integer, price:integer)
```

The database contains customer and vehicle information for a car dealership. The description is as follows: customers are uniquely identified by `cid` and they have as attributes name, age and zipcode of residence. Vehicles are uniquely identified by `vin`. Each vehicle has a manufacturer company (assume no two companies have the same name), production year and number of seats (how many persons fit in the car). The `Sales` relation provides information about car purchases, including price of purchase for each sale.

Write ***relational algebra*** expressions for the following queries (points shown for 430|630):

(a) Find the ages of customers in zipcode 02125. (2|2)
(b) Find the manufacturers of vehicles that sold for more than $30,000. (2|2)
(c) Find the ages of customers who bought a 'Honda' vehicle. (2|2)
(d) Find the zipcodes of customers who paid at most $20,000 for a Honda vehicle with at least 6 seats. (3|2)
(e) Find the zipcodes of customers who bought a vehicle with 2 seats, or who paid at least $50,000 for a vehicle. (3|3)
(f) Find the ages of customers who bought only vehicles manufactured by Ford. Consider only customers that bought at least one vehicle. (4|3)
(g) Find the manufacturers which had vehicles purchased from zipcode '02125', but also never had a vehicle purchased by a customer more than 40 years old. (4|3)
(h) Find the manufacturer and year of the most expensive vehicle sold. (5|3)
(i) [630 students only] Find the manufacturer(s) of the most expensive vehicle(s) bought by the youngest customer(s). Note that there may be multiple such manufacturers, due to age and/or price ties. (0|5)

Question 2 (25 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 (points shown for 430|630):

(a) Find the names of students who got grade 10 in some course. (2|2)
(b) Find the ages of students who take some course with 3 credits. (2|2)
(c) Find the names of students who take a course named 'Calculus'. (2|2)
(d) Find the names of students who obtained grade at least 8 in some course that has less than 4 credits. (3|2)
(e) Find the names of students who obtained only grades of 10 (implies that they took at least one course). (3|3)
(f) Find the names of students who took a course with three credits or who obtained grade 10 in some course. (4|3)
(g) Find the ages of students who attend 'Calculus' but never took any 4-credit course (assume there is a course 'Calculus' with 3 credits). (4|3)
(h) Find the names of students who are enrolled in a **single** course. (5|3)
(i) [630 only] Find the grades of students who are enrolled in course(s) with the highest number of credits. (0|5)