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 $R(A, B, C)$.

3. Consider a database with relations Students(id, name, year), Courses(id, title, ta), and Enrolls(student, course, credits). A tuple \((i, n, y) \in \text{Students}\) denotes a student with student-identifier \(i\), name \(n\), and year \(y\). A tuple \((i, t, a) \in \text{Courses}\) denotes a course with course-identifier \(i\), title \(t\), and whose teaching assistant’s student-identifier is \(a\). A tuple \((s, c, r) \in \text{Enrolls}\) 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.