Exercise 7.1.3: Suggest suitable keys and foreign keys for the relations of the PC database:
Product(maker, model, type)
PC(model, speed, ram, hd, price)
Laptop(model, speed, ram, hd, screen, price)
Printer(model, color, type, price)
of Exercise 2.4.1. Modify your SQL schema from Exercise 2.3.1 to include declarations of these keys.

```
CREATE TABLE Product (
    maker    CHAR(20),
    model    INT PRIMARY KEY,
    type     CHAR(20)
);

CREATE TABLE PC (
    model  INT REFERENCES Product(model),
    speed  REAL,
    ram    INT,
    hd     INT,
    price  REAL
);

CREATE TABLE Laptop (
    model  INT REFERENCES Product(model),
    speed  REAL,
    ram    INT,
    hd     INT,
    screen REAL,
    price  REAL
);
```

```
CREAT TABLE Printer (
    model INT REFERENCES Product(model),
    color BOOLEAN,
    type CHAR(20),
    price REAL
);
```

Exercise 7.2.2: Write the following constraints on attributes from our example schema
Product(maker, model, type)
PC(model, speed, ram, hd, price)
Laptop(model, speed, ram, hd, screen, price)
Printer(model, color, type, price)
of Exercise 2.4.1.
a) The speed of a laptop must be at least 2.0.

```
CREATE TABLE Laptop (
    model INT REFERENCES Products(model),
    speed REAL CHECK (speed >= 2.0),
    ram INT,
    hd INT,
    Screen REAL,
    price REAL
);
```

b) The only types of printers are laser, ink-jet, and bubble-jet.

```
CREATE TABLE Printer (
    model INT REFERENCES Product(model),
    color BOOLEAN,
    type CHAR(20) CHECK (type IN ('laser', 'ink-jet', 'bubble-jet')),
    price REAL
);
```

c) The only types of products are PC's, laptops, and printers.

```
CREATE TABLE Product (
    maker CHAR(20),
    model INT,
    type CHAR CHECK (type IN ('pc', 'laptop', 'printer')),
    PRIMARY KEY (model)
);
```

! d) A model of a product must also be the model of a PC, a laptop, or a printer.

```
CREATE TABLE Product (
    maker CHAR(20)
    model INT CHECK(model IN (SELECT model IN PC)
                    UNION (SELECT model IN laptop)
                    UNION (SELECT model IN printer)),
    type CHAR
    PRIMARY KEY (model)
);
```

Exercise 7.4.1: Write the following assertions. The database schema is from the "PC" example of Exercise 2.4.1:
Product(maker, model, type)
PC(model, speed, ram, hd, price)
Laptop(model, speed, ram, hd, screen, price)
Printer(model, color, type, price)
a) No manufacturer of PC's may also make laptops.

```
CREATE ASSERTIONS CHECK
(NOT EXISTS (SELECT maker FROM Product JOIN PC
             INTERSECT
             SELECT maker FROM Product JOIN laptop));
```

Exercise 7.5.2: Write the following as triggers. In each case, disallow or undo the modification if it does not satisfy the stated constraint. The database schema is from the "PC" example of exercise 2.4.1:
Product(maker, model, type)
PC(model, speed, ram, hd, price)
Laptop(model, speed, ram, hd, screen, price)
Printer(model, color, type, price)

b) When inserting a new printer, check that the model number exists in Product.

```
CREATE TRIGGER NewPrinterTrigger
AFTER INSERTION ON Printer
REFERENCES NEW ROW AS NewRow,
           NEW TABLE AS NewStuff
FOR EACH ROW
WHEN NOT EXISTS (SELECT *
                 FROM Product
                 WHERE Product.model = NewRow.model)
DELETE FROM Printer
WHERE (model, color, type, price) IN NewStuff;
```