1. The syntax of conceptual-modeling languages dictates cardinality relationships among sets of elements. These relationships may be 1–1, 1–n (one-many), n–1, or m–n (many-many). For the ER diagram in Figure 1, designate the relationship between each of the following sets as 1–1, 1–n, n–1, or m–n.

(a) from N to M
(b) from L to E
(c) from B to I
(d) from C to D
(e) from B to F
(f) from K to L

![Figure 1: ER diagram](image)

2. ! Using the procedure discussed in class (the one in the supplementary slides labeled “ER to RDB”), produce a database schema (a set of relation schemas) for the ER diagram in Figure 1. Mark all keys with an underline, mark chosen primary keys with a double underline if a relation schema has more than one key, and mark foreign keys by drawing an arrow from the foreign key to the key it references. (Make sure that underlines for keys with more than one attribute are continuous under all attributes of the key.)

3. A customer has an identifying customer number. A customer also has a name and address, which together also identify a customer. A customer insures one or more vehicles with an insurance company as of some date (a vehicle is insured by only one customer). A vehicle number identifies a vehicle, and a vehicle also has a make and model. A customer may have filed zero or more claims. A claim is for only one customer. A claim number identifies a claim, and a claim is filed for a certain amount. A claim is for one of the customer’s vehicles, and there may be several claims for a single vehicle.
(a) Create an ER diagram for this description. Be sure to use underlines appropriately to specify keys, and be sure to use arrowheads appropriately to specify functional relationship sets.

(b) Using the procedure discussed in class (the one in the supplementary slides labeled “ER to RDB”), produce relation schemas your ER diagram. Mark all keys with an underline, mark chosen primary keys with a double underline, and mark foreign keys by drawing an arrow from the foreign key to the key it references. (Make sure that underlines for keys with more than one attribute are continuous under all attributes of the key.)

4. As directed below, create ER diagrams for a simple genealogy record-keeping system and map them to a database schema.

(a) Create a diagram with one entity set, Person, with one identifying attribute, Name. For the Person entity set create recursive relationship sets, has mother, has father, and has children. Add appropriate roles (i.e. mother, father, child, parent) to the recursive relationship sets. (In an ER diagram, we denote roles by writing the role name next to the connection between an entity set and a relationship set. Be sure to specify the cardinalities of the relationship sets appropriately according to biological possibilities—a person has one mother, one father, and zero or more children).

(b) Create another diagram for the information in Part (a). This time, however, don’t use role names; instead, you should have an appropriate ISA hierarchy with entity sets for Parent, Father, Mother, and Child. (Be sure that the relationships specified in Part (a) connect to the proper entity sets.)

(c) The two diagrams should model the same information, therefore they should map to just one database schema. Produce a database schema for these diagrams.