Solve the following exercises by:

1. Creating the E-R diagram
2. Transforming the diagram into the relational model
3. Optimising the obtained database all the way through the 3NF/BCNF

Exercise 1

A vehicle insurance company with a number of customers wishes to create a database with the following features:

1. Each client can have several cars insured. A car belongs to a single customer.
2. For each vehicle we will store: license plate, brand, model, power, and type of insurance.
3. The data required for each client are: ID, name, date of birth, gender, address and telephone number.
4. A vehicle might have several accidents. For every one of them, we will need to know the date of the accident, and whether or not the driver was responsible for it (Y/N).
5. Each accident will be of a certain type with an accident code and a description e.g. (‘A01’, 'RIGHT SIDE IMPACT').

Exercise 2

Create a database to store the sales of items from the vendors of a company in several areas:

1. For every seller, we will need to store their national ID, name, address, telephone.
2. A seller will make sales and for each sale we will need to store: the number of units sold of an item, date of sale, zone code and the name of the sale zones.
3. Each seller can work in more than one zone and there can be more than one seller in a zone.
4. There can be no vendors without an area, or areas without vendors.
5. We will collect for each item the following information: item code, name, single unit price and quantity in stock.
6. We will need to know which sellers belong to each zone, regardless of whether they have made any sales or not.

Exercise 3

We are going to create a database for a health center:

1. A doctor has multiple patients assigned to him/her.
2. Each patient is assigned to a specific doctor.
3. Each doctor consults in one or several rooms on different dates and attends to patients.
4. Each room can be used by different doctors.
5. About the doctors, it is interesting to know their personal data and the year in which they joined the official association.
6. Regarding the patients, in addition to their personal data, it is required to keep track of their medical history. For this purpose we will store the room where each consultation took place, the date of the consultation, and also the diagnosis. A patient is usually seen by their doctor on a regular basis, but it might happen at times that another doctor reviews that patient.
7. The room's location and description of the room will be stored as well.

Exercise 4

A transport company that distributes packages throughout the territory needs to computerise their business activities. In order to do that, it takes the decision of creating a database to help out with the management operations:

1. The personnel in charge of carrying the packages are the truckers. For those we will keep track of their national ID numbers, name, telephone, address, salary and the town where they live in.
2. About the packages transported, it is interesting to know the package code, description, sender, sender's address, recipient and recipient's address.
3. A delivery person / driver delivers many packages, and a package can only be delivered by just one truck driver.
4. Regarding the provinces where the packages arrive, it is interesting to keep the province code and the name.
5. A package can only reach one province. However, many packages can arrive to each province.
6. We will also need information about the fleet of trucks. It is interesting to know the license plate, model, type and power.

7. A driver may drive different trucks on different routes and on different dates, and a truck can be driven by multiple delivery people.
8. Every route has an identifier, an origin and a destination, and the number of kilometers of the route.

Exercise 5

Design a database to store and manage the information used by a car dealer, taking into account the following aspects:

1. The company has a number of cars for sale. We need to know the license plate, brand, model, colour and selling price of each vehicle.
2. The data required for each client are the national ID number, name, address, city and telephone number. In addition, customers differ by an internal code of the company that automatically increases when a new client is registered.
3. A customer can buy as many cars as he/she wants from the company. A given car can be purchased only by a single customer.
4. The dealer is also responsible for the revisions that are made to each car.
5. Each revision of a specific vehicle has an associated number that starts at 1 for each vehicle and that is automatically increased for each revision that is carried out.
6. The date of each revision must be known, and so they are all the changes made (filter change, oil change, brake change, etc.) as well as the cost of each change.
7. The cars can go through multiple revisions at the dealership.

Exercise 6

In order to manage the customer database of a bank, we will come up with a database that fulfils the following requirements:

1. A client might have several accounts.
2. Accounts can belong to multiple clients.
3. Each account can have a set of notes associated with it. Each of those points will be an amount that is added to or subtracted from the account balance. For each note we must store the date of the operation, a description and a note number. The notes may or may not be

updated in the accounts. The entry number will be a consecutive number, which will start at 1 for all accounts.

4. The accounts can be of different types (S: savings, F: fixed term, C: current account) and they will be assigned an account number and an opening date.
5. The bank grants loans to clients. Each loan can be associated with several clients that already have an account. A client may have multiple loans. From each loan we will store: a loan number, the date of granting, total amount of the loan, interest rate, total number of installments, number of installments paid.
6. For each client we must know: national ID number, name, address, city, zip code and telephone number.

Exercise 7

In order to keep the information corresponding to the films projected in theaters, we are designing a database with these features:

1. About each film, it is interesting to know the information about its title, production year, producer, director, nationality and budget. Each movie will have a unique code.
2. Employees work in films, and we will store from them their national ID number, name, telephone and direction. These employees can be either operators or actors. The operators will have the data of the employees and also the category and the function they perform in the film. As for the actors, they will share the data of all the employees plus nationality and gender. The actors will be able to take part in several films carrying out a different role in each film (main actor, main actress, secondary actor, secondary actress).
3. A cinema can have one or more projection rooms. The rooms in theaters are numbered consecutively (1,2,3, etc. - the same in every cinema).
4. We will also store the capacity of the room (the number of seats for the total number of spectators).
5. From the cinema we are interested in storing the name of the theater, the owner company, address, population and province. Each cinema has a unique code.
6. As expected, a film can be shown in different theaters all over the country. And within every cinema, it is possible to show it in one or more rooms. For each screening we need to keep information of the screening date, the number of viewers and the total of earnings collected.

Exercise 8

Create a database for a publishing house with the following assumptions:

1. The publisher has several branches with name, address, town, telephone and zip code.
2. There are different types of workers who work for the publisher. These can be either branch employees or journalists (staff not on payroll – they carry out occasional contributions).
3. As for the workers we will need: national ID, name, address, population, telephone, email.
4. Each branch has multiple employees. An employee works in a single branch and he/she has a monthly salary.
5. Several magazines are published in each branch. However, a given magazine is published in just a single branch.
6. For each magazine we will save its code, name of the magazine, date of foundation, director, periodicity (weekly, quarterly, etc.), type (general information, sports, tabloid, etc.).
7. The publishing house has journalists (who do not work in branches) who can write articles for different magazines. We will consider the subject of the article, length and the date when it was written. We will store the same data for employees and journalists altogether; in addition, for the latter we will consider the area they are specialists in.
8. We will also store the fixed sections of each magazine, which will have a title and an extension (not all the magazines have the same fixed sections).
9. As for the copies published by a magazine we will keep: edition number (for each time the magazine comes out), date of edition, number of pages and the number of copies sold.

Exercise 9

Design an E/R schema that collects the organization of a database to contain the information on the roads of the country, knowing that the following must be fulfilled specs:

1. Roads are divided into several categories (local, regional, national, highways, etc.).
2. The roads are divided into sections. A section always belongs to a single road and cannot be changed.
3. A section can pass through several communities. It is interesting to know the kilometer point of the road and the community where the section begins and where it ends.
4. For sections that represent the beginning or end of the road, it is interesting to know whether the road physically ends there or joins another road. In this case, it is required to know what

road converges and in what kilometer, section and community.

Exercise 10

Obtain the E/R diagram for a flight control system adapted to the following management rules:

1. For each airport, its code, name, city and country must be known.
2. At every airport, different models of airplanes can land (the model of an airplane determines its capacity, that is, the number of seats).
3. At each airport there is a collection of flight schedules. In each flight program, the flight number, airline and days of the week in which said flight exists are indicated.
4. Each flight schedule takes off from one airport and lands at another.
5. Flight numbers are unique for everyone.
6. At each airport there are multiple landings and takeoffs. All the airports considered are active, that is, they have some landing and some take-off.
7. Each flight performed belongs to a certain flight program. For each flight you want to know its date, empty seats and the aircraft model used.
8. Some flight programs incorporate intermediate technical scales between the airports of departure and arrival. A technical stopover is understood as a consecutive landing and takeoff without high or low passengers.
9. For each flight, we want to know the ordered technical stopovers, assigning each one an order number.

For example, Iberia's flight program 555 with flights on Mondays and Thursdays takes off from Barajas (Madrid, Spain) and lands in Caudell (Sydney, Australia) having the following scales techniques: #1 Los Pradiños (Sao Paulo, Brazil), #2 El Emperador (Santiago, Chile) and #3 Saint Kitts (Auckland, New Zealand).

Exercise 11

The Olympic venues are divided into sports complexes. In turn, these sports complexes are sub-divided into those where a single sport takes place, and also multi-sport centers.

Multi-sports centers have dedicated areas for each sport, each one with a location indicator (for instance: center, corner#NE, and so on). A certain complex has a location, a single head of

organization, and an area (the space taken).

The two types of complexes (single sport and multi-sport) will also have different types of information. For each venue type, the number of complexes along with their approximate budget figures will be known (and kept track of).

In each complex a series of events are celebrated (for instance: in the track of the stadium many different races can take place). The events are planned in advance, therefore for each one of them we will know the date, duration, number of participants, and number of judges or referees. For each referee, there will be a list with all of the events that judge is involved into, and his or her role in the event will be noted: either as judge or as observer/consultant.

Certain equipment will be needed both for the events and also for maintenance (for example: arches, poles, parallel bars, etc). Every piece of equipment has an individual code. It is required to know which equipment was used in every event.

Exercise 12

A database for a small business should contain information about customers, items and orders. So far the following data is recorded in various documents:

- For each customer: customer number (unique), shipping addresses (several per customer), balance, credit limit (depends on the customer, it should not exceed 20,000€), discount.
- For each item: item number (unique), factories that distribute it, stock of that item in each factory, item description.
- Each request has a header and the request body. The header is formed by the number of customer, shipping address and order date. The body of the order consists of several lines, in each line the number of the ordered item and the quantity are specified.

In addition, it has been determined the information of the factories to be stored according to the use of distributors, namely: factory number (unique) and telephone number. They require to check how many items (in total) are in the factory supplies. Also, for strategic information, there is information on alternative factories providing similar items for this business.

Note: an address will be made up of number, street, zip code and town. A date includes time information as well.