CS-A1153 Databases, Homework 3

Deadline: Wednesday, 11 May 2022 at 18:00 (late submission until Wednesday, 18 May 2022 at 18:00 with 50% of the points)

The SQL exercises will be written and submitted in A+ environment. The problem descriptions and schemas can also be found in A+. Please submit the solutions for the problems 7–9 to the designated folder in A+ as a PDF file.

SQL aggregation queries

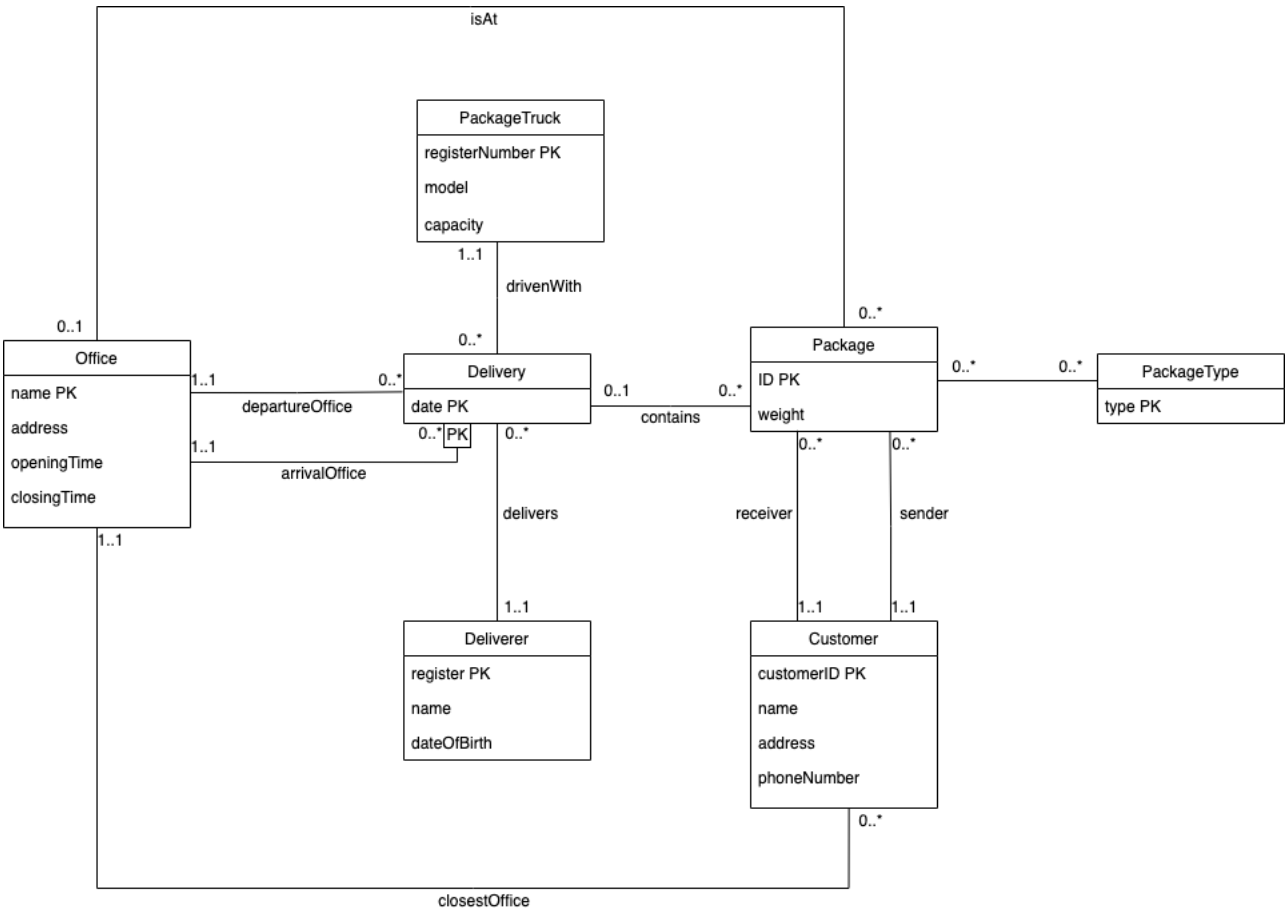
1. (1 p.) Consider the database of Orders. Write a SQL query to answer the following query: Find the average price of food products.
2. (1 p.) Consider the database of Orders. Write a SQL query to answer the following query: Find the total amount of products in each product type. The query should output the product type and the amount of products in it.
3. (2 p.) Consider the database of Orders. Write a SQL query to answer the following query: For each order, find the amount of different kinds of food products in it. The query should output the order ID and the amount of different kinds of food products.
4. (2 p.) Consider the database of Orders. Write a SQL query to answer the following query: Find the total price for each order. Note that same item can be included several times in single order (the attribute amount). The query should output the order ID and the total price of the order.
5. (3 p.) Consider the database of Orders. Write a SQL query to answer the following query: Find the customers who have spent in total at least €40 in the shop. "In total" means that the total spend can include many separate orders. The query should output the name of customer, the amount of orders he/she has made, and the total sum of the orders.
6. (3 p.) Consider the database of Orders. Write a SQL query to answer the following query: For each product type, list the number of products which have been ordered more than 1 time (e.g. the item is part of at least 2 different orders in the database).

UML to relational model

7. (8p.) Turn the given UML into a relational model using the techniques taught in the lectures. Remember to underline the key attributes.

   The UML diagram models a database for package delivery company (diagram on the next page).

   - The company has many offices, and the customers are supposed to pick their packages up from the offices unless the customer has requested home delivery. Each package can be either in an office or in a delivery truck on its way to some office.
   - The database contains the data about packages, including sender, receiver, weight of the package and the possible types of the package. The package type tells additional information about the package, for instance "express", "home delivery", "fragile", "export", or "large package". Each package can have arbitrarily many types.
   - The deliveries are driven with trucks. Each delivery will be done using exactly one truck, and each delivery is done by a single deliverer who drives the truck to the destination office. Each delivery has a departure and arrival offices.
   - Each customer has their own custom office from where they are supposed to pick up their packages.



Functional dependencies and BCNF

8. (6 p.) Consider the relational schema $R(A, B, C, D)$, and the dependencies $AB \to C$, $B \to D$, $C \to A$, and $D \to A$.

   (a) (3p.) Is the relation in BCNF? If not, prove this by counting the closures, and then use the decomposition algorithm until all the relations are in BCNF. Document each step and prove that the decomposed relations are in BCNF.

   (b) (2p.) What functional dependencies hold in the new relations?

   (c) (1p.) List for each relation which attributes form the minimal key.

9. (4p.) Consider the relational schema $R(A, B, C, D, E, F)$ with functional dependencies $AE \to CF$, $B \to F$, $C \to B$, $CDE \to A$, and $F \to DE$. Prove that the relation is not in BCNF and use the decomposition algorithm to break it to relations that are in BCNF. Document all the steps and reason why the resulting relations are in BCNF.