THE QUESTIONS 3, 4, 5, 6 and 7 REFER TO THE RELATIONAL TABLES LISTED BELOW

```
CREATE TABLE CUSTOMER(
 CUSTOMER_CODE VARCHAR(5)  NOT NULL,    /* Unique code of customer    */
 COMPANY_NAME  VARCHAR(40) NOT NULL,    /* Company name               */
 CITY          VARCHAR(15)     NULL,    /* City component of address  */
 COUNTRY       VARCHAR(15)     NULL, /* Country component of address */
  CONSTRAINT PK_CUSTOMER PRIMARY KEY (CUSTOMER_CODE) );

CREATE TABLE PRODUCT(
 PRODUCT_NAME  VARCHAR(40) NOT NULL,    /* Product name               */
 SUPPLIER_NAME VARCHAR(40) NOT NULL,    /* Supplier name              */
 CATEGORY_NAME VARCHAR(30) NOT NULL,    /* Product category           */
 UNIT_PRICE    DECIMAL(6,2) NOT NULL,   /* Unit price                 */
  CONSTRAINT PK_PRODUCT PRIMARY KEY (PRODUCT_NAME) );

CREATE TABLE ORDERS(
 ORDER_ID      DECIMAL(9)   NOT NULL,  /* Unique order identifier     */
 CUSTOMER_CODE VARCHAR(5)   NOT NULL,  /* Code of customer            */
 ORDER_DATE    DATE         NOT NULL,  /* Order date                  */
  CONSTRAINT PK_ORDERS PRIMARY KEY (ORDER_ID),
  CONSTRAINT FK_CUSTOMER_CODE FOREIGN KEY (CUSTOMER_CODE)
                              REFERENCES CUSTOMER(CUSTOMER_CODE) );

CREATE TABLE ORDER_DETAIL(
 ORDER_ID      DECIMAL(9)   NOT NULL,  /* Order identifier            */
 PRODUCT_NAME  VARCHAR(40) NOT NULL,  /* Name of ordered product     */
 QUANTITY      DECIMAL(9)   NOT NULL,  /* Ordered quantity            */
 DISCOUNT      DECIMAL(4,2)     NULL,  /* Discount applied            */
  CONSTRAINT PK_ORDER_DETAIL PRIMARY KEY (ORDER_ID, PRODUCT_NAME),
  CONSTRAINT FK_ORDER_ID FOREIGN KEY (ORDER_ID)
                         REFERENCES ORDERS (ORDER_ID),
  CONSTRAINT FK_PRODUCT_NAME FOREIGN KEY (PRODUCT_NAME)
                             REFERENCES PRODUCT (PRODUCT_NAME),
  CONSTRAINT CK_ORDER_DETAIL_QUANTITY CHECK (QUANTITY > 0),
  CONSTRAINT CK_ORDER_DETAIL_DISCOUNT CHECK (DISCOUNT between 0 and 1) );
```

QUESTION 1 (10 marks)

Read and analyse the following specification of a sample database domain.

A network of vehicle repair facilities would like to create a database with information about the repairs performed at each facility, repaired vehicles, and employees working at the facilities.

A network of vehicle repair facilities includes a number of facilities distributed all over a country. Each facility is located at a different address. An address consists of city name, street name and building number. Each facility has a name unique in a city it is located at. However, it may happen that two facilities located in different cities have the same names. Each facility has a unique phone number and unique fax number.

Each vehicle repair facility employs mechanics, junior mechanics and administration people. An employee is described by a unique employee number, first name, last name, date of birth, and hire date. A set of four attributes that includes first name, last name, date of birth, and hire date uniquely identifies each employee. Additionally, the mechanics are described by an experience level, administration people are described by a list of IT skills possessed, and junior mechanics are described by list of training courses passed. An employee works only at one maintenance facility.

The owners bring their vehicles to the repair facilities for repairs. A vehicle is described by a unique registration number, make, and model. The repair facilities perform the repairs of passenger cars, trucks, and busses. The trucks are additionally described by a weight and capacity. The busses are additionally described by the total seats available. The owners are described by a unique phone number, first name, and last name. Some of the owners use credit cards to pay for the repairs. In such cases, credit card numbers are recorded for some of the owners.

Each time a vehicle is brought for a repair, arrival date and time is recorded. When a repair process is completed, a departure date, time, and fee paid by an owner are recorded. A vehicle can be repaired at any of the repair facilities that belong to the network and of course any facility can be involved in repair of any vehicle. A repair process may take some time and its completion date is not known when the process is started.

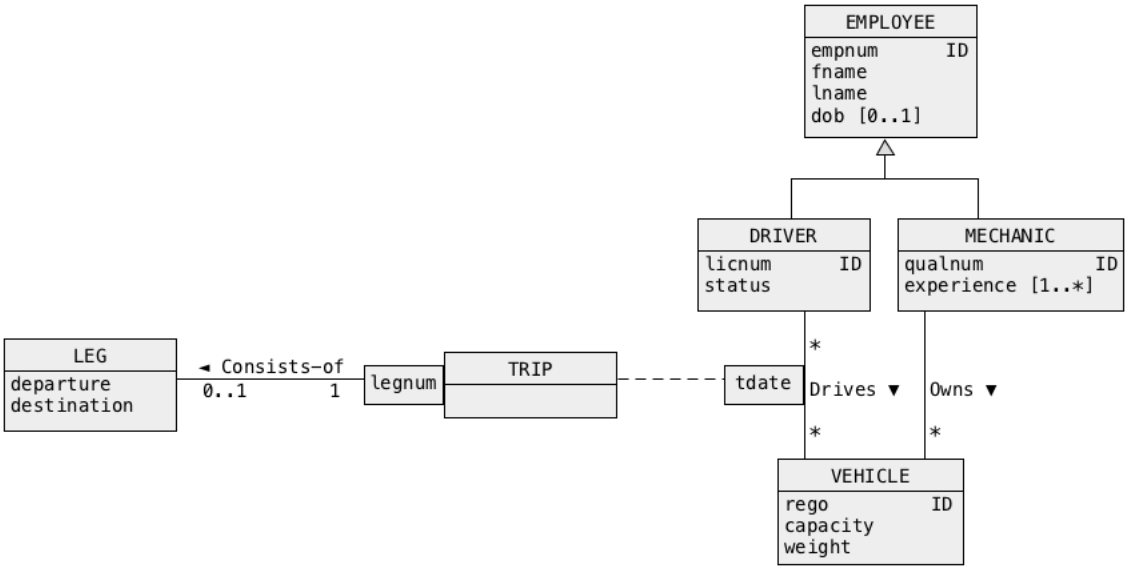
A repair process consists of one or more steps. Each step has a number, which is unique within a repair process, a short description, and a list of parts used at a step. Mechanics and junior mechanics are involved the repair processes. Both mechanics and junior mechanics can be involved in many steps of a process and each step may require involvement of many mechanics and junior mechanics.

Draw a conceptual schema for the specification of a database domain listed above. Use a notation of UML simplified class diagrams explained to you during the lecture classes in the subject.

There is NO NEED to provide a detailed analysis how a conceptual schema has been created. The final conceptual schema expressed in a notation of UML simplified classes is completely sufficient.

It is not allowed to use any artificial identifiers and any attributes that are not mentioned in a specification above.

QUESTION 2 (10 marks)
Consider a conceptual schema given below.



Your task is to perform a step of logical database design, i.e. to transform a conceptual schema given above into a collection of relational schemas.

For each relational schema clearly list the names of attributes, primary key, candidate keys (if any), and foreign keys (if any). Assume, that a **subset method** must be used to implement a generalization.

QUESTION 3 (8 marks)
Write the data definition statements of SQL that modify the structures of a database listed on a page 2 of the examination paper in the way described below. Note, that some of the modification may require more than one data definition statements of SQL statement.

(1) We would like to add to the database information about the total number of orders submitted by each customer. The total number of orders is a nonnegative integer number not greater than 999999.

(2 marks)

(2) We would like to increase the largest unit price up to 99999.99 in any currency.

(2 marks)

(3) We would like to add information about employees who handled the orders. Assume that each order can be handled by only one employee and an employee can handle many orders. An employee is described by employee number and full name. All other details are up to you.

(2 marks)

(4) In the future information about a product category name can be omitted.

(2 marks)

QUESTION 4 (8 marks)
Write the data manipulation statements of SQL that modify the contents of a database listed on page 2 of the examination paper in the ways described below. Note, that you are not allowed to modify and/or to drop any consistency constraints. Also note, that to implement some of the modifications listed below you may need more than one data manipulation statement of SQL.

(1) Today, a customer with a code `007` submitted a new order. At the moment, the largest order identifier is `123456789`. The order includes `50 Golden Bolts` and `25 Silver Screws`. No discount is applied for both items. Assume that, the descriptions of both products are already stored in the database.

(1 mark)

(2) An order with an identifier `777` has been cancelled and all information about the order must be removed from the database. Remember, that the foreign keys in `CREATE TABLE` statements have no `ON DELETE CASCADE` clause.

(2 marks)

(3) A product with a name `Golden Bolt` must change its name to `Platinum Bolt`. All other information related to the product must remain unchanged.

(3 marks)

(4) Information about the orders submitted before year `2000` must be copied to the relational tables `OLD_ORDERS` and `OLD_ORDER_DETAIL` and it must be removed from the relational tables `ORDERS` and `ORDER_DETAIL`. There is no need to enforce any consistency constraints on the new relational tables.

(2 marks)

QUESTION 5 (10 marks)
Write `SELECT` statements that implement the following queries.

(1) Find a customer code (`CUSTOMER_CODE`) and company name (`COMPANY_NAME`) of all customers who submitted at least one order in `2019`.

(2 marks)

(2) Find a customer code (`CUSTOMER_CODE`) and company name (`COMPANY_NAME`) of all customers who submitted no orders in `2019`.

(2 marks)

(3) Find a customer code (`CUSTOMER_CODE`) and company name (`COMPANY_NAME`) of all customers who submitted at least 50 orders in `2019`.

(2 marks)

(4) Find a unique order identifier (`ORDER_ID`) of all orders that included both products `Golden Bolts` and `Silver Screws`.

(2 marks)

(5) Find a company name (`COMPANY_NAME`) of all customers whose company name starts from a letter `X` and who did not provide information about their address (`CITY` and `COUNTRY`).

(2 marks)

QUESTION 6 (7 marks)
Assume that a user `root` with a password `'root'` created a database called `PURCHASES` and the user executed `CREATE TABLE` statements given on page 2 of the examination paper to create the relational tables in the database `ORDERS`.

Write SQL script that performs the following operations by a user `root`.

(1) The script creates two new users: `customer` and `clerk`. The passwords are up to you.

(2) The script allows a user `customer` for no more than 1 concurrent connection to the database and a user clerk for no more than 2 concurrent connections to the database.

(3) The script grants the access in a read (`SELECT`) and in a write mode (`INSERT`, `UPDATE`, `DELETE`) to the tables `ORDERS` and `ORDER_DETAIL`. All access rights listed above must be granted such that the user is not allowed to grant the access rights to the other users.

(4) The script grants access in read and write mode to all tables in `PURCHASES` database to a user `clerk`. The user `clerk` must have the rights to grant the privileges to the other users.

(5) The script grants the access in the read mode on a relational table `CUSTOMER` in `PURCHASES` database to a user `customer`. In this case, a user `customer` is allowed to grant the same privilege to the other users.

(6) The script grants the access in a read mode to the columns `PRODUCT_NAME`, and `CATEGORY_NAME` in a relational table `PRODUCT` to a user `customer`. A user `customer` is not allowed to grant the same privilege to the other users.

(7) The script grants the access in a read mode to information about an average unit price of all products to a user `clerk`. A user `clerk` is not allowed to grant the same privilege to the other users.

(8) The script grants the rights to create the relational tables and to create the relational views in a database `PURCHASES` to a user `clerk`. The user is allowed to propagate the privilege to the other users.

QUESTION 7 (7 marks)
MySQL does not allow for specification of complex data consistency constraints over the contents of a database within `CREATE TABLE` or `ALTER TABLE` statements.

For example, a data consistency constraint saying that *an order submitted earlier than today must include at least one product* cannot be enforced within `CREATE TABLE` or `ALTER TABLE` statements.

(1) Explain how would you enforce the following data consistency constraint:

An order submitted earlier than today must include at least one product

(2 marks)

(2) Write implementation of SQL script that enforces a constraint listed above in the sample database.

(5 marks)

In your solution, you are allowed to use a sample solution of laboratory/assignment task provided by your lecturer.