Tutorial 9 – ER Model

CSC343 - Introduction to Databases
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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 <u>registration number</u> and each vehicle *is of* a specific **model**; each model is identified by a <u>model number</u> (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*, <u>SIN</u>, *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.

- 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 *Beaureau of Motor Vehicles* (BMV) and is 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 **checked** 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.

(a) 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.

A Partial Solution:
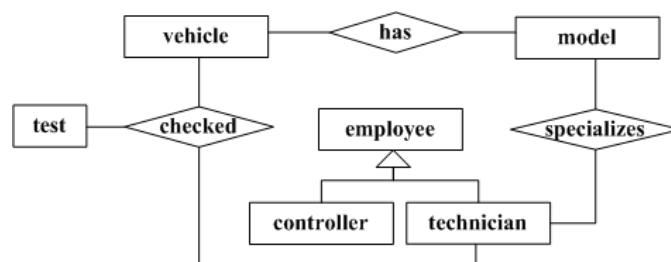
(b) The BMV passes a regulation which states that tests on a vehicle must be conducted only by a technician who specializes on that vehicle model. Explain how this constraint can be expressed in the ER diagram? Explain briefly if you cannot express it.

This constraint cannot be expressed in ER model.

Exercise 2 (Previous final question)

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*). 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 **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 are omitted if both the maximum and minimum numbers are 1):
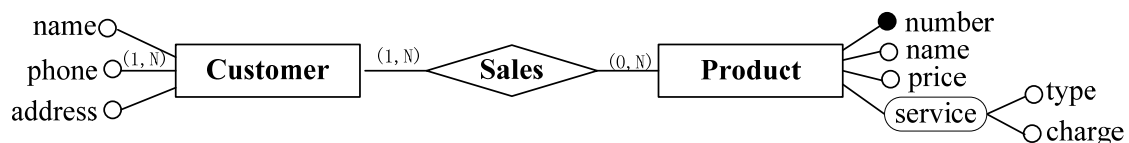
Part 1: Short Answers
Consider Amy's first ER diagram above and answer following questions.

a) What are the entity and relationship sets in the diagram?
Entity Set(s):   **Customer**, **Product**
Relationship Set(s):   **Sales**

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

d) What is the cardinality for *Customer*?   What does it mean?
(1, N).
It means each customer must buy at least one product and may buy as many products as he or she wants.

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

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

internal, single-attribute

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: **date, invoice_number**

Error for Service: **a product can have more than one services**

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 the both 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.

Solution: