Achievement 3.9
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Common Table Expressions.

Step 1: Answer the business questions from steps 1 and 2 of task 3.8 using CTEs

Step 1- A.3.8: Find the average amount paid by the top 5 customers.

Original Subquery

```
SELECT AVG(total_payment) AS total_amount_paid
FROM (
	SELECT B.customer_id,
		B.first_name,
		B.last_name,
		D.city,
		E.country,
		SUM(A.amount) AS total_payment
	 FROM payment A
		INNER JOIN customer B ON A.customer_id = B.customer_id
		INNER JOIN address C ON B.address_id = C.address_id
		INNER JOIN city D ON C.city_id = D.city_id
		INNER JOIN country E ON D.country_id = E.country_id
	WHERE D.city IN

	  (SELECT D.city
	   FROM customer B
		INNER JOIN address C ON B.address_id = C.address_id
		INNER JOIN city D ON C.city_id = D.city_id
		INNER JOIN country E ON D.country_ID = E.country_ID
	    WHERE E.country IN

			(SELECT E.country
			 FROM customer B
				INNER JOIN address C ON B.address_id = C.address_id
				INNER JOIN city D ON C.city_id = D.city_id
				INNER JOIN country E ON D.country_ID = E.country_ID
					GROUP BY E.country
					ORDER BY COUNT(B.customer_id) DESC
					LIMIT 10)

		GROUP BY E.country, D.city
		ORDER BY COUNT(B.customer_id) DESC
		LIMIT 10)

	GROUP BY E.country,  D.city,  B.customer_id,  B.first_name,  B.last_name
	ORDER BY SUM(A.amount) DESC
	 LIMIT 5)
```

Output 3.8.S1.1

total_amount_paid
105.5540000000000000

CTE

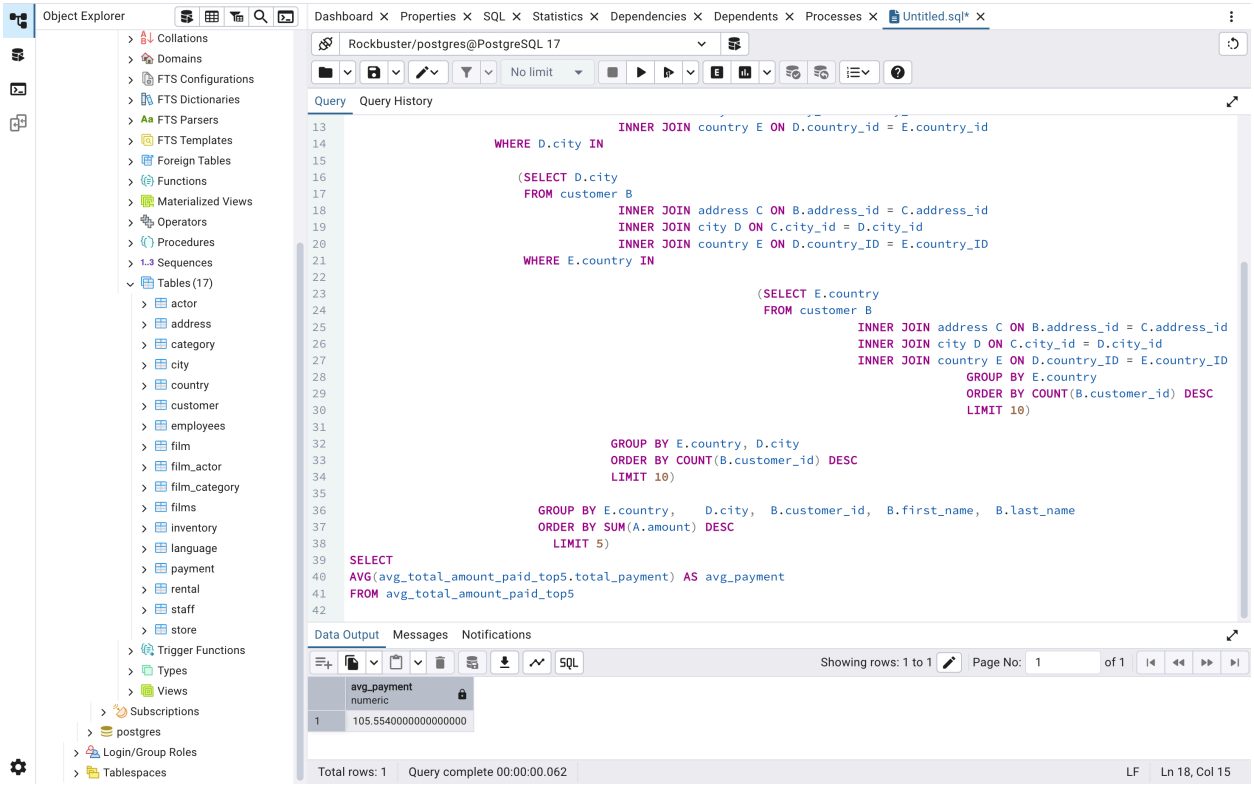
```
WITH avg_total_amount_paid_top5 AS

                SELECT B.customer_id,
                        B.first_name,
                        B.last_name,
                        D.city,
                        E.country,
                       SUM(A.amount) AS total_payment
                 FROM payment A
                        INNER JOIN customer B ON A.customer_id = B.customer_id
                        INNER JOIN address C ON B.address_id = C.address_id
                        INNER JOIN city D ON C.city_id = D.city_id
                        INNER JOIN country E ON D.country_id = E.country_id
                WHERE D.city IN

                  (SELECT D.city
                   FROM customer B
                        INNER JOIN address C ON B.address_id = C.address_id
                        INNER JOIN city D ON C.city_id = D.city_id
                        INNER JOIN country E ON D.country_ID = E.country_ID
                    WHERE E.country IN

                                (SELECT E.country
                                 FROM customer B
                                        INNER JOIN address C ON B.address_id = C.address_id
                                        INNER JOIN city D ON C.city_id = D.city_id
                                        INNER JOIN country E ON D.country_ID = E.country_ID
                                                GROUP BY E.country
                                                ORDER BY COUNT(B.customer_id) DESC
                                                LIMIT 10)

                        GROUP BY E.country, D.city
                        ORDER BY COUNT(B.customer_id) DESC
                        LIMIT 10)

                  GROUP BY E.country,   D.city,  B.customer_id,  B.first_name,  B.last_name
                  ORDER BY SUM(A.amount) DESC
                   LIMIT 5)

SELECT
AVG(avg_total_amount_paid_top5.total_payment) AS avg_payment
FROM avg_total_amount_paid_top5
```

Output:

Output 3.9 S1

avg_payment
105.5540000000000000

Screenshot Output.



Step 2-A.3.8: Find out how many of the top 5 customers you identified in step 1 are based within each country.

Original Subquery

```
SELECT E.country, COUNT (DISTINCT B.customer_id) AS all_customer_count,
    COUNT(DISTINCT top_5_customer.country) AS top_customer_count
FROM customer B
      INNER JOIN address C ON B.address_id = C.address_id
      INNER JOIN city D ON C.city_id = D.city_id
      INNER JOIN country E ON D.country_id = E.country_id
LEFT JOIN
       (SELECT B.customer_id,
                  B.first_name,
                  B.last_name,
                  D.city,
                  E.country,
                  SUM(A.amount) AS total_payment
        FROM payment A
                 INNER JOIN customer B ON A.customer_id = B.customer_id
                 INNER JOIN address C ON B.address_id = C.address_id
                 INNER JOIN city D ON C.city_id = D.city_id
                 INNER JOIN country E ON D.country_id = E.country_id
                 WHERE D.city IN

                  (SELECT D.city
                   FROM customer B
                          INNER JOIN address C ON B.address_id = C.address_id
                          INNER JOIN city D ON C.city_id = D.city_id
                          INNER JOIN country E ON D.country_ID = E.country_ID
                    WHERE E.country IN

                             (SELECT E.country
                              FROM customer B
                                     INNER JOIN address C ON B.address_id = C.address_id
                                     INNER JOIN city D ON C.city_id = D.city_id
                                     INNER JOIN country E ON D.country_ID = E.country_ID
                              GROUP BY E.country
                              ORDER BY COUNT(B.customer_id) DESC
                                                          LIMIT 10)

                     GROUP BY
                      E.country,
                      D.city
                     ORDER BY COUNT(B.customer_id) DESC
                                                 LIMIT 10)

           GROUP BY
                    E.country,
                    D.city,
                    B.customer_id,
                    B.first_name,
                    B.last_name
             ORDER BY SUM(A.amount) DESC
                                      LIMIT 5) AS top_5_customer ON top_5_customer.country = E.country
GROUP BY E.country
ORDER BY all_customer_count DESC
LIMIT 5;
```

Output A.3.8.S.2

country	all_customer_count	top_customer_count
India	60	1
China	53	1
United States	36	1
Japan	31	1
Mexico	30	1

CTE

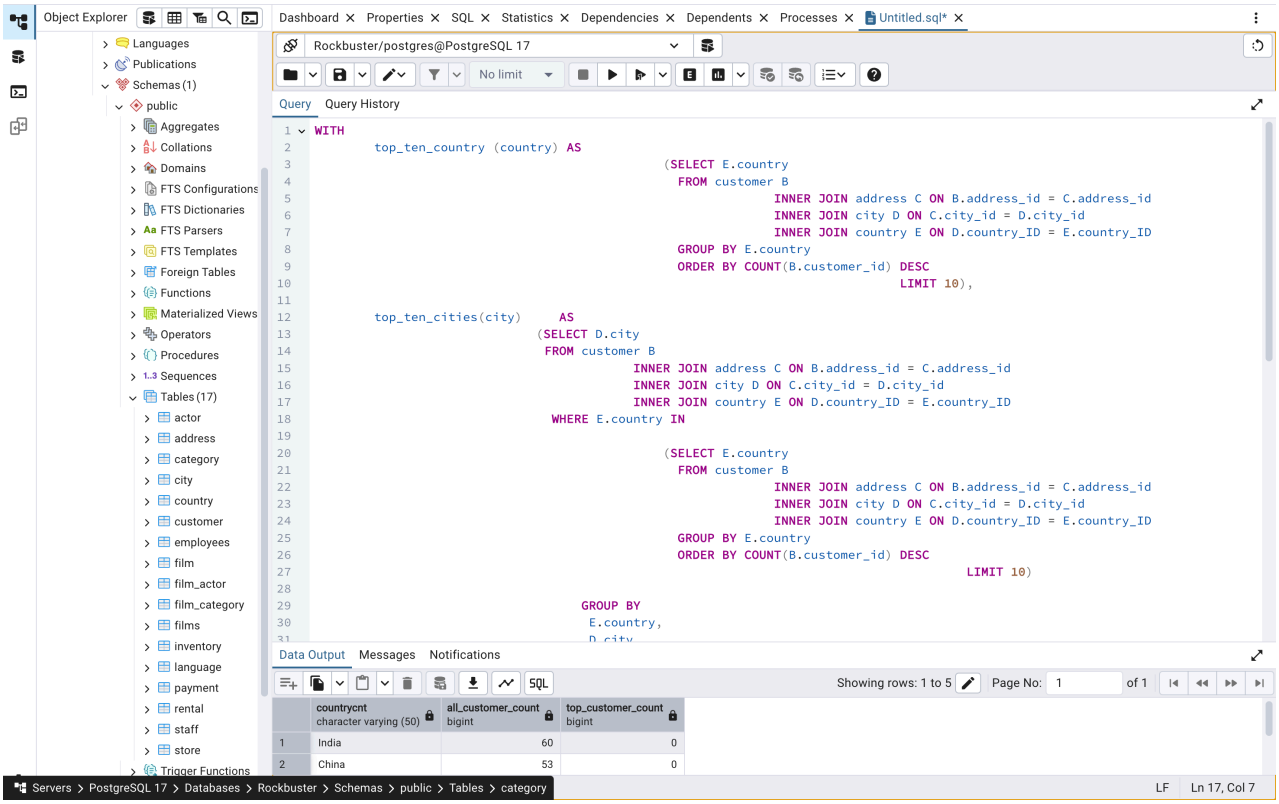
```
WITH
    top_ten_country (country) AS
                        (SELECT E.country
                         FROM customer B
                                INNER JOIN address C ON B.address_id = C.address_id
                                INNER JOIN city D ON C.city_id = D.city_id
                                INNER JOIN country E ON D.country_ID = E.country_ID
                         GROUP BY E.country
                         ORDER BY COUNT(B.customer_id) DESC
                                        LIMIT 10),

    top_ten_cities(city)  AS
                                (SELECT D.city
                FROM customer B
                        INNER JOIN address C ON B.address_id = C.address_id
                        INNER JOIN city D ON C.city_id = D.city_id
                        INNER JOIN country E ON D.country_ID = E.country_ID
                 WHERE E.country IN

                        (SELECT E.country
                         FROM customer B
                                INNER JOIN address C ON B.address_id = C.address_id
                                INNER JOIN city D ON C.city_id = D.city_id
                                INNER JOIN country E ON D.country_ID = E.country_ID
                         GROUP BY E.country
                         ORDER BY COUNT(B.customer_id) DESC
                                          LIMIT 10)

                   GROUP BY
                    E.country,
                    D.city
                   ORDER BY COUNT(B.customer_id) DESC
                                         LIMIT 10),


     top_5_customer (customer_id, city, customer_country, total_payment) AS

                (SELECT B.customer_id,
                     D.city,
                     E.country AS customer_country,
                     SUM(A.amount) AS total_payment
                 FROM payment A
                    INNER JOIN customer B ON A.customer_id = B.customer_id
                    INNER JOIN address C ON B.address_id = C.address_id
```

```
                    INNER JOIN city D ON C.city_id = D.city_id
                    INNER JOIN country E ON D.country_id = E.country_id
                GROUP BY E.country,
                                D.city,
                                B.customer_id
                ORDER BY SUM(A.amount) DESC LIMIT 5)

SELECT
    E.country AS countrycnt,
    COUNT (DISTINCT B.customer_id) AS all_customer_count,
    COUNT (DISTINCT top_5_customer.customer_id) AS top_customer_count
FROM customer B
      INNER JOIN address C ON B.address_id = C.address_id
      INNER JOIN city D ON C.city_id = D.city_id
      INNER JOIN country E ON D.country_id = E.country_id
LEFT JOIN top_5_customer ON B.customer_id = top_5_customer.customer_id
GROUP BY E.country
ORDER BY all_customer_count DESC LIMIT 5;
```

Output A.3.9 S.2

countrycnt	all_customer_count	top_customer_count
India	60	0
China	53	0
United States	36	1
Japan	31	0
Mexico	30	0

Screenshot Output.



1. Query 1. Write 2 to 3 sentences explaining how you approached this step,

a) In the first query, I began defining and locating the data I needed in my ERD.

b) Then I determined what was my main statement to get the information I needed.

c) I named the statement as “total_amount_paid_top5” and I obtained from the created column “total_payment”.

d) Then I selected I wanted to see the average AS avg_payment and take it from my defined statement “ total_amount_paid_top5” belonging to “total_payment”, that was giving me the top 5 payments. So, this way I would only see the total average.

2. Query 2. Write 2 to 3 sentences explaining how you approached this step.

a) First I decided what I wanted to see in my table, that was already determinated in the subquery.

b) Then I created my CTE’s

c) And my Main Query

Step 2: Compare the performance of your CTEs and subqueries.

1. Which approach do you think will perform better and why?

It depends of the situation. If I need to write over and over my Joins, problably a CTE can be more practical to use a CTE. Actually in the second step, probably wouldn't make such a difference if I only stayed with the 3 CTE.

2. Compare the costs of all the queries by creating query plans for each one.

- Subquery Step 1 : Aggregate (cost=166.06..166.07 rows=1 width=32)
- CTE Step 1: Aggregate (cost=166.06..166.07 rows=1 width=32)

- Subquery Step 2: Limit (cost=268.45..268.46 rows=5 width=25)
- CTE Step 2: Limit (cost=1148.60..1148.61 rows=5 width=25)

3. To find out the actual speed of your queries, run them in pgAdmin 4. After you've run each query, a popup window will display its speed in milliseconds.

- Subquery Step 1 : 97 msec
- CTE Step 1: 60 msec

- Subquery Step 2 : 113 msec
- CTE Step 2: 63 msec

4. Did the results surprise you? Write a few sentences to explain your answer.
   Is interesting to see how in the case of CTE's the speed tends to be shorter that subqueries.
   Now, speaking about cost, just in Step 2 we can see a difference in optimization.

Step 3:

Write 1 to 2 paragraphs on the challenges you faced when replacing your subqueries with CTEs.

Many of them. First to understand the mental map of where am I taking the information from and how does it look like. Still don't understand completely the logic behind that, but intuition helps.
Had trouble with Step 2 to get the same result with the CTE and the Subquery without success in finding the problem.