Assignment (I)

Due: March 5, 2023

Problem 1 (20 points). Consider the following sample database that consists of one relation.

ID	Artist	Year	City
1	Mozart	1756	Salzburg
2	Beethoven	1770	Bonn
3	Chopin	1810	Warsaw

Table 1: *Artists*(ID, Artist, Year, City)

1. What is the schema of the database? Describe the difference between database schema and database instance.
2. List all the attributes and tuples of table *Artists*.
3. What are the primary key and superkeys of table *Artists*?
4. Can {Year} be a primary key? Explain your answer.

Problem 2 (40 points). Write the following queries in relational algebra, using the university schema from the textbook. A brief description of the university schema can be found on pp. 37–44 and a sample database can be found on pp. 1292–1298.

1. Find the ID and name of each instructor in the 'Comp. Sci.' department.
2. Find the ID and name of each instructor with the highest salary.
3. Find the ID and name of each student who has not taken any course section in 2018.
4. Find the ID and name of each instructor who has advised more than one student. Note that the table *advisor*(s_id, i_id) stores the advisor-advisee relationship where i_id (resp. s_id) is a foreign key referencing the table *instructor* (resp. *student*).

Problem 3 (40 points). Let R be a relation with schema $(A_1, \ldots, A_n, B_1, \ldots, B_m)$ and S be a relation with schema $(B_1, \ldots, B_m)$. That is, the attributes of S is a subset of R. The *quotient* of R and S, denoted by $R \div S$, is the set of tuples t over attributes $A_1, \ldots, A_n$ such that for *every* tuple s in S, the tuple ts, consisting of the components of t for $A_1, \ldots, A_n$ and the components of S for $B_1, \ldots, B_m$, is a member of R. Below is a toy example.

A	B_1	B_2
1	2	3
1	4	5
2	2	3
3	3	4

Table 2: $R(A, B_1, B_2)$

B_1	B_2
2	3
4	5

Table 3: $S(B_1, B_2)$

A
1

Table 4: $R \div S$

Write a relational algebra expression equivalent to $R \div S$, using only the operations we have defined in the lecture.

Problem 4 (10 points). How long does it take you to finish the assignment (including thinking and discussion)? Give a score (1,2,3,4,5) to the difficulty of each problem. Do you have any collaborators? Please write down their names here.