

Exercise 1:

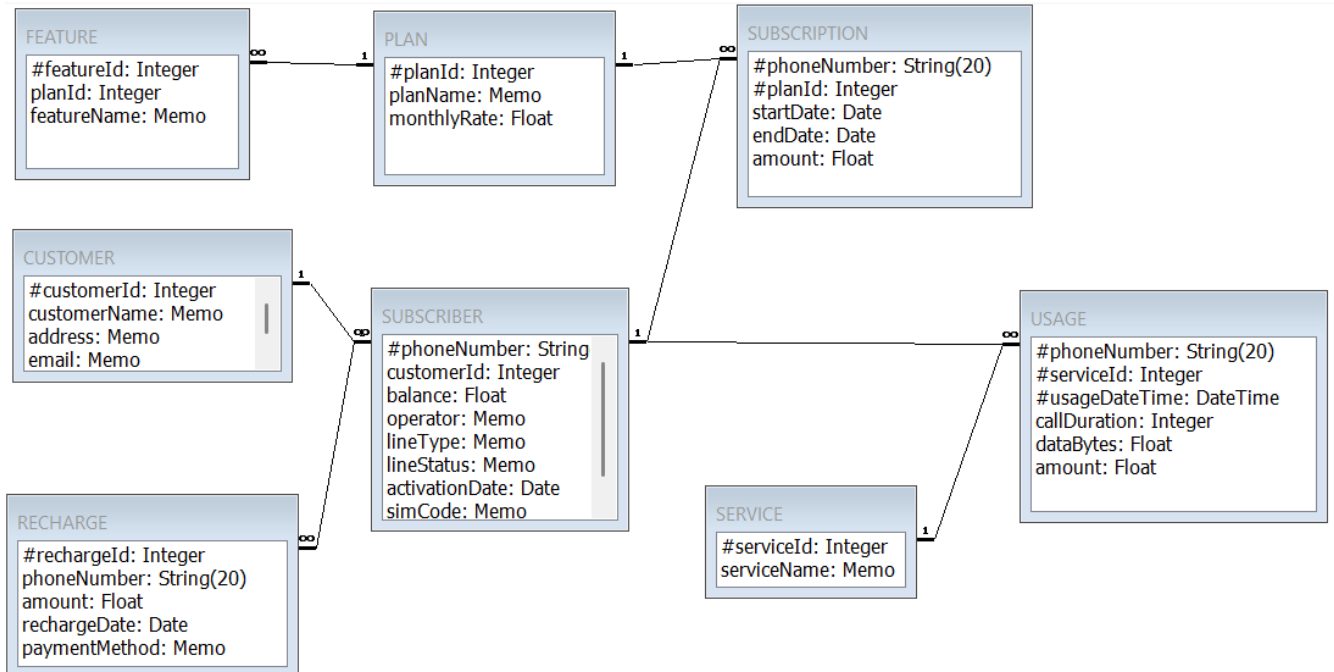
1. Link the operations of relational algebra with the purpose of each.
 - a. SELECT
 - b. PROJECT
 - c. THETA JOIN
 - d. EQUIJOIN
 - e. NATURAL
 - f. JOIN
 - g. UNION
 - h. INTERSECTION
 - i. EXCEPT
 - j. CARTESIAN PRODUCT
 - k. DIVISION

1. Produces a relation $R(X)$ that includes all tuples $t[X]$ in $R_1(Z)$ that appear in R_1 in combination with every tuple from $R_2(Y)$, where $Z = X \cup Y$.
2. Produces a new relation with only some of the attributes of R , and removes duplicate tuples.
3. Selects all tuples that satisfy the selection condition from a relation R .
4. Produces all the combinations of tuples from R_1 and R_2 that satisfy a join condition with only equality comparisons.
5. Produces a relation that has the attributes of R_1 and R_2 and includes as tuples all possible combinations of tuples from R_1 and R_2 .
6. Produces a relation that includes all the tuples in R_1 or R_2 or both R_1 and R_2 ; R_1 and R_2 must be union compatible.
7. Produces a relation that has the attributes of R_1 and R_2 and includes as tuples all possible combinations of tuples from R_1 and R_2 .
8. Produces a relation that includes all the tuples in both R_1 and R_2 ; R_1 and R_2 must be union Compatible.
9. Same as EQUIJOIN except that the join attributes of R_2 are not included in the resulting relation; if the join attributes have the same names, they do not have to be specified at all.
10. Produces all combinations of tuples from R_1 and R_2 that satisfy the join condition.
11. Produces a relation that includes all the tuples in R_1 that are not in R_2 ; R_1 and R_2 must be union compatible.

2. What is union compatibility?
3. Why do the UNION, INTERSECTION, and DIFFERENCE operations require that the relations on which they are applied be union compatible?
4. Discuss what is the renaming attributes operation and for what is it necessary?
5. Discuss the various types of Outer join operations.
6. Why is theta join required?
7. What role does the concept of foreign key play when specifying the most common types of meaningful join operations?

8. What is the FUNCTION operation? For what is it used?
9. How are the OUTER JOIN operations different from the INNER JOIN operations?

Exercise 2 (TelecomDz)



Queries:

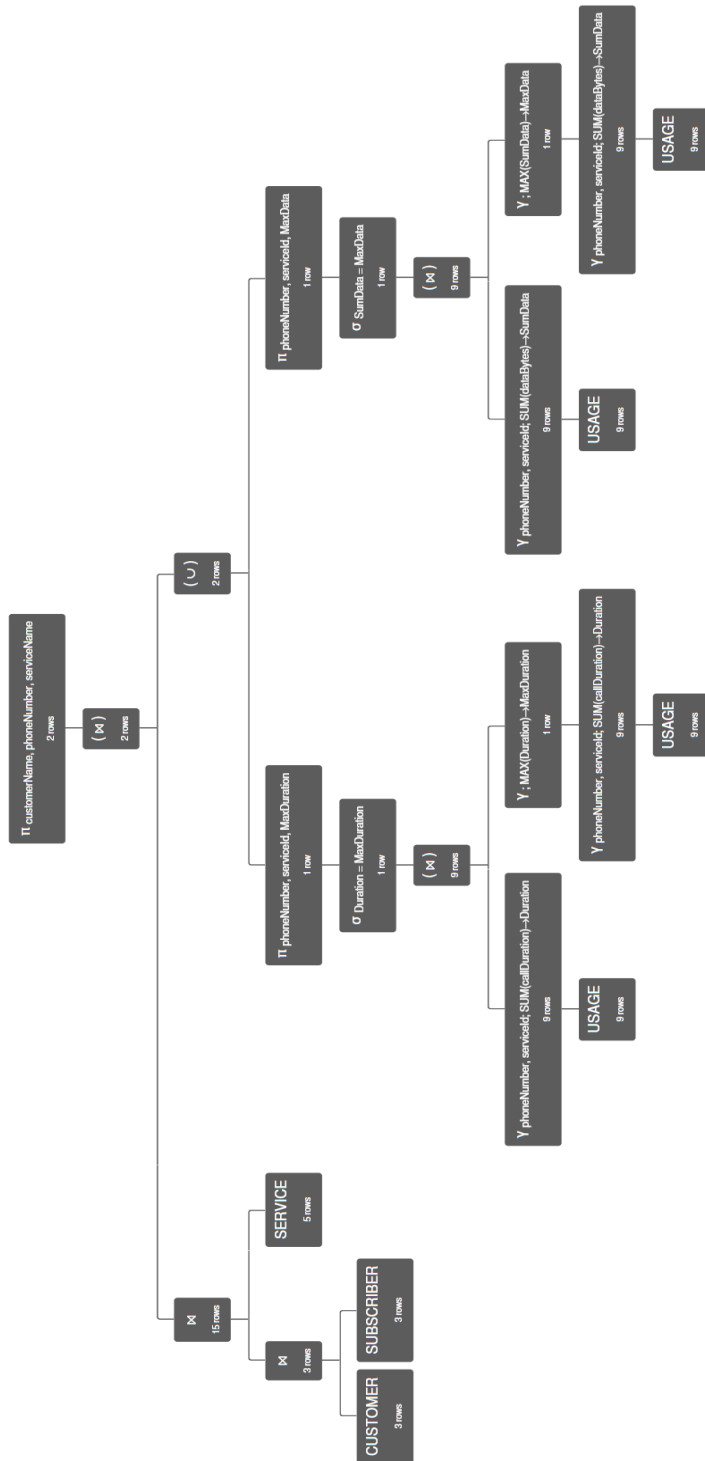
1. Write a query to display the phone number, customer name, and operator of all subscribers whose line status is 'Active'.
2. Write a query to find the plan with the highest monthly rate. Display the plan name and monthly rate.
3. Write a query to count the number of subscribers for each operator. Display the operator's name and the count.
4. Write a query to list all services that have never been used. Display the service ID and service name.
5. Write a query to find customers who do not have any mobile lines. Display the customer's name.
6. Write a query to find subscribers who have subscribed to at least two different plans. Display the customer's name, phone number, and the number of plans they have subscribed to.
7. Write a query to calculate for each service and each operator:
 - Total call duration in hours (callDuration is in minutes)
 - Total data consumption in GB (dataBytes is in bytes, 1 GB = 1024³ bytes)
 - Total cost

Display operator, service name, total hours, total data in GB, and total cost.

8. Write a query to find subscribers who do not have any active subscription (no subscription record with endDate = NULL). Display the phone number and customer name.
9. Write a query to list all plans along with the count of features they offer. Display the plan name and number of features.
10. Write a query to find subscribers who have used every available service at least once. Display the phone number and customer name.
11. Write a query to determine which service has generated the highest total revenue. Display the service ID, service name, and total revenue.
12. Write a query to find the subscriber whose total call duration exceeds that of all other subscribers. Display the customer name, phone number, and total call duration.
13. Write a query to find subscribers whose total data consumption is greater than the average data consumption across all subscribers. Display the phone number, customer name, and total data consumed.
14. Write a query to show, for each month of the year 2025, the number of recharges performed and the total amount recharged. Display the month number, number of recharges, and total amount, ordered by month.

Exercise 3:

Give, in natural language, the query that corresponds to this algebraic tree.



Exercise 4: For this Exercise, we will use the [online tool Relational Algebra Calculator \(RELAX\)](#)

Follow the steps below:

✓ **Steps to use your telecomdz database in RELAX**

1. download the telecomDZRelax file to create the DataBase.

2. **Open RELAX**

Go to the RELAX tool available online.

You will see an area where you can write definitions and queries. The zone is named Group Editor.



3. Paste the content of the **telecomDZRelax.txt** file then click on **Preview**, then on **Use Group in editor**, the DataBase will be available for use. NB. The content of **telecomDZRelax** file is already in Relax Format)

4. Come back to Relational Algebra zone to edit the queries.

TelecomDz DataBase loaded.

Question : Edit the query of the precedent exercise on RELAX.