Answers 3.9

Step 1

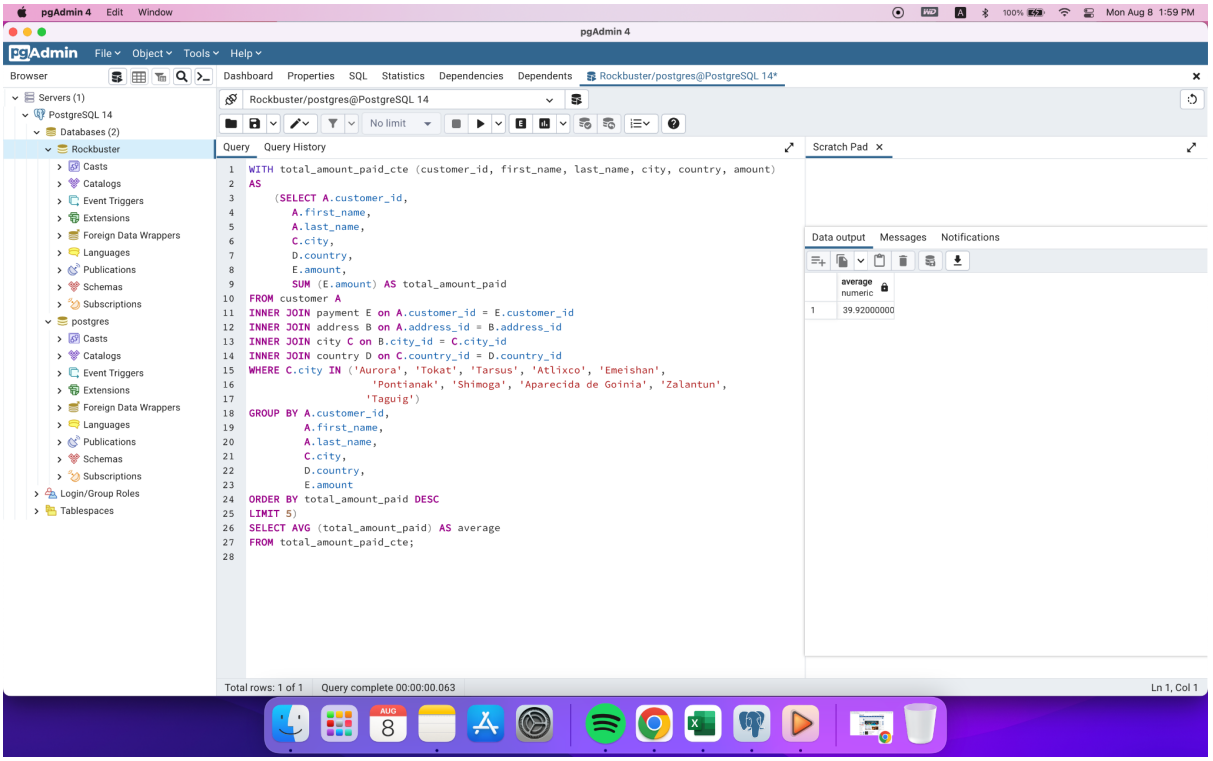
ORIGINAL 1

```
SELECT AVG (total_amount_paid) AS average
FROM
(SELECT A.customer_id,
      A.first_name,
      A.last_name,
      C.city,
      D.country,
      E.amount,
      SUM (E.amount) AS total_amount_paid
FROM customer A
INNER JOIN payment E on A.customer_id = E.customer_id
INNER JOIN address B on A.address_id = B.address_id
INNER JOIN city C on B.city_id = C.city_id
INNER JOIN country D on C.country_id = D.country_id
WHERE C.city IN ('Aurora', 'Tokat', 'Tarsus', 'Atlixco', 'Emeishan',
                 'Pontianak', 'Shimoga', 'Aparecida de Goinia', 'Zalantun',
                'Taguig')
GROUP BY A.customer_id,
       A.first_name,
       A.last_name,
       C.city,
       D.country,
       E.amount
ORDER BY total_amount_paid DESC
LIMIT 5) AS total_amount_paid;
```

CTE 1

```
WITH total_amount_paid_cte (customer_id, first_name, last_name, city, country, amount)
AS
   (SELECT A.customer_id,
      A.first_name,
      A.last_name,
      C.city,
      D.country,
      E.amount,
      SUM (E.amount) AS total_amount_paid
FROM customer A
INNER JOIN payment E on A.customer_id = E.customer_id
INNER JOIN address B on A.address_id = B.address_id
INNER JOIN city C on B.city_id = C.city_id
INNER JOIN country D on C.country_id = D.country_id
WHERE C.city IN ('Aurora', 'Tokat', 'Tarsus', 'Atlixco', 'Emeishan',
```

```
                'Pontianak', 'Shimoga', 'Aparecida de Goinia', 'Zalantun',
                'Taguig')
GROUP BY A.customer_id,
        A.first_name,
        A.last_name,
        C.city,
        D.country,
        E.amount
ORDER BY total_amount_paid DESC
LIMIT 5)
SELECT AVG (total_amount_paid) AS average
FROM total_amount_paid_cte;
```



ORIGINAL 2

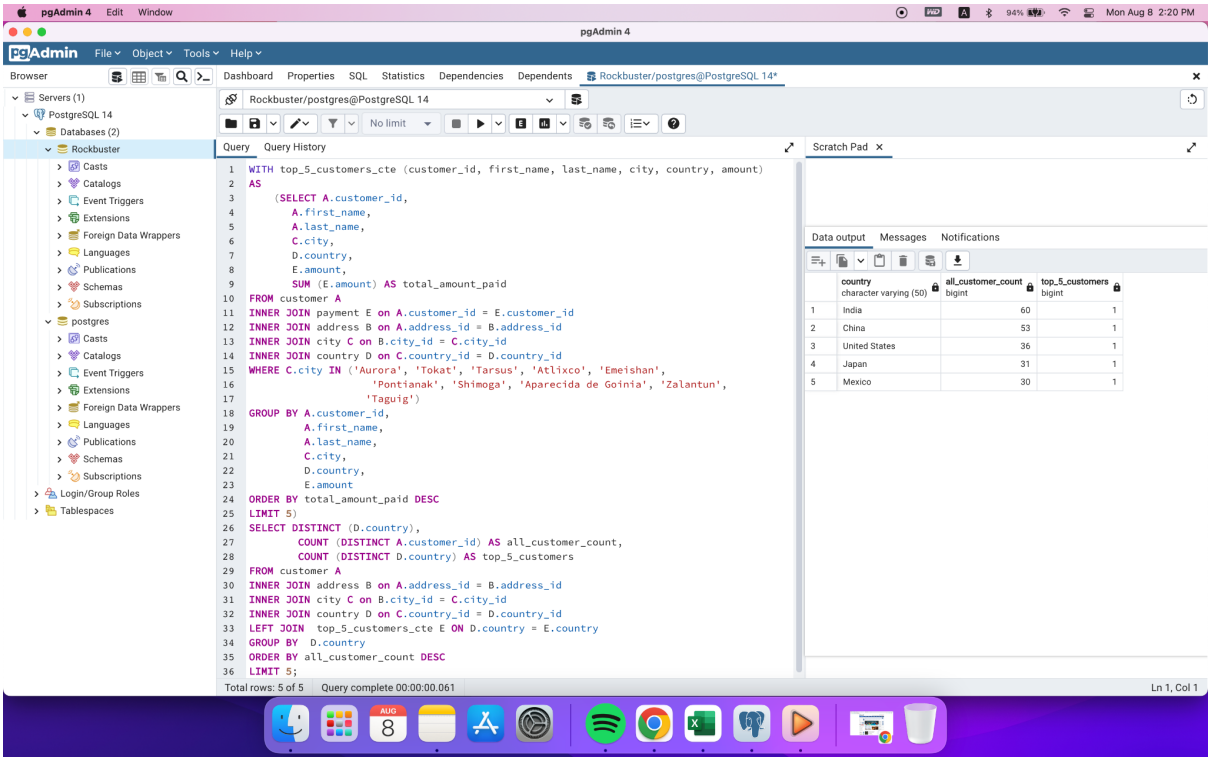
```
SELECT DISTINCT (D.country),
        COUNT (DISTINCT A.customer_id) AS all_customer_count,
        COUNT (DISTINCT D.country) AS top_5_customers
FROM customer A
INNER JOIN address B on A.address_id = B.address_id
INNER JOIN city C on B.city_id = C.city_id
INNER JOIN country D on C.country_id = D.country_id
LEFT JOIN (SELECT A.customer_id,
        A.first_name,
        A.last_name,
        C.city,
        D.country,
        E.amount,
        SUM (E.amount) AS total_amount_paid
FROM customer A
```

```
INNER JOIN payment E on A.customer_id = E.customer_id
INNER JOIN address B on A.address_id = B.address_id
INNER JOIN city C on B.city_id = C.city_id
INNER JOIN country D on C.country_id = D.country_id
WHERE C.city IN ('Aurora', 'Tokat', 'Tarsus', 'Atlixco', 'Emeishan',
                 'Pontianak', 'Shimoga', 'Aparecida de Goinia', 'Zalantun',
                'Taguig')
GROUP BY A.customer_id,
        A.first_name,
        A.last_name,
        C.city,
        D.country,
        E.amount
ORDER BY total_amount_paid DESC
LIMIT 5) AS top_5_customers
ON D.country = top_5_customers.country
GROUP BY  D.country
ORDER BY all_customer_count DESC
LIMIT 5;
```

CTE 2

```
WITH top_5_customers_cte (customer_id, first_name, last_name, city, country, amount)
AS
   (SELECT A.customer_id,
      A.first_name,
      A.last_name,
      C.city,
      D.country,
      E.amount,
      SUM (E.amount) AS total_amount_paid
FROM customer A
INNER JOIN payment E on A.customer_id = E.customer_id
INNER JOIN address B on A.address_id = B.address_id
INNER JOIN city C on B.city_id = C.city_id
INNER JOIN country D on C.country_id = D.country_id
WHERE C.city IN ('Aurora', 'Tokat', 'Tarsus', 'Atlixco', 'Emeishan',
                 'Pontianak', 'Shimoga', 'Aparecida de Goinia', 'Zalantun',
                'Taguig')
GROUP BY A.customer_id,
        A.first_name,
        A.last_name,
        C.city,
        D.country,
        E.amount
ORDER BY total_amount_paid DESC
LIMIT 5)
SELECT DISTINCT (D.country),
       COUNT (DISTINCT A.customer_id) AS all_customer_count,
       COUNT (DISTINCT D.country) AS top_5_customers
FROM customer A
INNER JOIN address B on A.address_id = B.address_id
```

```
INNER JOIN city C on B.city_id = C.city_id
INNER JOIN country D on C.country_id = D.country_id
LEFT JOIN  top_5_customers_cte E ON D.country = E.country
GROUP BY  D.country
ORDER BY all_customer_count DESC
LIMIT 5;
```



I considered the use of CTE to be a function of creating a name for a new combined table that would be used for the main statement. As I use the function of CTE, the name of the table used in the text was simplified, and elements constituting the new table were excluded from the main statement, thereby its readability of the main statement was improved.

Step 2-1

I don't think the way of using CTE and Subquery is not that different. However, in terms of improving the readability of main statements, CTE's property improves the readability of main statements.

Step 2-2

EXPLAIN ORIGINAL 1 :
https://docs.google.com/spreadsheets/d/15TRMmBNvkMZppRSvuaCHXovu6YzAb-RJcvfHYjVDncQ/edit#gid=103366501

EXPLAIN CTE 1 :
https://docs.google.com/spreadsheets/d/1hzZ_oZ-vE3CpGJCOOxzfdzI8kjxJ5wEI27hqVNnSUqo/edit#gid=487657557

EXPLAIN ORIGINAL 2 :
https://docs.google.com/spreadsheets/d/1m57Z-PpxTNGs6f0ziQvHoSGjpllCkz2wT9PyWrNf2nM/edit#gid=599184174

EXPLAIN CTE 2 :
https://docs.google.com/spreadsheets/d/1a32y1YHjq2_tOnZ19QlTG953ejP1F7oTvHIo_8Rsl9w/edit#gid=1993082688

Step 2-3

ORIGINAL 1 - 57/22
CTE 1 - 54/22
ORIGINAL 2 - 53/47
CTE 2 - 55/47

Step 2-4

I thought the time would take longer if the query was longer or more complicated. However, the length of the original 1 and the original 2 is almost twice as long, but the speed was almost the same.

When I compare the prices of the two queries, my prediction was right that the larger the queries, the more expensive they would be. Comparing the two versions of query's price, it was concluded that query's price and efficiency were less related.

Step 3

Basically, CTE and subquery share similar functions, so it was difficult to see which parts of the main query should be converted to CTE. However, I understood that the main purpose of CTE's use was to replace complex subqueries with the name of one new table, so the next steps after I understood went smoothly.