1. List the members of your group below. Underline your name.

2. Answer the following based on Codd's paper.[1]

   (a) How many paths are needed to support symmetric exploitation of an n-ary relation? Explain your answer.

   (b) Provide a relational algebra expression (using the algebra defined in class) for the active domain of a database composed of a single relation $R(A, B, C)$.

[1] Edgar F. Codd, "A Relational Model of Data for Large Shared Data Banks," *Communications of the ACM* 13/6 (1970).

3. Consider a database with relations `Students(id, name, year)`, `Courses(id, title, ta)`, and `Enrolls(student, course, credits)`. A tuple $(i, n, y) \in$ `Students` denotes a student with student-identifier i, name n, and year y. A tuple $(i, t, a) \in$ `Courses` denotes a course with course-identifier i, title t, and whose teaching assistant's student-identifier is a. A tuple $(s, c, r) \in$ `Enrolls` denotes the enrollment of the student with identifier s in the class with identifier c, for r credits.

   We say student t *is a TA of* student s, for r credits, if s is enrolled for r credits in a course whose TA is t. We say a *TA* t *is responsible for* r *credits* if r is the sum of credits of all student enrollments in all courses whose TA is t.

   Write a SQL query for the names and IDs of the TAs who are the TAs of the maximum number of students for r credits, for each distinct value of r occurring in the database.

4. Write an extended algebra query that is equivalent to the query of Question 3.

5. Prove or disprove: Bag intersection may be expressed using bag union and difference.

6. Provide formal definitions of each of the bag algebra operators: selection, projection, cross product, union, difference.

7. Provide expressions for the minimum and maximum cardinalities of the result of each of the operators of Question 6 as a function of the cardinalities of its operands. Justify your answers.