

# UNIT 1

## CONCEPTUAL MODELING (EER)

**BASES DE DATOS 2023/2024**  
CFGs DAW

## WORKSHOP C: HIGH LEVEL ER

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**GENERAL RECOMMENDATIONS ON ER MODELING:**

1. Be consistent with the type of notation you choose (filled diamonds or max N, double lines or min 1, ...).
2. Include EVERY **participation (a,b)** and **cardinality (c:d)**.
3. Justify and describe EVERY **weakness** and every **ternary** relationship.
4. Do not create an **existence weakness** unless it is stated explicitly.
5. Do not cross lines or make a small bend in every cross if you can't avoid them.
6. Include just the **attributes explicitly mentioned** on the exercise and an **identifier** for each entity.
7. If you are not sure of which identifier attribute to choose, just set cod\_xxx or id\_xxx.
8. Name all entities in plural or singular (do not mix both), all relationships using verbs, and all attributes in singular.
9. An attribute should become an entity when it's multivaluated or it has more than one attribute.
10. Two binary relationships become one ternary when the three entities are always participating.

Although we all love to type and tinker with our computer, for this section I advise everyone to have a pen and paper nearby to make drafts until we get the model that seems most appropriate.

It is also very important to keep in mind that when the E-R model has already some complexity, surely the solution is not unique. It is possible that one may be better than the other, but this is like programming, two different programs can solve the same problem, one may be more optimal than the other, but both work.

**Draw now the most suitable ER diagram for every context of the following.**

**YOU MUST HAND ONLY EXERCISES: 2, 3, 4, 5**

**EXERCISE 1: CAR DEALERSHIP (SOLVED)**

A car dealership wants to computerize its vehicle sales management. In particular, it wants to store information about the customers who buy at the dealership, the vehicles sold, as well as the salesmen who make the different sales.

For this purpose, it will be taken into account that:

- The dealership has a catalog of vehicles defined by their make, model, cylinder capacity and price.
- As for the customers, the information of interest is the name, ID number, address and telephone number, the same as for the sellers.
- Customers can transfer their used car at the time of purchasing a new vehicle. The used car will be defined by its make, model, license plate number and appraised price. It is important to know the date on which the customer makes this transfer.
- You want to know which dealer sold which model to which customer. Also the date of the sale and the license plate number of the new vehicle. A customer has been able to buy different cars and each one from a different seller.
- If a customer is removed, his/her used cars are also removed.

**EXERCISE 2: MEANS**

We want to make a schema in the ER Model, which stores information about teachers and the subjects they teach, as well as the various means they use to teach each subject (whiteboard, transparencies, etc.).

Every mean can be either (but not only) digital or physical, associating the first one to a provider (id and name) and the second ones to a shelf (1, 2 3) inside a shelving (A, B ,C), a room (1, 2, 3) and a floor (1, 2, 3).

**EXERCISE 3: NETWORK OF BANKS**

Consider a network of banks with offices/branches, in which we have accounts, with that can be standard or savings accounts and with customers.

One customer can have several accounts of either type (savings or standard), but each account has only one customer as account holder. We just need to know the type of each account.

Each bank has many branches/offices, and every account can be open at any branch of any bank. Account numbers are unique for the entire network of banks. On the contrary, each branch belongs to a single bank, which assigns it a branch number (1, 2, 3...).

We have the following requirements:

1. Given a bank, we want to know its name, head office, and a list of branches indicating the branch number, its address and the name of the manager (just the name).

2. Given a client, we want to know his address, his age, his Id card number, and a list of the accounts he has open, indicating for each one of them, the account number, the name of the entity, the type of account, the current balance, and the branch where it was opened.

3. Given an account, we want to know the name of the account holder, the account holder's address, telephone number and current balance of the account.

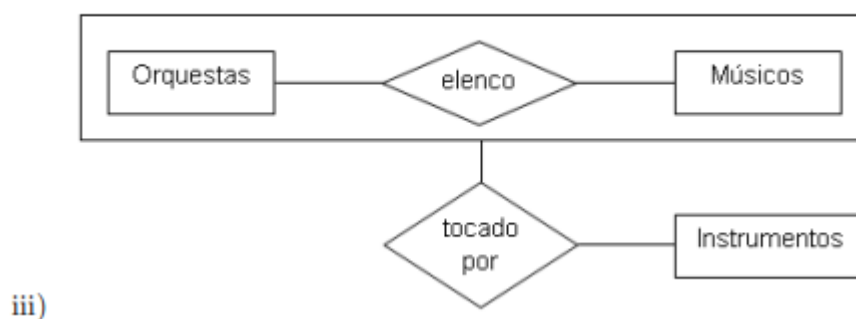
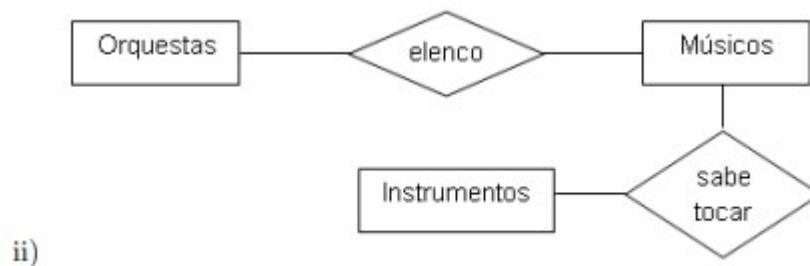
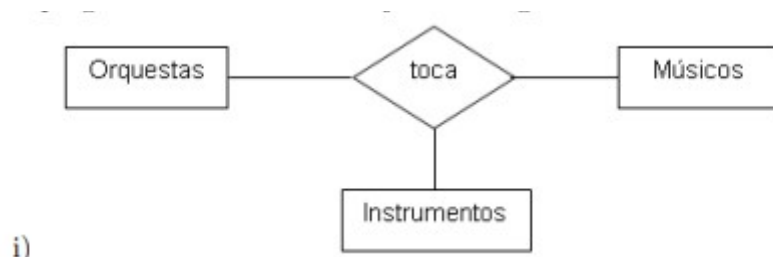
As you already guessed, no branch information is needed if its bank is removed, no account information is needed if its branch is removed, and no account information is needed if its customer is removed.

Advice: before creating a new attribute be sure that information is not already provided by the diagram.

**EXERCISE 4: MUSICAL INSTRUMENTS**

Below are three possible representations of the relationships between Musicians, Orchestras and Instruments.

Justify in which circumstances the following diagrams are valid, stating the advantages and drawbacks of each solution.



**EXERCISE 5: RESEARCH CENTER**

In a research center several projects are carried out. Each research project is carried out by a number of researchers. If there is a project, there is at least one researcher working on it. Each researcher works on only one project at the center, the one assigned to him or her. For each project we are interested in the name of the project (which is unique per project) and the date on which the project was started. In case we discard a project, we would not be interested in their researchers.

There are only two types of research projects: new and review (never both). For new projects we would be interested in recording the economic budget (in euros) available to carry it out, while for revision projects we would be interested in keeping just a text explaining the reason for the revision (e.g. "Initial calculation error" or "Adaptation to new market needs").

Among the researchers there are supervised and not supervised researchers. Each researcher (who is not a manager) is supervised by a manager, while those who are managers do not have a superior manager to supervise them. Also, for each researcher we would be interested in recording their full name (although separated into first and last names), ID number, address, locality, and one or more telephone numbers.

In addition, the researchers will give lectures in other centers about their research, although not all researchers will give them. Each lecture will be given by one or more researchers. The most gifted researchers will be able to participate in more than one conference. For each lecture we are interested in its identifying name, date and time of the beginning of the lecture, number of hours of the presentation and just the name of the place where it will be held (for example, at the Faculty of Statistics).

**EXERCISE 6: PHARMACIES (OPTIONAL; NOT ASSESSABLE)**

You want to maintain a database for a chain of pharmacies distributed in different cities. Each pharmacy hires a staff made up of its own employees and a pharmacist. For each city, with at least one pharmacy, there is only one pharmacist; that is, if there were more than one pharmacy in a city, the same pharmacist would be in charge of all the pharmacies in that city. Only cities with at least one pharmacy will be registered in the database.

Each pharmacy offers several drugs, being necessary to store how many items, their presentation (pills, powder...) and the price of each drug each pharmacy has. If a pharmacy is registered, it is because it is already established in a city and has employees, but if it is new, it may not yet have drugs in stock.

Medicines (drugs) are organized according to the laboratory that sells them (each one can sell several medicines and each medicine can be sold by only one laboratory), and their therapeutic actions (analgesic, antibiotic, etc.), which can be different for the same medicine. Each drug must have ingredients, but it can be ingredients registered in the database that are not yet present in any medicine. Some laboratories may not be selling to any pharmacy yet, but we need their telephone number.

For each medicine, the name and description (extensive text field) are kept. For each employee we keep their ID, name and contact telephone number. For each pharmacist we want to know in which year he/she obtained his/her university degree, and for each regular employee (not a pharmacist) we want to know the type of contract held (permanent, indefinite, etc.). The only information of interest for the ingredients is their name and main therapeutic characteristic (calm headaches, back-pain...). For the laboratory, the name and telephone number are of interest; and for the therapeutic actions, only its name is of interest.

Note the *main therapeutic characteristic* is related to the ingredient and the *therapeutic actions* are related to the drug. Moreover, pharmacies are not needed in the database when their city is discarded, cities are not needed if the pharmacist is removed and drugs are not needed when the laboratory is deleted.



**EXERCISE 7: GYM (OPTIONAL; NOT ASSESSABLE)**

A gym wants to maintain information about the classes it offers, its members and its instructors:

Classes are held in the various rooms of the gym. Each room has a number, a location within the gym, is of a type (cardio, general, muscle) and has a number of square meters. There are rooms that have equipment and rooms that do not. The equipment has a code, a description and an indication of its state of conservation. Some of them are permanently assigned to a room.

The classes that are taught have their code, the type of class (step, aerobics, spinning, etc.), the day of the week on which each class is taught and the time. These classes are taught by instructors, whose personal data (ID, name, telephone number), qualifications (if any), professional experience and training as instructors, i.e., what types of classes they can teach (step, aerobics, spinning, etc.) and since what year.

Those who receive the classes are the members, whose number, personal data (name, telephone, address), their profession and the bank account through which they pay the monthly fees of the gym are known.

In addition, the gym has squash courts. Each court has a number (different from that of any of the rooms), a location within the gym and an indication of its state of conservation. These courts can be reserved by members.

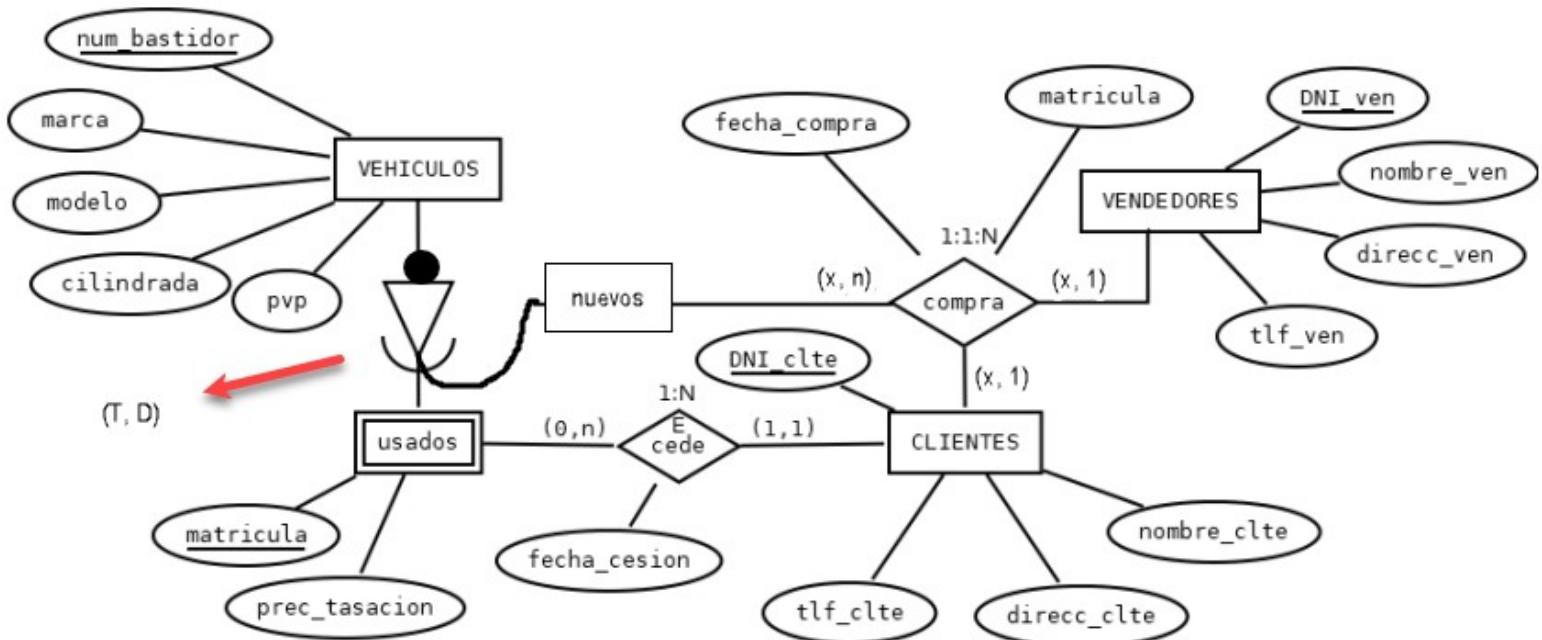
Each reservation will be for a specific date and time. In order to be able to carry out studies on the use of the courts, we want to keep historical information of all the reservations made.

Once the database schema is obtained, we realize that the squash courts and the classrooms are considered in the same way for the elaboration of the cleaning shifts, which will be based on their occupancy. Therefore, members will only be able to book rooms that are squash courts and classes will be held in rooms that are not squash courts.

Modify the conceptual schema (i.e., entity-relationship diagram) to reflect cleaning shifts for all rooms, whether they are class rooms or squash rooms. Cleaning shifts are a series of times at which the room must be attended for cleaning.

## SUGGESTED SOLUTIONS

## EXERCISE 1: CAR DEALERSHIP (SOLVED)



The entity VEHICLES represents both new and used vehicles, to express this in our diagram we will make the specialization partial (not total), therefore there may be vehicles that are not used, and those will be the new ones.

On the other hand, the statement "We want to know which salesperson has sold which model to which customer" is indicating a relationship between the three entities SELLERS - CUSTOMERS - VEHICLES. For this we will need to use a ternary relationship.

The maximum cardinalities are clear:

- Given a **new vehicle and a customer** how many sellers will that customer have bought this vehicle from? At most  $\rightarrow (x,1)$ . (minimum ignored)
- Given a **customer and a salesman** how many vehicles will that customer have bought from that salesman? At most  $\rightarrow (x,n)$ . (minimum ignored)
- And finally, given a **new vehicle and a salesman** how many customers will that salesman have sold that vehicle to? At most  $\rightarrow (x,1)$ . (minimum ignored)

We also have a weak USED with existence dependence on the strong CUSTOMERS, which is NOT of identity since it has an attribute that univocally identifies it (license plate).