

## CS430/630 – Homework 1

Released Sep 17, Due Oct 06

100 points (10/100 of final grade)

**Instructions:** The homework is due **MIDNIGHT (23:59:59)** on Mon Oct 06. You must submit a single file called HW1.pdf. Place the file in your course folder for the class. The submissions will be automatically collected, so make sure the correct version is in your class folder at the exact time of the deadline.

Your solution must be TYPESET (you can use any text processor you like, then export to PDF). Handwritten solutions are NOT accepted.

### Question 1 (50 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. (4|4)
- (b) Find the manufacturers of vehicles that sold for more than \$30,000. (4|4)
- (c) Find the ages of customers who bought a 'Honda' vehicle. (4|4)
- (d) Find the zipcodes of customers who paid at most \$20,000 for a Honda vehicle with at least 6 seats. (6|4)
- (e) Find the zipcodes of customers who bought a vehicle with 2 seats, or who paid at least \$50,000 for a vehicle. (6|6)
- (f) Find the ages of customers who bought only vehicles manufactured by Ford. Consider only customers that bought at least one vehicle. (8|6)
- (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. (8|6)
- (h) Find the manufacturer and year of the most expensive vehicle sold. (10|6)
- (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|10)

## Question 2 (50 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. (4|4)
- (b) Find the ages of students who take some course with 3 credits. (4|4)
- (c) Find the names of students who take a course named 'Calculus'. (4|4)
- (d) Find the names of students who obtained grade at least 8 in some course that has less than 4 credits. (6|4)
- (e) Find the names of students who obtained only grades of 10 (implies that they took at least one course). (6|6)
- (f) Find the names of students who took a course with three credits or who obtained grade 10 in some course. (8|6)
- (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). (8|6)
- (h) Find the names of students who are enrolled in a **single** course. (10|6)
- (i) [630 only] Find the name(s) of the youngest student(s) who are enrolled in some course(s) with the highest number of credits. (0|10)