Experiment 3: Vertical Fragmentation

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- Subject: Advanced Database Management System

Aim:

Design a distributed database by applying the concept of vertical fragmentation

Implementation

Query for creation of table

```sql
drop table if exists bank_details;


create table bank_details (
    acc_no integer ,
    cust_name varchar(100),
    mobile_no bigint,
    branch varchar(100),
    balance integer,
    loan_amount integer,
    amount_due integer,
    customer_id integer,
    date_of_birth date,
    transaction_no varchar(100),
    date_of_transaction date,
    mode_of_transaction varchar(100),
    transaction_type varchar(100),
    transaction_amount integer,
    primary key (acc_no, customer_id)
);



drop table if exists customer, customer_transaction, customer_loan;
INSERT INTO bank_details (acc_no, cust_name, mobile_no, branch, balance,
loan_amount, amount_due, customer_id, date_of_birth, transaction_no,
date_of_transaction, mode_of_transaction, transaction_type, transaction_amount)
VALUES
  (1001, 'John Doe', 9876543210, 'Central Branch', 5000, 10000, 500, 101, '1980-01-
01', 'T1001', '2023-02-01', 'Cash', 'Deposit', 1000),
  (1002, 'Jane Doe', 9876543211, 'Central Branch', 6000, 20000, 1000, 102, '1982-02-
01', 'T1002', '2023-02-02', 'Cheque', 'Withdrawal', 500),
  (1003, 'John Smith', 9876543212, 'West Branch', 7000, 30000, 1500, 103, '1984-03-
01', 'T1003', '2023-02-03', 'Net Banking', 'Deposit', 2000),
  (1004, 'Jane Smith', 9876543213, 'West Branch', 8000, 40000, 2000, 104, '1986-04-
```

```
01', 'T1004', '2023-02-04', 'Cash', 'Withdrawal', 800),
  (1005, 'Bob Brown', 9876543214, 'South Branch', 9000, 50000, 2500, 105, '1988-05-
01', 'T1005', '2023-02-05', 'Cheque', 'Deposit', 1500),
  (1006, 'Alice Brown', 9876543215, 'South Branch', 10000, 60000, 3000, 106, '1990-
06-01', 'T1006', '2023-02-06', 'Net Banking', 'Withdrawal', 700),
  (1007, 'Charlie Smith', 9876543216, 'East Branch', 11000, 70000, 3500, 107, '1992-
07-01', 'T1007', '2023-02-07', 'Cash', 'Deposit', 1700),
  (1008, 'Emily Smith', 9876543217, 'East Branch', 12000, 80000, 4000, 108, '1994-
08-01', 'T1008', '2023-02-08', 'Cheque', 'Withdrawal', 900),
  (1009, 'David Brown', 9876543218, 'North Branch', 13000, 90000, 4500, 109, '1996-
09-01', 'T1009', '2023-02-09', 'Net Banking', 'Deposit', 1900),
  (1010, 'Emma Brown', 9876543219, 'North Branch', 14000, 100000, 5000, 110, '1998-
10-01', 'T1010', '2023-02-10', 'Cash', 'Withdrawal', 1100);
select * from bank_details;









create table customer (
    acc_no integer ,
    cust_name varchar(100),
    mobile_no bigint,
    branch varchar(100),
    balance integer,
    date_of_birth date,
    customer_id integer,
    primary key (acc_no, customer_id)
);


insert into customer (select acc_no, cust_name, mobile_no, branch, balance,
date_of_birth, customer_id from bank_details);
select * from customer;
create table customer_loan (
    acc_no integer,
    amount_due integer,
    customer_id integer,
    loan_amount integer,
    primary key (acc_no, customer_id)
);

insert into customer_loan (select acc_no, amount_due, customer_id, loan_amount from
bank_details);
```

```sql
drop table if exists customer_transaction;
create table customer_transaction (
    acc_no integer,
    customer_id integer,
    transaction_no varchar(100),
    date_of_transaction date,
    transaction_type varchar(100),
    mode_of_transaction varchar(100),
    transaction_amount integer,
    primary key (acc_no, customer_id)
);
insert into customer_transaction (select acc_no, customer_id, transaction_no,
date_of_transaction, transaction_type , mode_of_transaction , transaction_amount
from bank_details);
select * from (customer join customer_loan using (acc_no) ) join
customer_transaction using (acc_no);
select * from customer_transaction;
```

PART A

Query 1

```sql
-- find all the customer with branch ANDHERI
SELECT * FROM (
    SELECT * FROM (
    (SELECT * FROM customer WHERE branch = 'ANDHERI') y join (SELECT * FROM
customer_loan) z using (acc_no)
) x JOIN (SELECT * FROM customer_transaction) q USING (acc_no)) w;
```

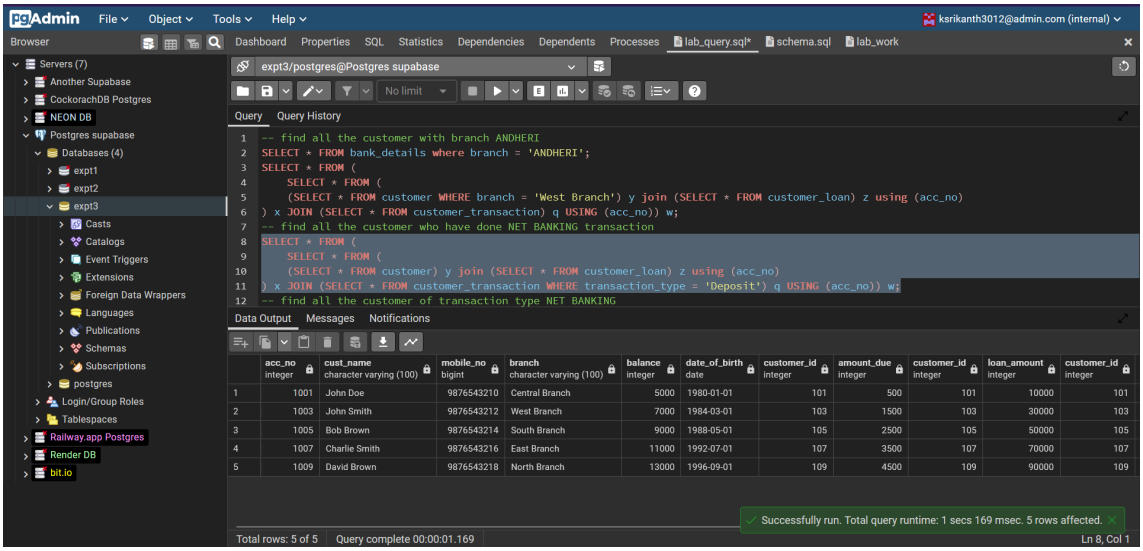
Result From table 1

	acc_no integer	cust_name character varying (100)	mobile_no bigint	branch character varying (100)	balance integer	date_of_birth date	customer_id integer	amount_due integer	customer_id integer	loan_amount integer	customer_id integer
1	1003	John Smith	9876543212	West Branch	7000	1984-03-01	103	1500	103	30000	103
2	1004	Jane Smith	9876543213	West Branch	8000	1986-04-01	104	2000	104	40000	104

Query 2

```sql
-- find all the customer who have done NET BANKING transaction
SELECT * FROM (
    SELECT * FROM (
    (SELECT * FROM customer) y join (SELECT * FROM customer_loan) z using (acc_no)
) x JOIN (SELECT * FROM customer_transaction WHERE transaction_type = 'Deposit') q
USING (acc_no)) w;
```

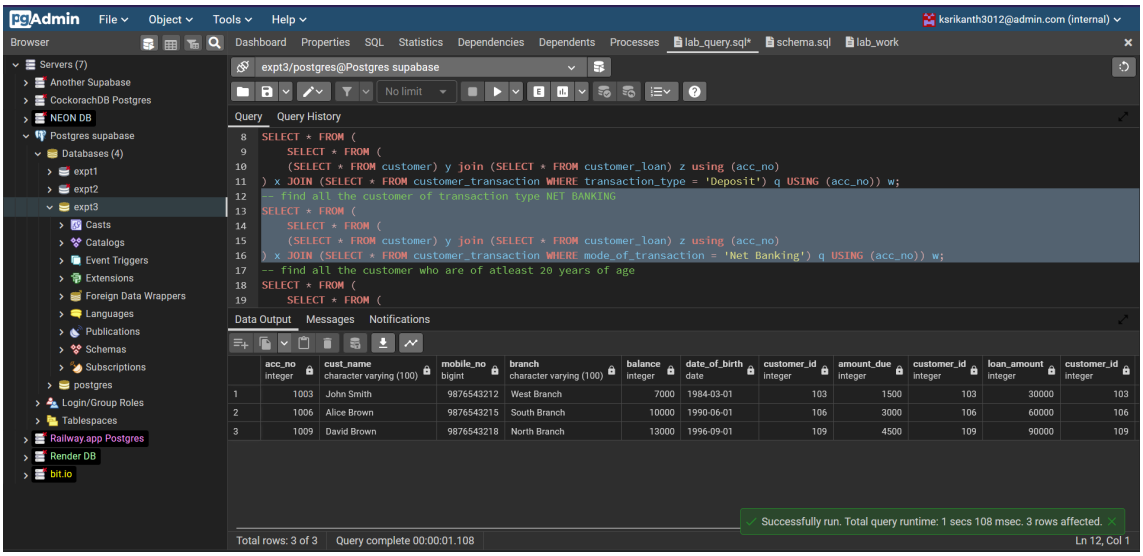
Result From table 1



Query 3

```
-- find all the customer of transaction type NET BANKING
SELECT * FROM (
    SELECT * FROM (
    (SELECT * FROM customer) y join (SELECT * FROM customer_loan) z using (acc_no)
) x JOIN (SELECT * FROM customer_transaction WHERE mode_of_transaction = 'Net
Banking') q USING (acc_no)) w;
```

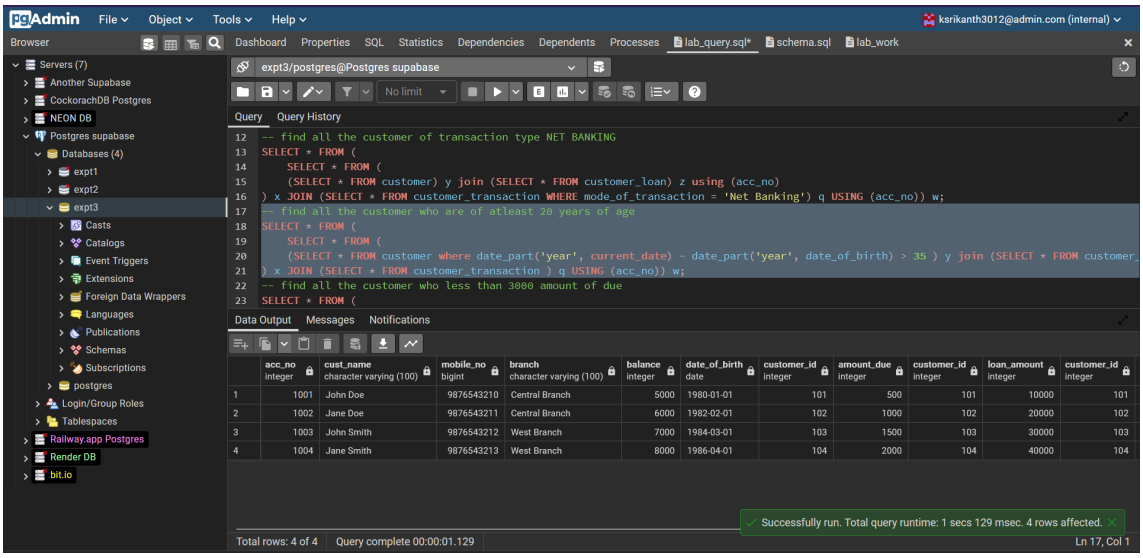
Result From table 1



Query 4

```sql
-- find all the customer who are of atleast 20 years of age
SELECT * FROM (
    SELECT * FROM (
    (SELECT * FROM customer where date_part('year', current_date) -
date_part('year', date_of_birth) > 35 ) y join (SELECT * FROM customer_loan) z using
(acc_no)
) x JOIN (SELECT * FROM customer_transaction ) q USING (acc_no)) w;
```

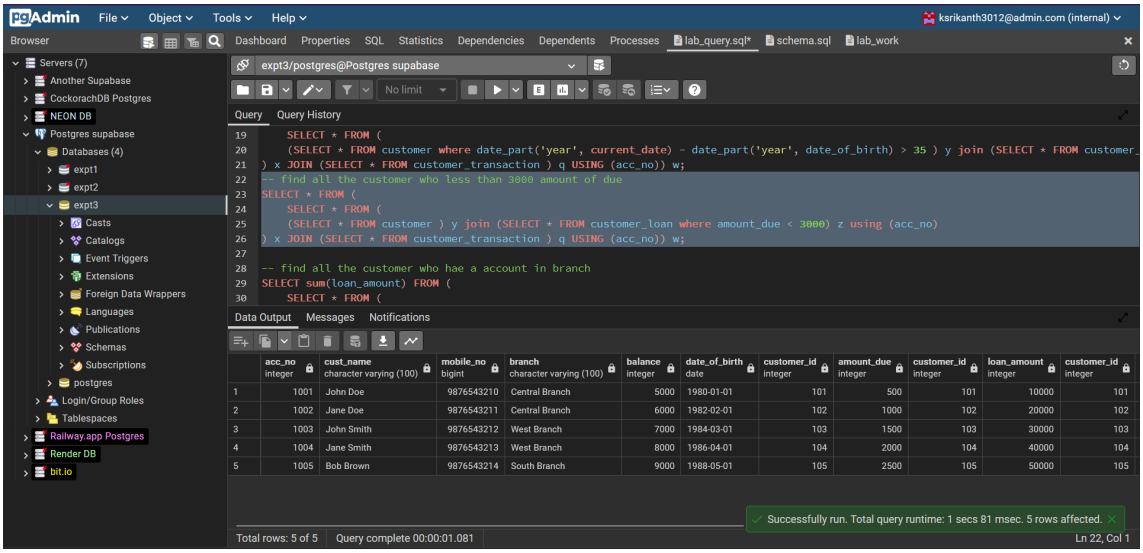
Result From table 1



Query 5

```sql
-- Find all the customer who less than 3000 amount of due
SELECT * FROM (
    SELECT * FROM (
    (SELECT * FROM customer ) y join (SELECT * FROM customer_loan where amount_due <
3000) z using (acc_no)
) x JOIN (SELECT * FROM customer_transaction ) q USING (acc_no)) w;
```

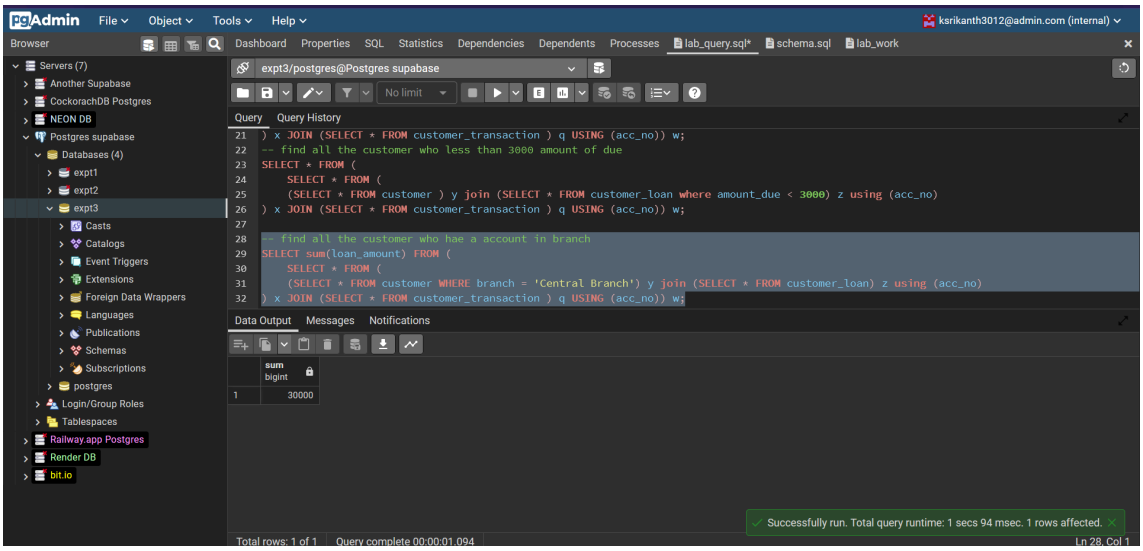
Result From table 1



Query 6

```
-- Find all the customer who has a account in branch
SELECT sum(loan_amount) FROM (
    SELECT * FROM (
    (SELECT * FROM customer WHERE branch = 'Central Branch') y join (SELECT * FROM
customer_loan) z using (acc_no)
) x JOIN (SELECT * FROM customer_transaction ) q USING (acc_no)) w;
```

Result From table 1



PART B

Implementation of part B

Flight Table

Flight Id	Flight Name	Source	Destination	Tickets Available
1	Transatlantic Express	New York	London	100
2	City Hopper	London	Paris	90
3	European Voyager	Paris	Berlin	80
4	Continent Cruiser	Berlin	Rome	70
5	Mediterranean Flyer	Rome	Madrid	60
6	Iberian Explorer	Madrid	Barcelona	50
7	Nordic Adventurer	Barcelona	Amsterdam	40
8	Oceanic Odyssey	Amsterdam	New York	30
9	Atlantic Ascension	New York	London	20
10	Skyline Shuttle	London	Paris	10
11	Continental Commuter	Paris	Berlin	20
12	Bella Italia	Berlin	Rome	30
13	España Express	Rome	Madrid	40
14	Dutch Delight	Madrid	Barcelona	50
15	Viking Venture	Barcelona	Amsterdam	60
16	Big Apple Bounce	Amsterdam	New York	70
17	British Airways	New York	London	80
18	French Connection	London	Paris	90
19	German Getaway	Paris	Berlin	100
20	Italian Holiday	Berlin	Rome	110

App user Table

Username	Password	Tickets Booked	Location
johndoe123	5f4dcc3b5aa765d61d8327deb882cf99	2	New York
janedoe456	5e884898da28047151d0e56f8dc62927	1	London
bobsmith789	21232f297a57a5a743894a0e4a801fc3	4	Paris
alicebrown101	ee11cbb19052e40b07aac0ca060c23ee	0	Berlin

tomgreen202	25f9e794323b453885f5181f1b624d0b	3	Madrid
jennypink303	a665a45920422f9d417e4867efdc4fb8	5	Rome
chrisblack404	5d41402abc4b2a76b9719d911017c592	6	Moscow
kimwhite505	bdbafc1b5f5dc8ab2f0196b5cd543a33	7	Toronto
paulred606	1a1dc91c907325c69271ddf0c944bc72	8	Sydney
lucyyellow707	ac0eafeed417f0ffa7befa0d1c01a7a6	9	Seoul
mikeblue808	098f6bcd4621d373cade4e832627b4f6	10	Tokyo
sarahpurple909	0b7c75b0f4b7e585a1c73e72409f3b7c	11	Shanghai
davidorange010	76a2173be6393254e72ffa4d6df1030a	12	Beijing
emmablack112	c1dfd96eea8cc2b62785275bca38ac26	13	Mexico City
danielgreen213	98f13708210194c475687be6106a3bce	14	Rio de Janeiro
elizabethpurple314	f0d2f1e2dc9abceb877557a483e07c3a	15	Sao Paulo
richardblue415	5ab5dbc27120680fa6f0b6ed7b6c0098	16	Buenos Aires
jenniferred516	7c222fb2927d828af22f592134e89324	17	Lima
robertyellow617	7a74f16c3e7d20a03b356f7bcf8c8f7a	18	Bogota

Query for creation of required tables

```sql
drop table if exists app_user;

CREATE TABLE IF NOT EXISTS public.app_user
(
    username character varying(100) COLLATE pg_catalog."default" NOT NULL,
    user_password character varying(100) COLLATE pg_catalog."default",
    tickets_booked integer,
    address varchar(100),
    CONSTRAINT app_user_pkey PRIMARY KEY (username)
);

INSERT INTO public.app_user (username, user_password, tickets_booked, address)
VALUES
('johndoe123', '5f4dcc3b5aa765d61d8327deb882cf99', 2, 'New York'),
('janedoe456', '5e884898da28047151d0e56f8dc62927', 1, 'London'),
('bobsmith789', '21232f297a57a5a743894a0e4a801fc3', 4, 'Paris'),
('alicebrown101', 'ee11cbb19052e40b07aac0ca060c23ee', 0, 'Berlin'),
('tomgreen202', '25f9e794323b453885f5181f1b624d0b', 3, 'Madrid'),
('jennypink303', 'a665a45920422f9d417e4867efdc4fb8', 5, 'Rome'),
('chrisblack404', '5d41402abc4b2a76b9719d911017c592', 6, 'Moscow'),
('kimwhite505', 'bdbafc1b5f5dc8ab2f0196b5cd543a33', 7, 'Toronto'),
('paulred606', '1a1dc91c907325c69271ddf0c944bc72', 8, 'Sydney'),
```

```
('lucyyellow707', 'ac0eafeed417f0ffa7befa0d1c01a7a6', 9, 'Seoul'),
('mikeblue808', '098f6bcd4621d373cade4e832627b4f6', 10, 'Tokyo'),
('sarahpurple909', '0b7c75b0f4b7e585a1c73e72409f3b7c', 11, 'Shanghai'),
('davidorange010', '76a2173be6393254e72ffa4d6df1030a', 12, 'Beijing'),
('emmablack112', 'c1dfd96eea8cc2b62785275bca38ac26', 13, 'Mexico City'),
('danielgreen213', '98f13708210194c475687be6106a3bce', 14, 'Rio de Janeiro'),
('elizabethpurple314', 'f0d2f1e2dc9abceb877557a483e07c3a', 15, 'Sao Paulo'),
('richardblue415', '5ab5dbc27120680fa6f0b6ed7b6c0098', 16, 'Buenos Aires'),
('jenniferred516', '7c222fb2927d828af22f592134e89324', 17, 'Lima'),
('robertyellow617', '7a74f16c3e7d20a03b356f7bcf8c8f7a', 18, 'Bogota');



drop table if exists flight;

CREATE TABLE IF NOT EXISTS public.flight
(
    flight_id integer NOT NULL,
    flight_name character varying(100) COLLATE pg_catalog."default" NOT NULL,
    flight_source character varying(100) COLLATE pg_catalog."default" NOT NULL,
    flight_destination character varying(100) COLLATE pg_catalog."default" NOT NULL,
    tickets_available integer NOT NULL,
    CONSTRAINT flight_pkey PRIMARY KEY (flight_id)
);



insert into flight values
(1, 'Transatlantic Express', 'New York', 'London', 100),
(2, 'City Hopper', 'London', 'Paris', 90),
(3, 'European Voyager', 'Paris', 'Berlin', 80),
(4, 'Continent Cruiser', 'Berlin', 'Rome', 70),
(5, 'Mediterranean Flyer', 'Rome', 'Madrid', 60),
(6, 'Iberian Explorer', 'Madrid', 'Barcelona', 50),
(7, 'Nordic Adventurer', 'Barcelona', 'Amsterdam', 40),
(8, 'Oceanic Odyssey', 'Amsterdam', 'New York', 30),
(9, 'Atlantic Ascension', 'New York', 'London', 20),
(10, 'Skyline Shuttle', 'London', 'Paris', 10),
(11, 'Continental Commuter', 'Paris', 'Berlin', 20),
(12, 'Bella Italia', 'Berlin', 'Rome', 30),
(13, 'España Express', 'Rome', 'Madrid', 40),
(14, 'Dutch Delight', 'Madrid', 'Barcelona', 50),
(15, 'Viking Venture', 'Barcelona', 'Amsterdam', 60),
(16, 'Big Apple Bounce', 'Amsterdam', 'New York', 70),
(17, 'British Airways', 'New York', 'London', 80),
(18, 'French Connection', 'London', 'Paris', 90),
(19, 'German Getaway', 'Paris', 'Berlin', 100),
(20, 'Italian Holiday', 'Berlin', 'Rome', 110);

DROP TABLE IF EXISTS flight_transaction;

CREATE TABLE flight_transaction (
```

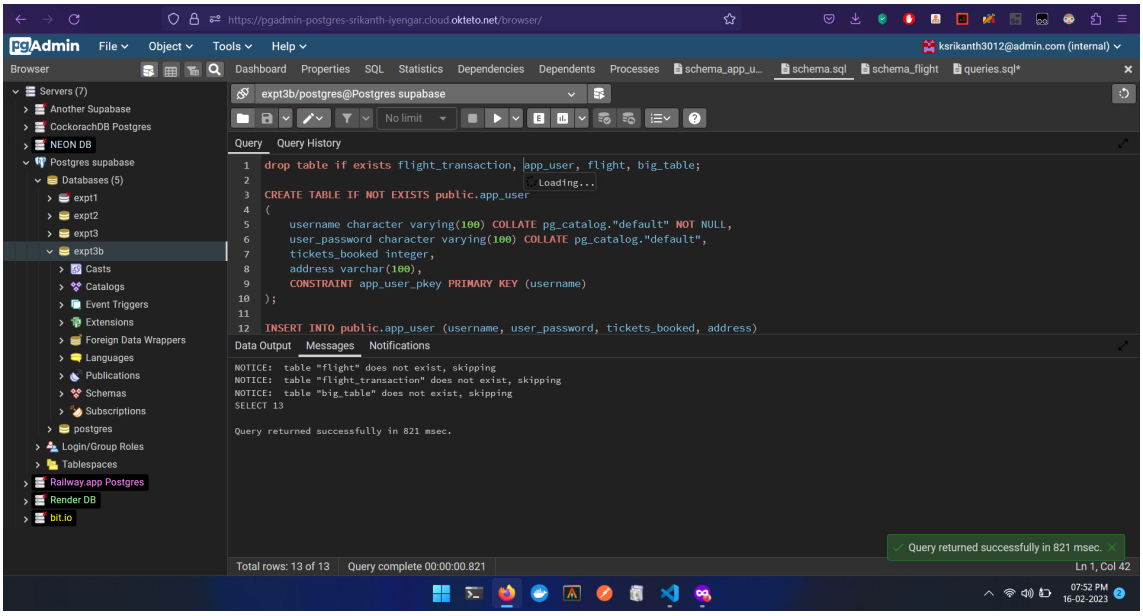
```sql
    transaction_id SERIAL PRIMARY KEY,
    username VARCHAR(100) NOT NULL,
    flight_id INTEGER NOT NULL,
    tickets_booked INTEGER NOT NULL,
    transaction_time TIMESTAMP DEFAULT NOW(),
    FOREIGN KEY (username) REFERENCES app_user(username),
    FOREIGN KEY (flight_id) REFERENCES flight(flight_id)
);


INSERT INTO flight_transaction (username, flight_id, tickets_booked)
SELECT
    u.username,
    f.flight_id,
    (CASE WHEN u.tickets_booked < f.tickets_available THEN u.tickets_booked ELSE
f.tickets_available END) as tickets_booked
FROM app_user u
INNER JOIN flight f ON (u.address = f.flight_source)
WHERE u.tickets_booked > 0 AND f.tickets_available > 0;

DROP TABLE IF EXISTS big_table;

CREATE TABLE big_table AS
SELECT au.username, au.user_password, au.address, f.flight_id, f.flight_name,
f.flight_source, f.flight_destination, f.tickets_available, ft.transaction_id,
ft.tickets_booked, ft.transaction_time
FROM app_user AS au
JOIN flight_transaction AS ft ON au.username = ft.username
JOIN flight AS f ON ft.flight_id = f.flight_id;
```

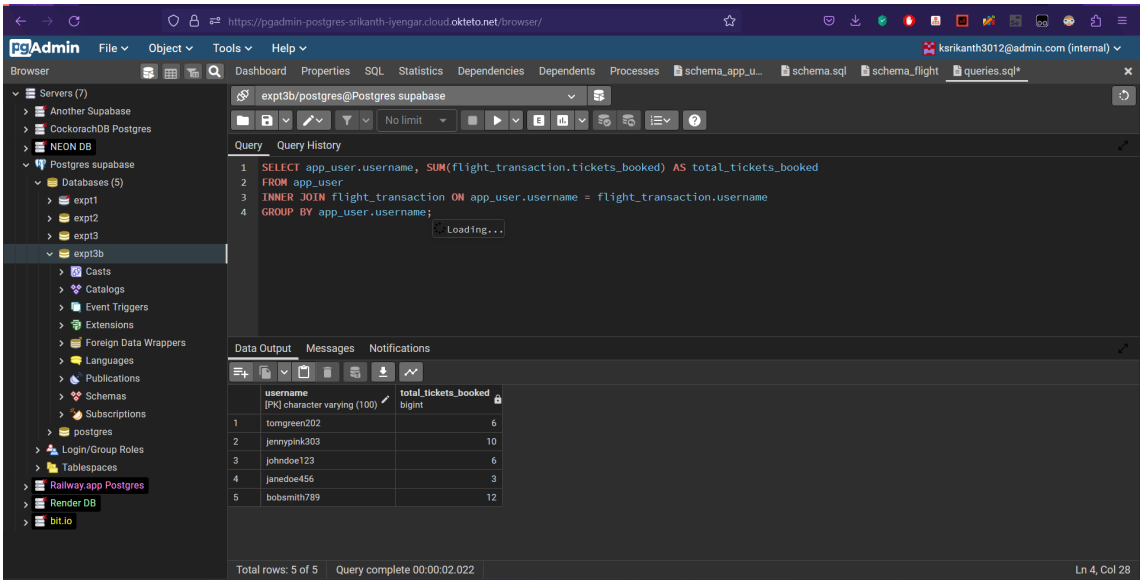
Table creation output:



Query 1

```
-- What are the total number of tickets booked by each user?
SELECT app_user.username, SUM(flight_transaction.tickets_booked) AS
total_tickets_booked
FROM app_user
INNER JOIN flight_transaction ON app_user.username = flight_transaction.username
GROUP BY app_user.username;
```

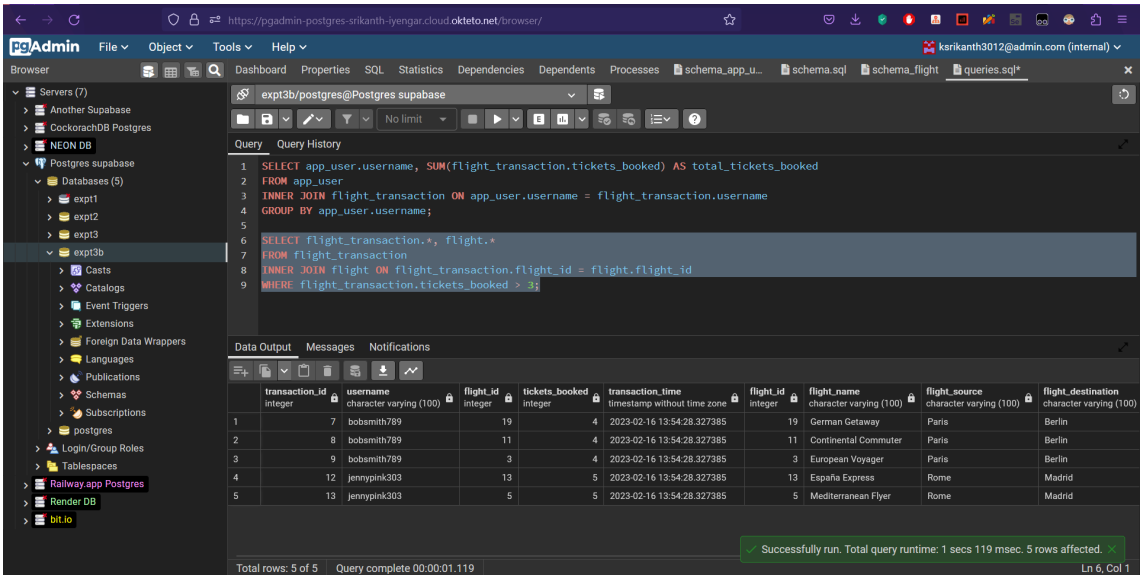
Result:



Query 2

```
-- What are the flight details of all transactions where more than 10 tickets were
booked?
SELECT app_user.username, SUM(flight_transaction.tickets_booked) AS
total_tickets_bookedSELECT flight_transaction.*, flight.*
FROM flight_transaction
INNER JOIN flight ON flight_transaction.flight_id = flight.flight_id
WHERE flight_transaction.tickets_booked > 3;
```

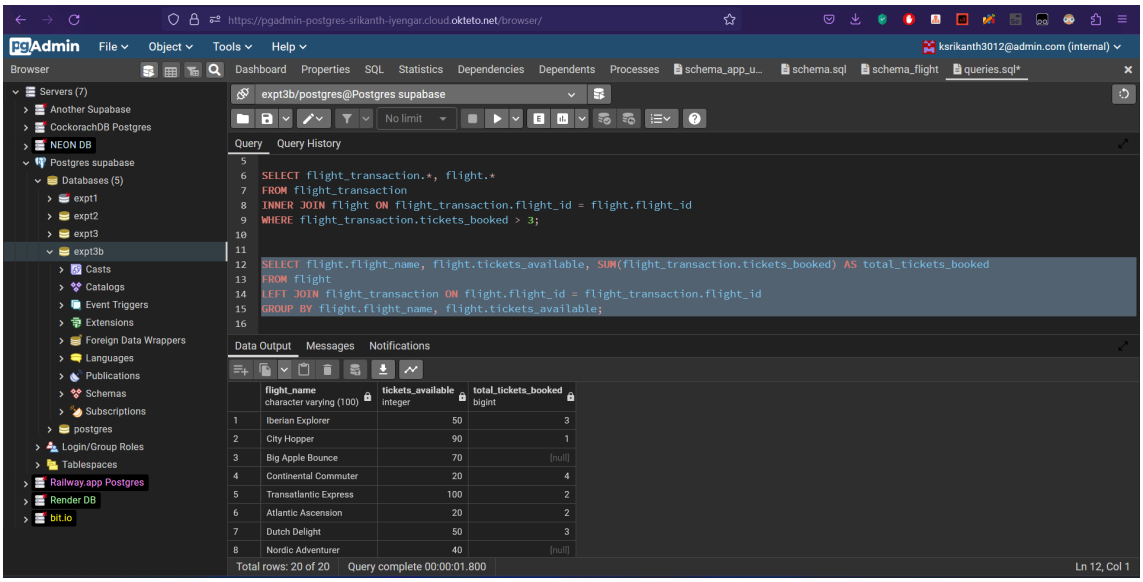
Result:



Query 3

```
--What are the total number of tickets booked for each flight, and how many tickets
are available for each flight?
SELECT flight.flight_name, flight.tickets_available,
SUM(flight_transaction.tickets_booked) AS total_tickets_booked
FROM flight
LEFT JOIN flight_transaction ON flight.flight_id = flight_transaction.flight_id
GROUP BY flight.flight_name, flight.tickets_available;
```

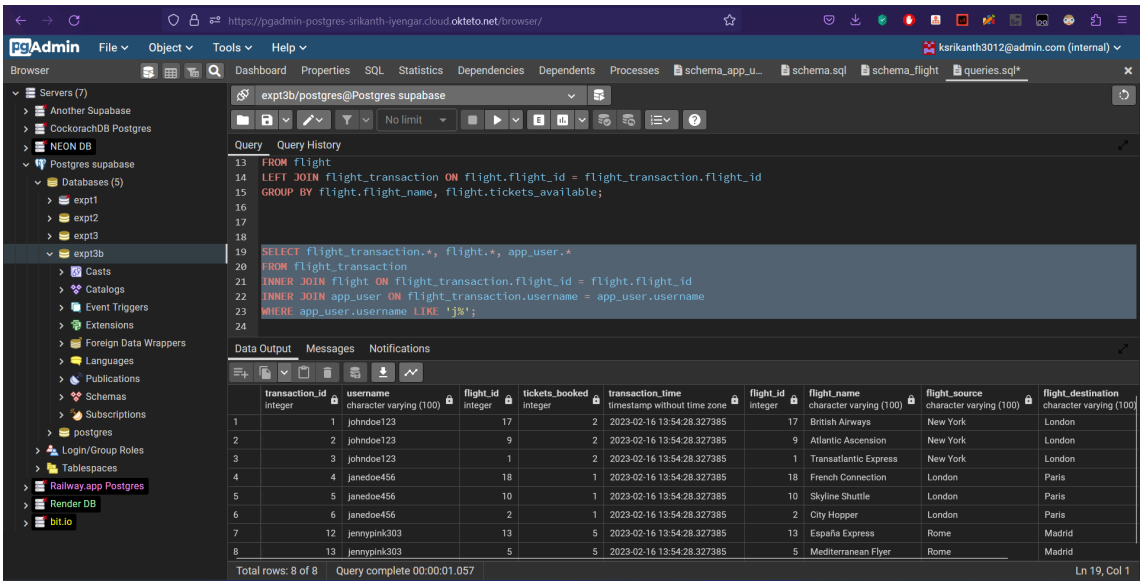
Resut:



Query 4

```
-- What are the flight details of all transactions made by users whose username
starts with the letter "J"?
SELECT flight_transaction.*, flight.*, app_user.*
FROM flight_transaction
INNER JOIN flight ON flight_transaction.flight_id = flight.flight_id
INNER JOIN app_user ON flight_transaction.username = app_user.username
WHERE app_user.username LIKE 'j%';
```

Result:

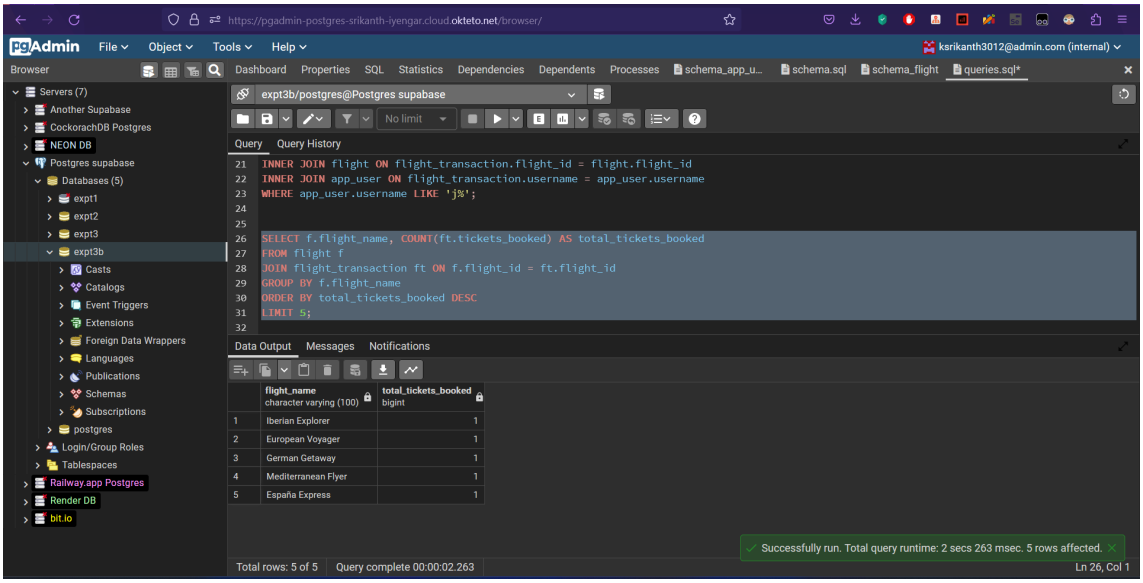


	transaction_id integer	username character varying (100)	flight_id integer	tickets_booked integer	transaction_time timestamp without time zone	flight_id integer	flight_name character varying (100)	flight_source character varying (100)	flight_destination character varying (100)
1	1	johndoe123	17	2	2023-02-16 13:54:28.327385	17	British Airways	New York	London
2	2	johndoe123	9	2	2023-02-16 13:54:28.327385	9	Atlantic Ascension	New York	London
3	3	johndoe123	1	2	2023-02-16 13:54:28.327385	1	Transatlantic Express	New York	London
4	4	janedoe456	18	1	2023-02-16 13:54:28.327385	18	French Connection	London	Paris
5	5	janedoe456	10	1	2023-02-16 13:54:28.327385	10	Skyline Shuttle	London	Paris
6	6	janedoe456	2	1	2023-02-16 13:54:28.327385	2	City Hopper	London	Paris
7	12	jennypink303	13	5	2023-02-16 13:54:28.327385	13	España Express	Rome	Madrid
8	13	jennypink303	5	5	2023-02-16 13:54:28.327385	5	Mediterranean Flyer	Rome	Madrid

Query 5

```
-- What are the top 5 flights with the highest number of tickets booked?
SELECT f.flight_name, COUNT(ft.tickets_booked) AS total_tickets_booked
FROM flight f
JOIN flight_transaction ft ON f.flight_id = ft.flight_id
GROUP BY f.flight_name
ORDER BY total_tickets_booked DESC
LIMIT 5;
```

Result:



Conclusion

Learned how to design a distributed database by applying the concept of vertical fragmentation in PostgreSQL.