Instructions

• When writing a query, write the query in a way that it would work over all possible database instances and not just for the given example instance!

Consider the following database schema and example instance for a race car database:

Good luck

|  |  |  |  |
| --- | --- | --- | --- |
| **Racer** | **Car** | | |
| |  |  |  |  | | --- | --- | --- | --- | | **A\_ID** | **Name** | **Gender** | **Birth\_year** | | 1 | Sam | M | 1984 | | 2 | Suzan | F | 1982 | | 3 | Alice | F | 1980 | | |  |  |  |  | | --- | --- | --- | --- | | **C\_ID** | **Manufacturer** | **Horse\_power** | **Nbr of cylinder** | | C1 | Mercedes | 1200 | 6 | | C2 | Ferrari | 2400 | 8 | | C3 | Mercedes | 800 | 4 | | | |
| **Result** | **Race Sponsor** | | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Result\_ID** | **C\_ID** | **R\_ID** | **A\_ID** | **Time** | | R1\_1 | C1 | R1 | 1 | 400 | | R1\_2 | C2 | R1 | 2 | 600 | | R1\_3 | C3 | R1 | 3 | 375 | | |  |  |  | | --- | --- | --- | | **R\_ID** | **Type** | **Location** | | R1 | F1 | UK | | R2 | RallyCross | Portugal | | R3 | F1 | USA | | **R\_ID** | **C\_ID** | | **Sponsor** |
| R1 | C1 | | Motorola |
| R1 | C3 | | Pepsi |
| R2 | C4 | | Michelin |

**Schema:**

Racer: (A\_ID, Name, Gender, Birth\_year)

Race (R\_ID, Type, Location)

Result (Result\_ID, C\_ID, A\_ID, R\_ID, Time) C\_ID is a foreign key for car and A\_ID is foreign key for Racer and R\_ID is a foreign key for Race.

Sponsor (R\_ID, C\_ID, Sponsor)

Car (C\_ID, Make, Horsepower)

# Relational Algebra (total 50 points)

Question I (3 Points) Write a relational algebra expression that returns the racer’s name along with the car horsepower driven in each race.

Question II (2 Points) Write a relational algebra expression that returns the racer’s name associated with different location they raced in.

Question III (4 Points) Write a relational algebra expression that returns the sponsor, the race, and the racer name they have sponsored.

Question IV (5 Points) Write a relational algebra expression that returns the female racer ‘s name, born before 1982 with the highest race time.

Question V (5 Points) Write a relational algebra expression that returns the racer’s name and associated race sponsor that drove a ‘Mercedes’ car during at least one of their races.

Question VI (4 Points) Write a relational algebra expression that return the winner name in each race. The winner is the racer that finishes the race in least time.

Question VII (4 Points) Write a relational algebra expression that returns the horsepower per cylinder, assuming that the horsepower is equally proportional to the number of cylinders.

Question VIII (4 points) Write a relational algebra that returns the racer’s name that only drives Ferrari.

Question IX- (3 points) Write a relational algebra name that never participated in a ‘rallycross’ racer.

Question X. (4 points) Write a relational algebra expression for the cars that finished the race in a time smaller than all races average time.

Question XI- (3 points) Write a relational algebra name that participated in each race.

Question XII (5 points) Write a relational algebra expression that returns the manufacturer name whose cars won the greatest number of races.

Question XIII. (4 points) Write a relational algebra expression manufacturer for cars with low horsepower, meaning that all its manufactured cars are less than 800 horsepower.