# Chapter 2

## Exercise 2.1

Describe in words, the information organized in the database in figure2.23.

**PATIENT**

| Code | Surname | FirstName |
|---|---|---|
| A102 | Harris | Lucy |
| B372 | Rossini | Peter |
| B543 | Johnson | Nadia |
| B444 | Johnson | Luigi |
| S555 | Rose | Jean |

**WARD**

| Code | Name | Consultant |
|---|---|---|
| A | Surgical | 203 |
| B | Paediatric | 574 |
| C | Medical | 530 |

**ADMISSION**

| Patient | Admitted | Discharged | Ward |
|---|---|---|---|
| A102 | 2/05/94 | 9/05/94 | A |
| A102 | 2/12/94 | 2/01/95 | A |
| S555 | 5/10/94 | 3/12/94 | B |
| B444 | 1/12/94 | 1/01/95 | B |
| S555 | 5/10/94 | 1/11/94 | A |

**DOCTOR**

| Number | Surname | FirstName | Ward |
|---|---|---|---|
| 203 | Black | Peter | A |
| 574 | Bisi | Mavis | B |
| 461 | Boyne | Steve | B |
| 530 | Clark | Nicola | C |
| 405 | Mizzi | Nicola | A |
| 501 | Mount | Mavis | A |

**Fig 2.23**

**Solution:**
This is a database for a hospital or a clinic.
The relation PATIENT contains information about people who have been admitted at least once in the hospital. People are identified by a Code.
The relation WARD describes all the hospital's wards, showing for each ward the name and the respective consultant (through a reference to the DOCTOR relation). The Wards are identified by a code (A,B,C).
The DOCTOR relation contains informations about all doctors in the hospital, giving their surnames, first names and wards. The ward is indicaded only with the respective Code. Each doctor has a number.
The last relation, ADMISSION, contains all the admissions made in the hospital. For each one we have the patient (through his code), the admission and the discharge dates, and the ward in which the patient was admitted.
The same patient may be admitted several times in the same hospital, and also in the same ward; the admission are identified by the different dates.

## Exercise 2.2

Highlight the keys and the referential constraints that exist in the database in Figure 2.23 and that it is reasonable to assume are satisfied by all databases in the same schema. Highlight also the attributes on which it could be reasonable to admit null values.

**Solution:**
The keys are:
- "Code" for relation PATIENT;
- "Number" for relation DOCTOR;

- “Code” for relation WARD;
- “Patient” and “Admitted” for relation ADMISSION;

The choice made on relation ADMISSION assumes that one patient can be admitted only one time in the same day.
If we suppose that this hypothesis is not satisfied, and so a patient can be admittedt two or more times in the same day, the relation would not be correct; in fact two or more admissions in the same day and in the same ward would have also the same discharge date, and so would be represented in the same row in the relation.

The referential constraints that exist in the database are beetwen the attribute “Patient” in relation ADMISSION and “Code” in relation PATIENT, beetwen “Ward” in relation ADMISSION and “Code” in relation WARD, beetwen “Consultant” in relation WARD and “Number in relation DOCTOR, and finally beetwen “Ward” in relation DOCTOR and “Code” in relation WARD.

Null values could be allowed in attributes “Surname” and “FirstName” in relation PATIENT, “Discharged” in relation ADMISSION, “Surname” and “FirstName” in relation DOCTOR and “Name” in relation WARD. All these attributes are not keys in the respective relations and have not any referential constraints.

## Exercise 2.3

Consider the information for the management of loans from a personal library. The owner lends books to his friends, which he records simply by means of the respetive names or nicknames (thus avoiding repetition) and refers to the books by the title (not having two books of the same title ). When he lends a book he makes a note of the date planned for its return. Define a relational schema to represent this information, highlighting suitable domains for its various attributes and show an instance of it in tabular form. Show the key or the keys of the relation.

**Solution:**

This information may be represented by means of a single relation, containg the loans, because there is no other information about friends and books beyond names and titles.
A possible schema is the following:

LOAN (<u>Book</u>, Name, ReturnDate)

These attributes denote respectively the book’s title, friend’s name or nickname and the date planned for the return. The key is “Book”, because every book is unique, while a friend could have more than one book at the same time.

This is an instance of the relation:

| **Book** | **Name** | **ReturnDate** |
|---|---|---|
| Romeo and Juliet | John | 15/04/95 |
| Hamlet | Mary | 20/03/95 |
| Macbeth | Tom | 1/04/95 |
| King Lear | Peter | 20/03/95 |

## Exercise 2.4

Represent, by means of one ore more relations, the information contained in a timetable of departures from a railway station: show the number, time, final destination, category and stops of every departing train.

**Solution:**

A possible schema is:

DEPARTURE (Number, Time, FinalDestination,Category)
STOP (Train,Station,Time)

The relation DEPARTURES represents all the departures from the station; it contains the number of the train, which is the key, the time, the category and the final destination. The stops are represented with the second relation, STOP, because the number of stops change for each train, and so it is not possible to represent them in the relation DEPARTURE which must have a prearranged number of attributes. The key of this relation is made of two attributes, "Train" and "Station", which indicate the number of the train and the stations in which it stops. It is necessary to have a referential constraint beetwen "Train" in STOP and "Number" in DEPARTURE.

## Exercise 2.5

Define a database schema to organize the information of a company that has employees (each with Social Security Number, surname, first name and date of birth), and subsidiaries (each with code, branch and director, who is an employee). Each employee works for a subsidiary.
Indicate the keys and the referential constraints of the schema. Show an istance of the database and check that it satisfied the constraints.

**Solution:**

A possible schema for this database is:

EMPLOYEE (Number,Surname,FirstName,Birth,Subsidiary)
SUBSIDIARY (Code,Branch,Director)

The keys are "Number" for relation EMPLOYEE and "Code" for relation SUBSIDIARY.
The referential constraints existing in this schema are beetwen attribute "Subsidiary" in relation EMPLOYEE and "Code" in relation SUBSIDIARY, and beetwen "Director" and "Number".

EMPLOYEE

| Number | Surname | FirstName | Birth | Subsidiary |
|---|---|---|---|---|
| 68784583 | Brown | Peter | 15/04/54 | A231 |
| 87594321 | Smith | Andrew | 18/03/60 | A231 |
| 39212344 | Smith | Ann | 20/09/58 | A574 |
| 37830822 | Harris | John | 21/11/52 | B421 |
| 45738288 | Black | Thomas | 12/01/55 | B421 |

SUBSIDIARY

| **Code** | **Branch** | **Director** |
|---|---|---|
| A231 | New York1 | 87594321 |
| A574 | New York2 | 39212344 |
| B421 | Boston4 | 37830822 |
| C538 | Los Angeles1 | NULL |

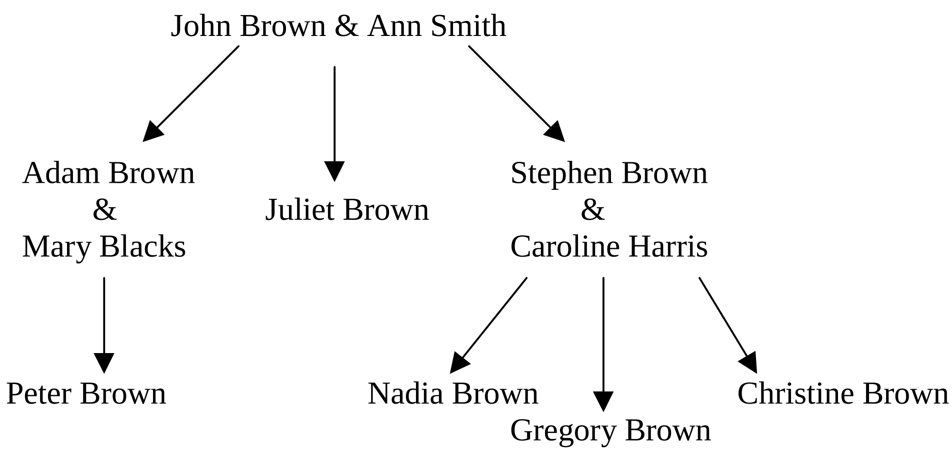
Every value of attribute “Subsidiary” appears in “Code”; similarly for “Director” and “Number”.

However it is possible to admit a value in “Code” that is not present in “Subsidiary” (nobody works in this subsidiary) and a NULL value for “Director”. This situation means for example that this subsidiary is only just created and at this time it has no employees.
Of course, if “Code” has a reference in “Subsidiary”, the value for “Director” must be present.

## Exercise 2.6

A family tree represents the structure of a family. Show how the information of a family tree can be represented by means of a relational database, possibly starting with a simplified structure, in which only the male line or only the female line is represented (that is, only the offspring of the male or the female members of the family are represented )

**Solution:**
A tipical family tree may be like this:




This information can be represented by the database:

MARRIAGE (Husband, Wife)
PATERNITY(Father, Child)

This schema involves that each person has an unique name.
The family see in picture above becomes:

MARRIAGE

| Husband | Wife |
|---|---|
| John Brown | Ann Smith |
| Adam Brown | Mary Blacks |
| Stephen Brown | Caroline Harris |

PATERNITY

| Father | Child |
|---|---|
| Jonh Brown | Adam Brown |
| Jonh Brown | Juliet Brown |
| Jonh Brown | Stephen Brown |
| Adam Brown | Peter Brown |
| Stephen Brown | Nadia Brown |
| Stephen Brown | Gregory Brown |
| Stephen Brown | Christine Brown |

To represent also the offspring of the female members, it is necessary to add another relation for maternity.

## Exercise 2.7

For each of the Exercise 2.3-2.6, evalutate the needs for null values, with the related benefits and difficulties.

**Solution:**
In the schema of Exercise 2.3, null values could be admitted on attibute “ReturnDate”, because it is possible to loan a book without fixing an exact return date; it would be more difficult to admitt null values on attribute “Name”, because usually it is necessary to know who has the book.
The attribute “Book” is the key and so cannot have null values.

In Exercise 2.4, apart the keys, it is difficult to allow null values even for the others attributes, because all the pieces of information are very important for the travellers.

In Exercise 2.5 it is interesting underline that a null values can be admitted in attribute “Director” in relation SUBSIDIARY, if the respective value in “Code” has not a reference in attribute “Subsidiary” in relation EMPLOYEE; this situation means for example that this subsidiary is only just created, and at this time has not employes. Of course, if “Code” has a reference in “Subsidiary”, the value for “Director” must be present.
Of course it is possible to imagine null values on “Surname”, “Name” or “Birth”, but it is very strange that these piece of information can be unknow.

In Exercise 2.6 it is possible to admitt null values on attribute “Wife”, if we consider only the male line of the family.

## Exercise 2.8

Define a database schema that organizes the information necessary to generate the radio programmes page of a daily newspaper, with station, times and programme title; besides the name, include tranmission frequency and the location of the radio station.

**Solution:**
A possible schema is:

STATION (<u>Name</u>, Frequency, Address)
PROGRAMME(<u>Title</u>,Station,Time)

This schema assumes that the same title can not be used for other programme in different stations. If instead this happens, then the key for PROGRAMME must be composed of both Title and Station.