**Chapter 2**

**Exercise 2.3.1:**

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 (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:

1. A suitable schema for relation Product.
2. A suitable schema for relation PC.
3. A suitable schema for relation Laptop.
4. A suitable schema for relation Printer.
5. An alteration to your Printer schema from (d) to delete the attribute color.
6. An alteration to your Laptop schema from (c) to add the attribute od (optical-disk type, e.t., cd or dvd). Let the default value for this attribute to be ’none’ if the laptop does not have an optical disk.

**Solutions:**

1. **CREAT** **TABLE** Product (

maker **CHAR**(20),

model **INT PRIMARY KEY**,

type **CHAR**(10));

1. **CREAT** **TABLE** PC (

model **INT PRIMARY KEY**,

speed **DECIMAL**(10,2),

ram **INT**,

hd **INT**,

price **DECIMAL**(10,2));

1. **CREAT** **TABLE** Laptop (

model **INT PRIMARY KEY**,

speed **DECIMAL**(10,2),

ram **INT**,

hd **INT**,

screen **DECIMAL**(10,2),

price **DECIMAL**(10,2) );

1. **CREAT** **TABLE** Printer (

model **INT** **PRIMARY** **KEY**,

color **BOOLEAN**,

type **CHAR**(6),

**price** (10,2));

1. **ALTER** **TABLE** Printer **DROP** color;
2. **ALTER** **TBALE** Laptop **ADD** od **CHAR**(5) **DEFAULT** ’none’;

**Errors from students:**

1. Attributes not been seperated by comma when creating tables

**For example:**

**CREAT** **TABLE** Product (

maker **CHAR**(20)

model **INT PRIMARY KEY**

type **CHAR**(10));

1. Not attach **PRIMARY KEY** or **UNIQUE** modifier to attribute model
2. The type of color in table Printer is not BOOLEAN

**Exercise 2.4.1:**

This exercise builds upon the products schema of Exercise 2.3.2. Recall that 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)**

Some sample data for the relation Product is shown in Fig. 2.20. Sample data for the other three relations is shown in Fig. 2.21. Manufacturers and model numbers have been “sanitized”, but the data is typical of products on sale at the beginning of 2007.

Write expressions of relational algebra to answer the following queries. You may use the linear notation of Section 2.4.13 if you wish. For the data of Figs, 2.20 and 2.21, show the result of your query. However, your answer should work for arbitrary data, not just the data of these figures.

1. What PC models have a speed of at least 3.00?
2. Find those hard-disk sizes that occur in two or more PC’s.
3. Find those manufacturers of at least two different computers (PC’s or laptops) with speeds of at least 2.80.

**Solutions:**

1. The answer is:

Result:

1005

1006

1013

1. The answer is:

*1 := (PC)*

*2 := (PC)*

*:= 1 2*

Result:

250

80

160

1. The answer is:

*R1 :=*

*R2 := (R1 Product)*

*R3 = (R2)*

*R4 = R2 R3*

*Answer(maker) = (R4)*

Result:

B

E

**Errors from students:**

The most significant problems encountered in f) and h) is that many students haven’t understood the differences between NATURAL JOIN and THEAT JOIN. I can give an erroneous example about f).

PC1 := (PC)

PC2 := (PC1)

**Answer(hd) := (*PC1 PC2*)**

The correct way should be:

**Answer(hd) := (*PC1 PC2*)**

OR

**Answer(hd) := (**(***PC1 PC2*))**

**Note:**

Such error happens because many students believe **THETA JOIN** first do **NATURAL JOIN** and then impose condition C. But actually, THETA JOIN first do **Cartesian Product** and then impose condition C.

**Exercise 2.5.1:**

Express the following constraints about the relations of Exercise 2.3.1, reproduced here:

**Product(maker, model, type)**

**PC(model, speed, ram, hd, price)**

**Laptop(model, speed, ram, hd, screen, price)**

**Printer(model, color, type, price)**

You may write your constraints either as containments or by equating an expression to the empty set. For the data of Exercise 2.4.1, indicate any violation to your constraints.

1. A laptop with s careen size less than 15.4 inches must have at least a 100 gigabyte hard disk or sell for less than $1000.

**Solutions:**

1. The answer is:

Or:

Violation:

Model speed ram hd screen price

2004 2.00 512 60 13.3 1150

**Issues from students:**

Some students use set operations to impose the constraint, such as

or

The correct way to do this is:

Also some issues are caused by students’ misunderstanding the mean of question “**at least**” and “**less than**”. “**at least**” means “>=”, but some students use it as “>”. And “**less than**” means “<”, but some students use it as “<=”.