Exercises: 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2.

Exercises

Exercise 2.1 : In Fig. 6 are instances of two relations that might constitute part of a banking database. Indicate the following:

a) The attributes of each relation.

b) The tuples of each relation.

c) The components of one tuple from each relation.

d) The relation schema for each relation.

e) The database schema.

f) A suitable domain for each attribute.

g) Another equivalent way to present each relation.

acctNo	*type*	*balance*
12345	savings	12000
23456	checking	1000
34567	savings	25

The relation `Accounts`

firstName	*lastName*	*idNo*	*account*
Robbie	Banks	901-222	12345
Lena	Hand	805-333	12345
Lena	Hand	805-333	23456

The relation `Customers`

Figure 6: Two relations of a banking database

Exercise 2.2 : In Section 2.7 we suggested that there are many examples of attributes that are created for the purpose of serving as keys of relations. Give some additional examples.

!! Exercise 2.3 : How many different ways (considering orders of tuples and attributes) are there to represent a relation instance if that instance has:

a) Three attributes and three tuples, like the relation Accounts of Fig. 6?

b) Four attributes and five tuples?

c) *n* attributes and *m* tuples?

Exercise 3.1 : In this exercise we introduce one of our running examples of a relational database schema. The database schema consists of four relations, whose schemas are:

```
Product(maker, model, type)
PC(model, speed, ram, hd, price)
Laptop(model, speed, ram, hd, screen, price)
Printer(model, color, type, price)
```

The `Product` relation gives the manufacturer, model number and type (PC, laptop, or printer) of various products. We assume for convenience that model numbers are unique over all manufacturers and product types; that assumption is not realistic, and a real database would include a code for the manufacturer as part of the model number. The **`PC`** relation gives for each model number that is a PC the speed (of the processor, in gigahertz), the amount of RAM (in megabytes), the size of the hard disk (in gigabytes), and the price. The **`Laptop`** relation is similar, except that the screen size (in inches) is also included. The **`Printer`** relation records for each printer model whether the printer produces color output (true, if so), the process type (laser or ink-jet, typically), and the price.
Write the following declarations:

a) A suitable schema for relation **`Product`**.
b) A suitable schema for relation **`PC`**.
c) A suitable schema for relation **`Laptop`**.
d) A suitable schema for relation **`Printer`**.
e) An alteration to your **`Printer`** schema from (d) to delete the attribute color.
f) An alteration to your Laptop schema from (c) to add the attribute **`od`** (optical-disk type, e.g., cd or dvd). Let the default value for this attribute be '**none**' if the laptop does not have an optical disk.

Exercise 3.2 : This exercise introduces another running example, concerning World War II capital ships. It involves the following relations:

```
Classes(class, type, country, numGuns, bore, displacement)
Ships(name, class, launched)
Battles(name, date)
Outcomes(ship, battle, result)
```

Ships are built in "classes" from the same design, and the class is usually named for the first ship of that class. The relation **`Classes`** records the name of the class, the type ('**bb**' for battleship or '**bc**' for battlecruiser), the country that built the ship, the number of main guns, the bore (diameter of the gun barrel, in inches) of the main guns, and the displacement (weight, in tons). Relation **`Ships`** records the name of the ship, the name of its class, and the year in which the ship was launched. Relation **`Battles`** gives the name and date of battles involving these ships, and relation **`Outcomes`** gives the result (sunk, damaged, or ok) for each ship in each battle.
Write the following declarations:

a) A suitable schema for relation **`Classes`**.
b) A suitable schema for relation **`Ships`**.
c) A suitable schema for relation **`Battles`**.
d) A suitable schema for relation **`Outcomes`**.
e) An alteration to your **`Classes`** relation from (a) to delete the attribute **`bore`**.
f) An alteration to your **`Ships`** relation from (b) to include the attribute **`yard`** giving the shipyard where the ship was built.