EXERCISE LIST N°1:
Relational model and relational algebra

I. Relational Model

The relational model that we are going to use for this exercise list corresponds to the database of an enterprise fixing air-conditioners. Technicians are sent for an intervention in a customer's house and fix the air-conditioner. They may have to replace air-conditioner parts or the whole air-conditioner (both parts air-conditioners are stored in the table PRODUCTS). After one or more interventions of technicians, the air-conditioner is fixed, the customer pays for the reparations and an invoice is issued.

CUSTOMERS (cust_no, name, surname, address, city, ZIP, tel)
PRODUCTS (reference, designation, unit_price, stock_quantity, min_quantity)
INVOICES (inv_no, date, state, customer)
REPLACEMENTS(product, intervention, qtity)
INTERVENTIONS(interv_no, date, technician, duration, invoice)
TECHNICIAN (tech_no, name, hour_rate)

1. Add the primary keys (underlined attributes) and foreign keys (add a # after the attribute name) on the relational model above.

2. Draw a scheme of this relational database. In that scheme, every table will be represented by a rectangle and every referential integrity constraint will be represented by a link between two tables. No table should be completely isolated from the others.

3. Answer the following questions:
    a. I need to know how many interventions the technician "Dupont Jean" has proceeded. Which tables will I need in this query?
    b. I need to know the name(s) of the technician(s) who worked for the customer "NGUYEN Dô". Which tables will I need in this query?
    c. I need to know what was the total summed duration of all the interventions attended by the technician "Dupont Jean". Which tables will I need in this query?
    d. I need to compare the total quantity of products replaced by each technician. Which tables will I need in this query?
    e. I need to know the total price of all the parts (products) replaced by the technician "Dupont Jean". Which tables will I need in this query?
    f. I need to know how much the customer "NGUYEN Dô" owes me, in total, including the parts replaced and the work of the technicians. Which tables will I need in this query?

4. Why did we split this data into several tables, why not keeping all data inside the same table?

II. Relational Algebra

Translate the following queries into relational algebra.

5. Which are the references and designations of all the products in the database?

6. Which are the references of the products which have already been replaced at least once (the ones that appear in at least in one replacement)?

7. Which are the references and designations of the products which price is higher than 15€?

8. What is the address of the customer “Dallalon”?

9. Names of all the persons in the database (customers or technicians)?

10. References of the products which price is higher than 15€ and have already been replaced at least once (the ones that appear in at least in one replacement)?

11. References of the products which have never been replaced?

12. Which are the numbers, dates and durations of the interventions corresponding to invoices that have already been regulated (state=’R’)?

13. Which are the numbers (interv_no), dates and durations of the interventions carried out by the technician “Foucher”?

14. Numbers of the invoice(s) (inv_no) assigned to the customer “Rivoire”?

15. Designations of all the products replaced during the interventions held on the 3rd of July 2020?

16. Numbers of the invoices not regulated yet (i.e. state≠' R'), along with the identifiers (numbers) of the corresponding interventions and with the name of the corresponding customer?

17. Dates of the invoices corresponding to interventions carried out by the technician “Saultier” where at least a product has been replaced?

18. Designation (names) of the products replaced for the customer “Provent”, along with the duration of the replacement and the state of the invoice?

19. Number of the invoices (inv_no) regulated from the customer “Rivoire”, together with the number of the invoices (inv_no) that are not regulated yet from the customer “Favero”?

20. The customer identifiers (cust_no) for whom no invoice has been issued?

21. Which are the identifiers of the invoices for which both the technicians « Bonnaz » and « Mauras » have worked?