Exercise 1

You have been hired to design an RDBMS for the *Luxury Limousines Inc*. which operates a number of vehicles. The relevant information is given below.

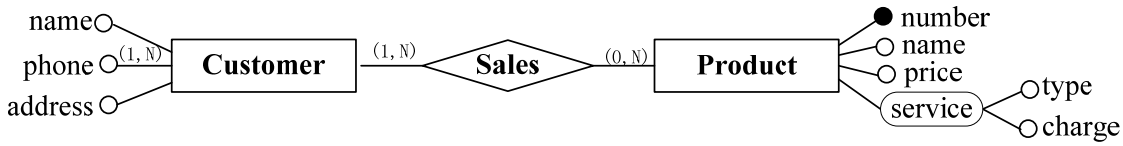
- Every vehicle has a registration number and each vehicle is of a specific model; each model is identified by a model number (e.g, LIN-2000) and has a capacity and weight. In addition, the model also has a range (eg. 100 km, 1000 km) associated with it.
- A number of technicians work for the company. You need to store the name, SIN, address, phone number and salary of each technician; Each technician specializes in one or more vehicle models. This expertise may overlap with that of other technicians. This information also needs to be recorded.
- The company has controllers who control the incoming and outgoing vehicle traffic in the vehicle areas. As they are exposed to a lot of smoke emissions and also because their job is important, they need to have an *annual medical examination*. The *date* of the *most recent exam* must be stored for each controller.
- All company employees including technicians and controller belong to a *union*. Each employee has a union membership number which must be stored. You can assume that the SIN uniquely identifies each employee.
- The company performs a number of *checks* periodically to ensure that the vehicles are in good condition. These tests are standardized by the *Bureau of Motor Vehicles* (BMV) and are identified by a *BMV test number*. The test also has a *name* and a *maximum possible score*.
- The BMV requires the company to keep track of each time a given vehicle is tested by a given technician using a given test. The information for each testing event is the date, the number of hours spent in testing and the score the vehicle received on the test.

Draw an ER diagram for the company database. Make sure to indicate the various attributes of each entity and relationship set. Also specify the key and cardinality constraints. Specify (in English) any necessary overlap and covering constraints as well.

Exercise 2

Amy's Bikes is a new bike shop located in a suburb in Ontario, offering a wide range of bicycles and related accessories. Amy, the shop's owner, has been conducting her daily business mostly on paper. She records sales on preprinted forms, which contains the invoice number and date of the sale, the customer and the employee involved in the sale and the product being sold. Employee and customer information is maintained on sheets of paper. For each employee, this includes his/her social insurance number, first and last name, and home phone number. For each customer, Amy records the first, middle (if any) and last name, as well as at least one phone number and home address (consisting of street number and post code). Different customers may have the same name. To keep track of the product inventory, Amy uses a spreadsheet program to record the number, name, price and quantity of the products in stock. For each product, a range of after-sales services is offered. The spreadsheet program is also used to list the type (e.g., repair, exchange) and charge for each service. Multiple types of service may be offered to one product (e.g., repair and exchange for bikes) and a service may be offered to multiple products (e.g., repair for bikes and accessories) at different prices.

Amy spends a lot of time maintaining this information. Recently, she has decided to use database to manage all this data. After a brief study of database design techniques, Amy drew the first ER diagram of her life (the cardinality constrains with both the maximum and minimum numbers being 1 are omitted for clarity):



Part 1: Short Answers

Consider Amy's *first attempt* of the ER design above and answer following questions.

a) What are the entity and relationship sets in the diagram?

Entity Set(s):

Relationship Set(s):

b) Are there multi-valued attributes in the diagram?

d) What is the cardinality for **Customer**?

e) What is the name of ER notation for **Service** (the rounded rectangle) in the diagram?

f) What is the key for **Product** in the diagram?

g) This diagram is both incomplete and incorrect with respect to the requirements. Give *one* missing attribute for **Sales** and explain why **Service** is modeled inappropriately.

Missing attribute: Error for Service:

Part 2: ER Schema

Now help Amy to design an ER schema that better captures the requirements. The schema should contain all relevant concepts in the requirements. You can omit the cardinality constrains if both the maximum and minimum numbers are 1. All other integrity constrains have to be explicitly represented using proper ER notation. If you think there is ambiguity in the requirements, make your assumptions and state them clearly.