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«НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ ИТМО»

Отчет

по лабораторной работе №4 «Запросы на выборку и модификацию данных. Представления. Работа с индексами»
по дисциплине **«Проектирование и реализация баз данных»**

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Цель работы: овладеть практическими навыками создания представлений и запросов на выборку данных к базе данных PostgreSQL, использования подзапросов при модификации данных и индексов.

Практическое задание:

Создать запросы и представления на выборку данных к базе данных PostgreSQL (согласно индивидуальному заданию, часть 2 и 3).

Составить 3 запроса на модификацию данных (INSERT, UPDATE, DELETE) с использованием подзапросов.

Изучить графическое представление запросов и просмотреть историю запросов.

Создать простой и составной индексы для двух произвольных запросов и сравнить время выполнения запросов без индексов и с индексами. Для получения плана запроса использовать команду EXPLAIN.

Выполнение:

Запросы

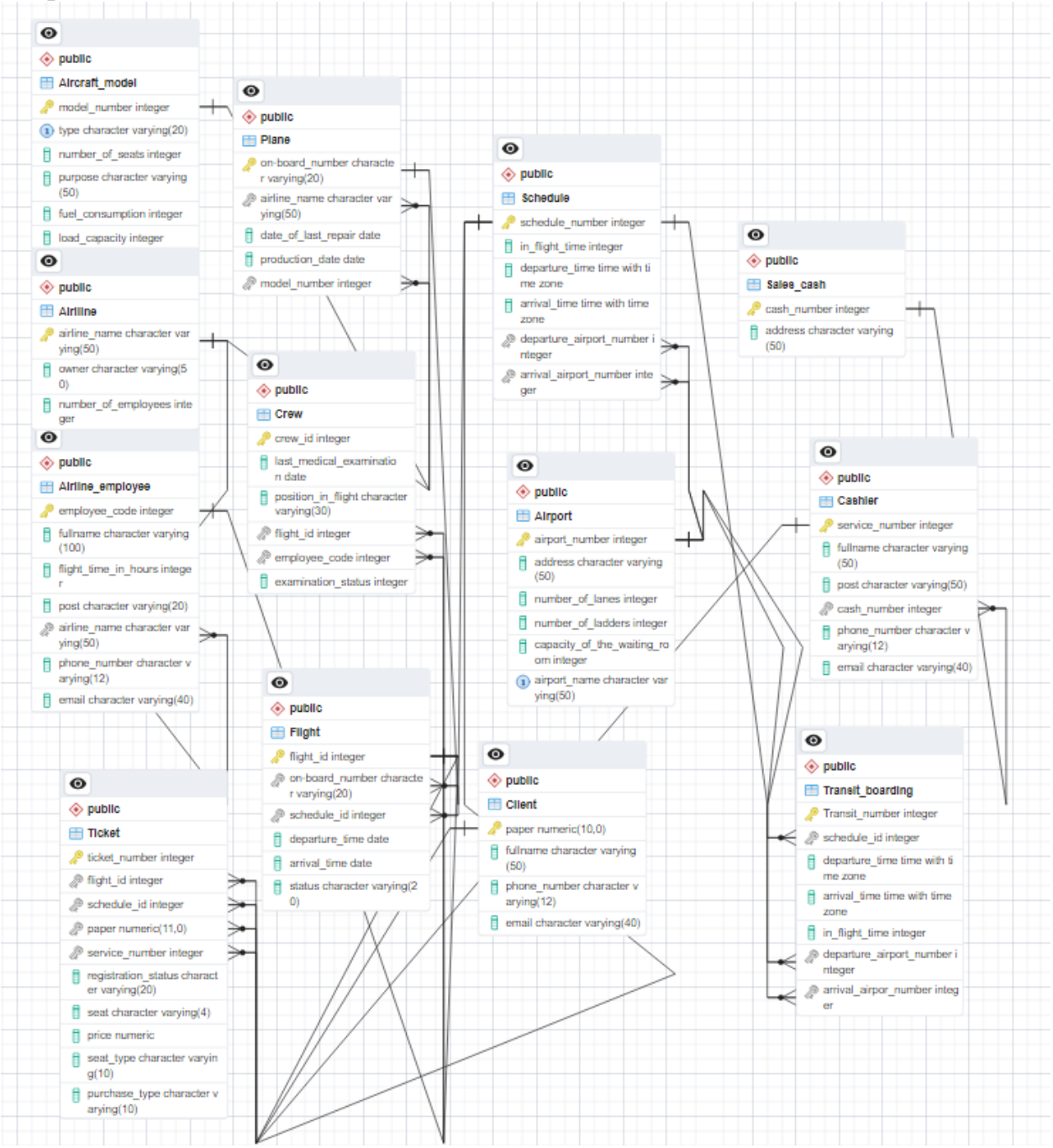
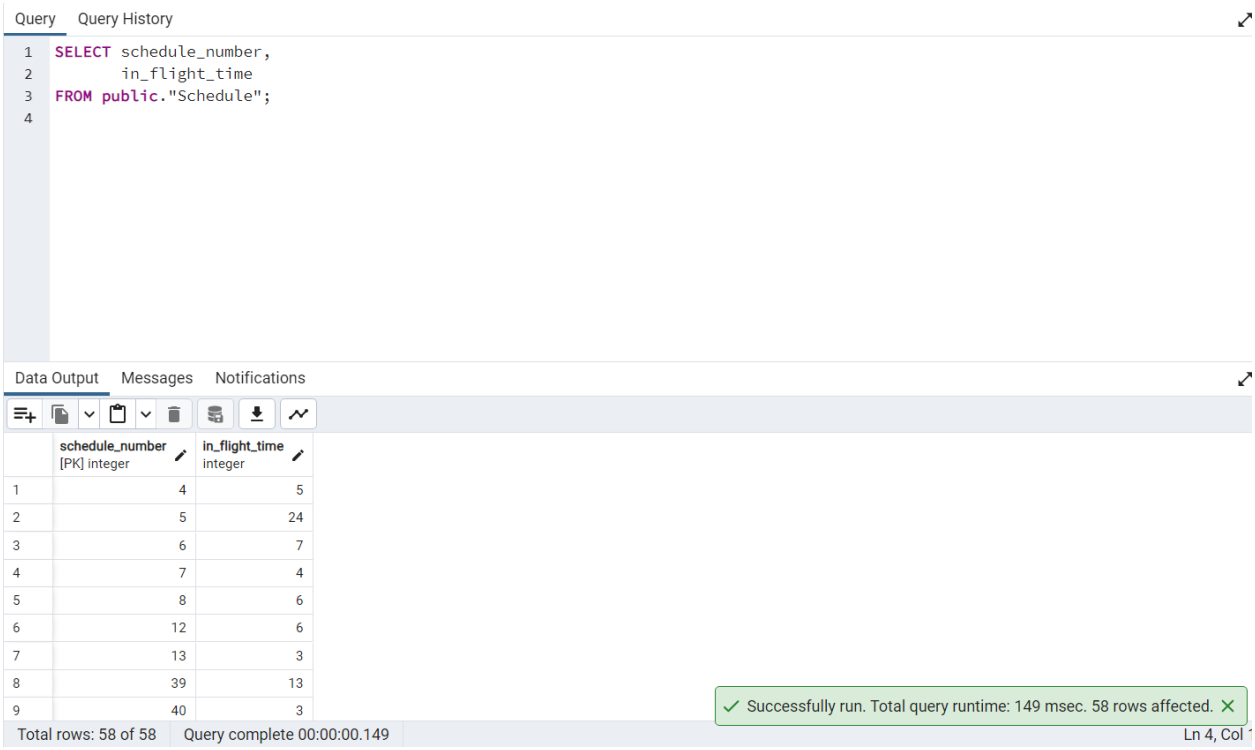


Рисунок 1 – Схема базы данных

Запросы

Определить расчетное время полета по всем маршрутам.

```
SELECT schedule_number,
    in_flight_time
FROM public."Schedule";
```



Определить расход топлива по всем маршрутам.

```
SELECT
    flight_id,
    f."on-board_number",
    f.schedule_id,
    a.fuel_consumption * s.in_flight_time AS fuel_consumption_on_flight
FROM
    public."Flight" f
JOIN
    public."Plane" p ON f."on-board_number" = p."on-board_number"
JOIN
    public."Aircraft_model" a ON p.model_number = a.model_number
JOIN
    public."Schedule" s ON f.schedule_id = s.schedule_number;
```

Query | Query History

```sql
SELECT
    flight_id,
    f."on-board_number",
    f.schedule_id,
    a.fuel_consumption * s.in_flight_time AS fuel_consumption_on_flight
FROM
    public."Flight" f
JOIN
    public."Plane" p ON f."on-board_number" = p."on-board_number"
JOIN
    public."Aircraft_model" a ON p.model_number = a.model_number
JOIN
    public."Schedule" s ON f.schedule_id = s.schedule_number;
```

Data Output | Messages | Notifications

	flight_id [PK] integer	on-board_number character varying (20)	schedule_id integer	fuel_consumption_on_flight integer
1	1	ПУ-205	4	75
2	2	НЕ-1488	8	126
3	3	ХК-504	7	40
4	4	ПД-3534	5	360
5	5	НЕ-1488	4	105
6	8	ХК-504	61	150
7	9	ПУ-3894	52	200
8	10	ПУ-1933	58	320
9	11	ПУ-2349	82	260

Successfully run. Total query runtime: 191 msec. 83 rows affected.

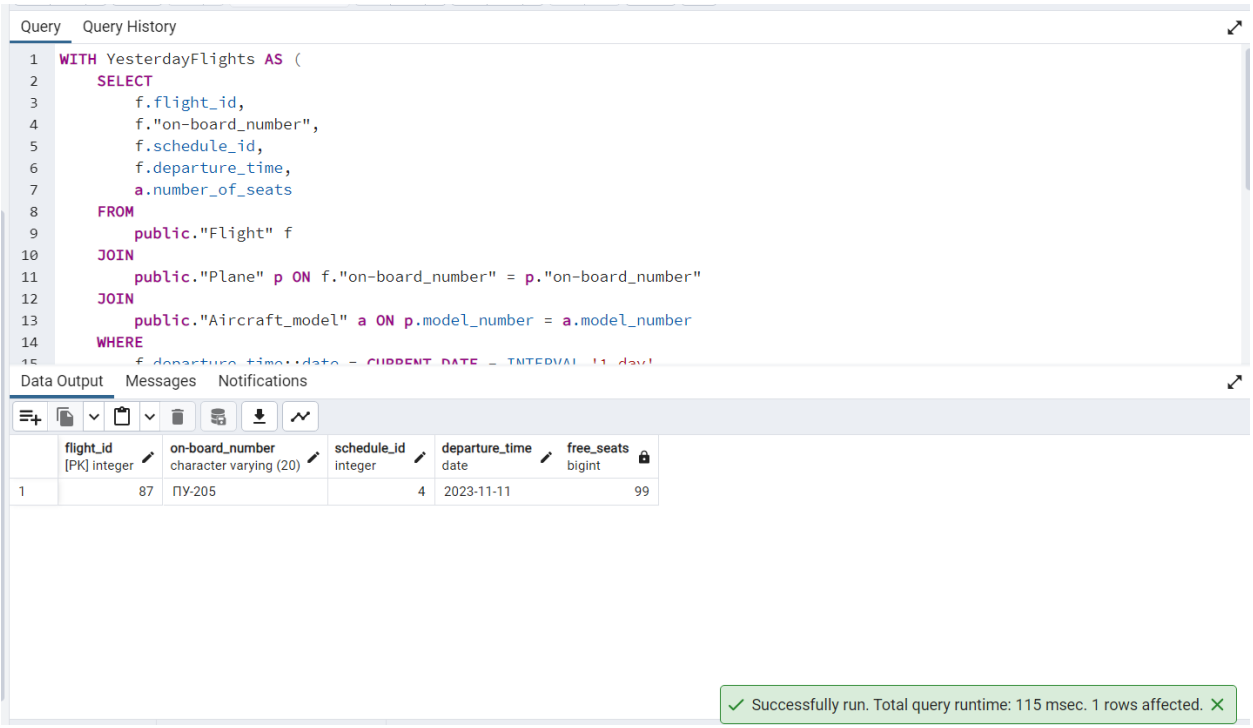
Total rows: 83 of 83 | Query complete 00:00:00.191 | Ln 13, Col 62

Вывести данные о том, сколько свободных мест оставалось в самолетах, совершавших полет по заданному из рейсов за вчерашний день.

```
WITH YesterdayFlights AS (
        SELECT
    f.flight_id,
    f."on-board_number",
    f.schedule_id,
    f.departure_time,
    a.number_of_seats
  FROM
    public."Flight" f
  JOIN
    public."Plane" p ON f."on-board_number" = p."on-board_number"
  JOIN
    public."Aircraft_model" a ON p.model_number = a.model_number
  WHERE
```

```
        f.departure_time::date = CURRENT_DATE - INTERVAL '1 day'
)

SELECT
    yf.flight_id,
    yf."on-board_number",
    yf.schedule_id,
    yf.departure_time,
    yf.number_of_seats - COALESCE(COUNT(t.ticket_number), 0) AS free_seats
FROM
    YesterdayFlights yf
LEFT JOIN
    public."Ticket" t ON yf.flight_id = t.flight_id
WHERE
    t.seat IS NOT NULL
GROUP BY
    yf.flight_id, yf."on-board_number", yf.schedule_id, yf.departure_time, yf.number_of_seats;
```



Рассчитать убытки компании за счет непроданных билетов за вчерашний день.

```
WITH RevenuePerFlight AS (
    SELECT
        f.flight_id,
                f."on-board_number",
        f.schedule_id,
        AVG(t.price) AS avg_ticket_price,
        COUNT(t.ticket_number) AS total_sold_tickets
    FROM
        public."Flight" f
    LEFT JOIN
        public."Ticket" t ON f.flight_id = t.flight_id
    WHERE
        t.seat IS NOT NULL
    GROUP BY
```

```
    f.flight_id, f."on-board_number", f.schedule_id
)

SELECT
    a.airline_name,
    COALESCE(SUM(rapf.avg_ticket_price * (rapf.total_sold_tickets - am.number_of_seats)), 0)*-1 AS total_losses
FROM
    public."Airlline" a
LEFT JOIN
    public."Plane" p ON a.airline_name = p.airline_name
LEFT JOIN
    public."Flight" f ON p."on-board_number" = f."on-board_number"
LEFT JOIN
    public."Aircraft_model" am ON p.model_number = am.model_number
LEFT JOIN
    RevenuePerFlight rapf ON f.flight_id = rapf.flight_id
GROUP BY
    a.airline_name;
```

Query Query History

```
WITH RevenuePerFlight AS (
    SELECT
        f.flight_id,
        f."on-board_number",
        f.schedule_id,
        AVG(t.price) AS avg_ticket_price,
        COUNT(t.ticket_number) AS total_sold_tickets
    FROM
        public."Flight" f
    LEFT JOIN
        public."Ticket" t ON f.flight_id = t.flight_id
    WHERE
        t.seat IS NOT NULL
    GROUP BY
```

Data Output Messages Notifications

	airline_name [PK] character varying (50)	total_losses numeric
1	Россия	3113786.9999999999810000
2	Победа	8110371.0000000000000000
3	Аэрофлот	12285228.0000000000000000
4	S7 AIRLINES	19498718.0000000000000000
5	Уральские авиалинии	9898644.0000000000000000

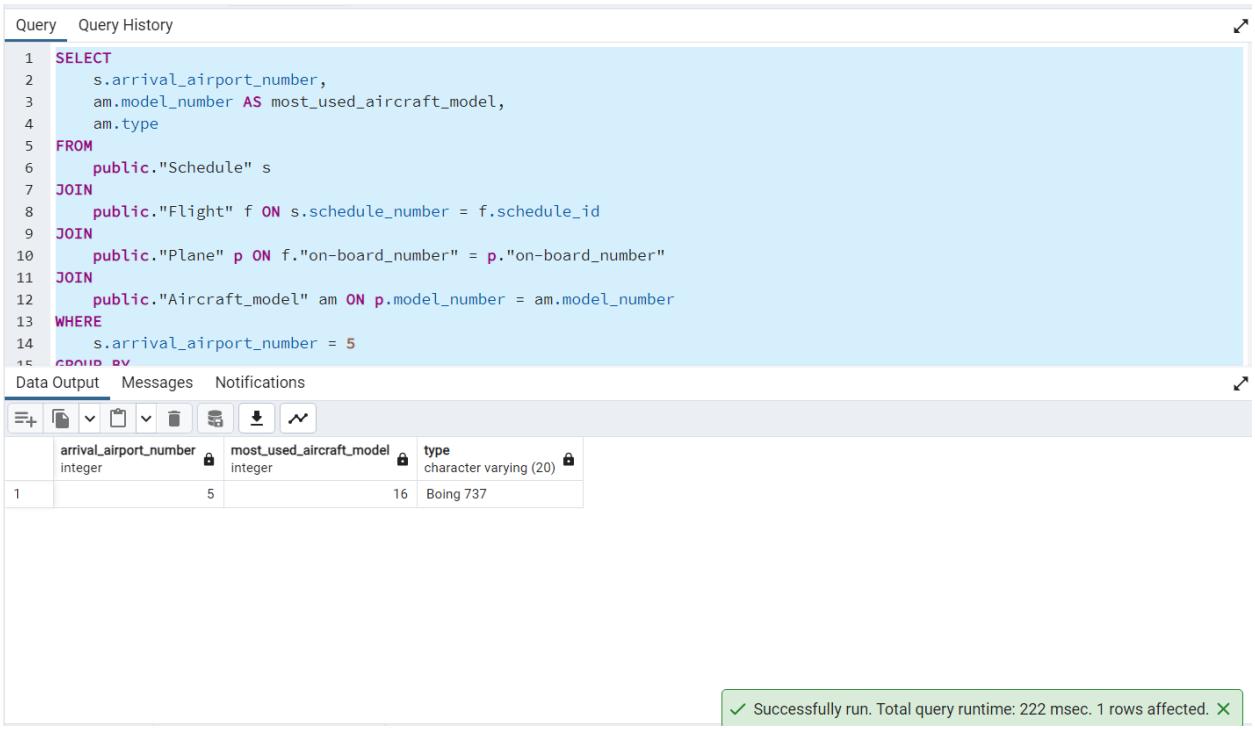
Successfully run. Total query runtime: 102 msec. 5 rows affected.

Total rows: 5 of 5 Query complete 00:00:00.102 Ln 21, Col 6

Определить, какой тип самолетов чаще всего летал в заданный аэропорт назначения(у нас в аэропорт с номером 5).

```
SELECT
    s.arrival_airport_number,
    am.model_number AS most_used_aircraft_model,
        am.type
FROM
    public."Schedule" s
JOIN
    public."Flight" f ON s.schedule_number = f.schedule_id
JOIN
    public."Plane" p ON f."on-board_number" = p."on-board_number"
JOIN
    public."Aircraft_model" am ON p.model_number = am.model_number
WHERE
    s.arrival_airport_number = 5
GROUP BY
    s.arrival_airport_number, am.model_number
```

```
ORDER BY
    COUNT(f."on-board_number") DESC
LIMIT 1;
```



Вывести список самолетов, “возраст” которых превышает средний “возраст” самолетов этого типа.

```
SELECT
    p."on-board_number",
    p.production_date,
    EXTRACT(YEAR FROM AGE(NOW(), p.production_date)) AS aircraft_age,
    avg_model_age.avg_age AS average_model_age
FROM
    public."Plane" p
JOIN (
    SELECT
        model_number,
        AVG(EXTRACT(YEAR FROM AGE(NOW(), production_date))) AS
avg_age
    FROM
```

public."Plane"

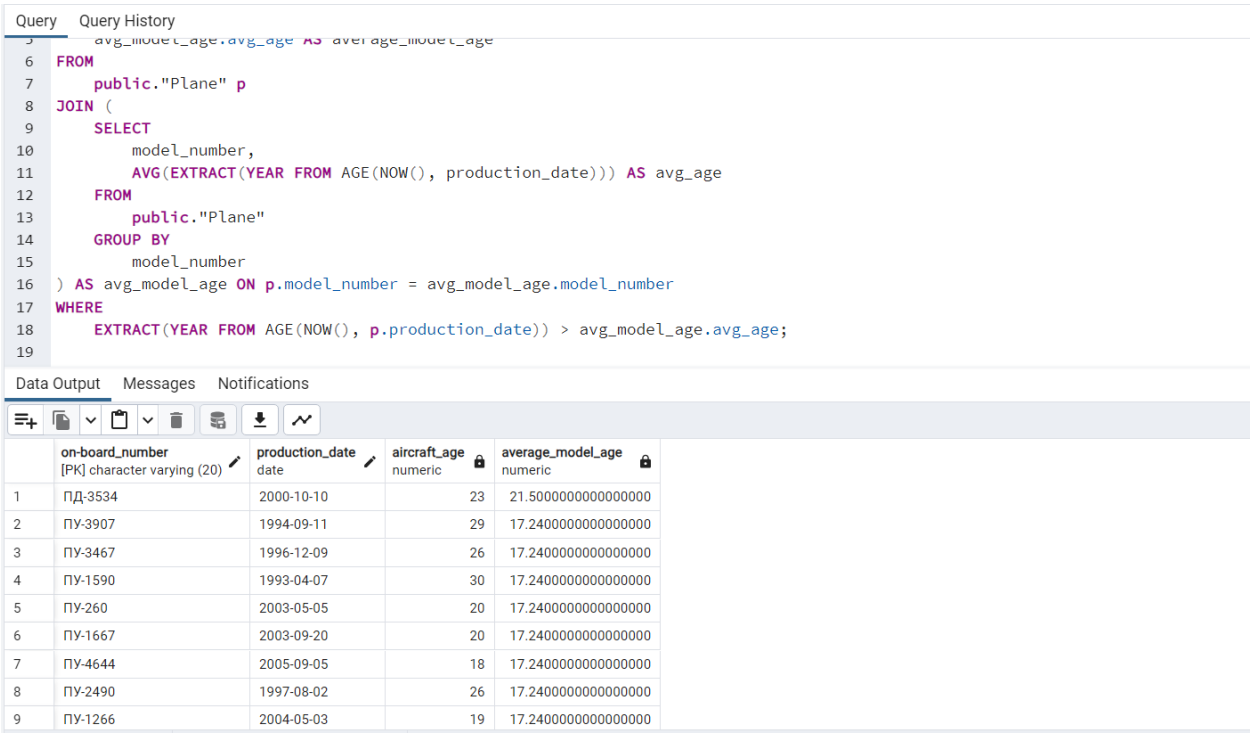
GROUP BY

model_number

) AS avg_model_age ON p.model_number = avg_model_age.model_number

WHERE

EXTRACT(YEAR FROM AGE(NOW(), p.production_date)) > avg_model_age.avg_age;



Определить тип самолетов, летающих во все аэропорты назначения.

SELECT

p.model_number,

p.type

FROM

public."Plane" p

JOIN

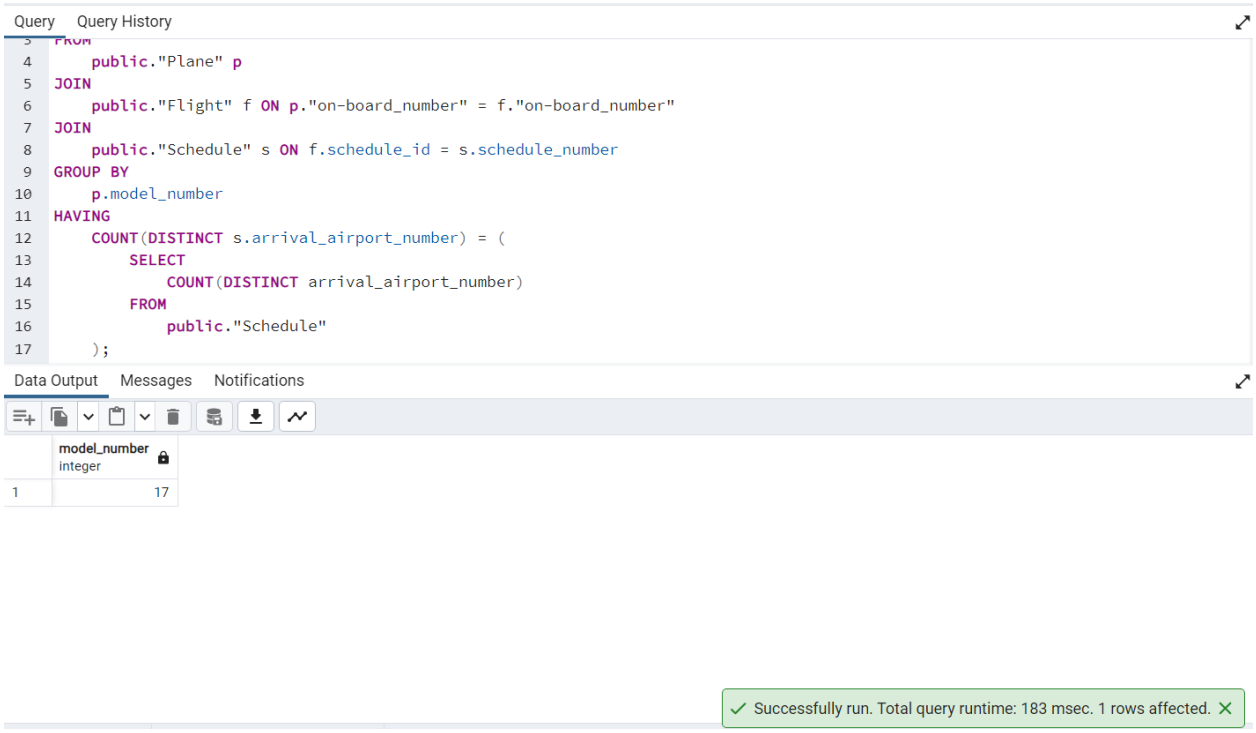
public."Flight" f ON p."on-board_number" = f."on-board_number"

JOIN

public."Schedule" s ON f.schedule_id = s.schedule_number

GROUP BY

```
    p.model_number
HAVING
    COUNT(DISTINCT s.arrival_airport_number) = (
        SELECT
            COUNT(DISTINCT arrival_airport_number)
        FROM
            public."Schedule"
    );
```



Представления

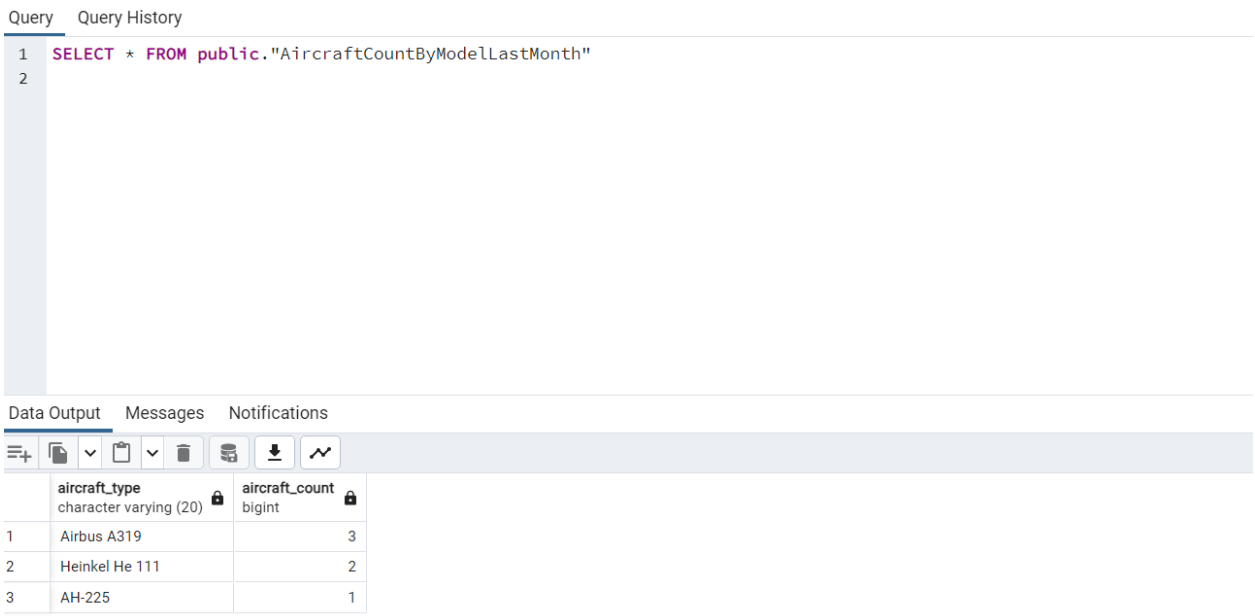
для пассажиров авиакомпании о рейсах в Москву на ближайшую неделю

```
CREATE VIEW public."MoscowFlightsView" AS
SELECT
    f.flight_id,
    f."on-board_number",
    f.departure_time,
    f.arrival_time,
    s_departure.airport_name AS departure_airport,
```

```
    s_arrival.airport_name AS arrival_airport,
    p.airline_name
FROM
    public."Flight" f
JOIN
    public."Schedule" s ON f.schedule_id = s.schedule_number
JOIN
    public."Plane" p ON f."on-board_number" = p."on-board_number"
JOIN
    public."Airport" s_departure ON s.departure_airport_number =
s_departure.airport_number
JOIN
    public."Airport" s_arrival ON s.arrival_airport_number =
s_arrival.airport_number
WHERE
    s_arrival.airport_number IN (1, 8, 21, 31, 41, 51, 61)
    AND f.departure_time BETWEEN CURRENT_TIMESTAMP AND
CURRENT_TIMESTAMP + INTERVAL '7 days'
ORDER BY
    f.departure_time;
```

количество самолетов каждого типа, летавшими за последний месяц.

```
CREATE VIEW public."AircraftCountByModelLastMonth" AS
SELECT
    am.type AS aircraft_type,
    COUNT(p."on-board_number") AS aircraft_count
FROM
    public."Plane" p
JOIN
    public."Flight" f ON p."on-board_number" = f."on-board_number"
JOIN
    public."Aircraft_model" am ON p.model_number = am.model_number
WHERE
    f.departure_time BETWEEN CURRENT_DATE - INTERVAL '1 month' AND CURRENT_DATE
GROUP BY
    am.type;
```



Запросы на модификацию данных.

```
INSERT INTO public."Flight" ("on-board_number", schedule_id, departure_time, arrival_time, status)
SELECT
```

```
    p."on-board_number",
    s.schedule_number,
    '2023-11-15 08:00:00',
    '2023-11-15 10:00:00',
    'Регистрация'
FROM
    public."Schedule" s
JOIN
    public."Airport" a ON s.departure_airport_number = a.airport_number
JOIN
    public."Plane" p ON p.airline_name = 'Аэрофлот'
WHERE
    a.airport_name = 'Внуково'
ORDER BY
    p."on-board_number";
```

Вставка

Создать рейсы в аэропорт «Внуково» для авиакомпании «Аэрофлот»

```
INSERT INTO public."Flight" ("on-board_number", schedule_id, departure_time, arrival_time, status)
SELECT
    p."on-board_number",
    s.schedule_number,
    '2023-11-15 08:00:00',
    '2023-11-15 10:00:00',
    'Регистрация'
FROM
    public."Schedule" s
JOIN
    public."Plane" p ON p.airline_name = 'Аэрофлот'
```

JOIN

public."Airport" a ON a.airport_name = 'Внуково'

WHERE

s.departure_airport_number = a.airport_number;

	flight_id [PK] integer	on-board_number character varying (20)	schedule_id integer	departure_time date	arrival_time date	status character varying (20)
77	139	ПУ-410	73	2023-11-15	2023-11-15	Регистрация
78	140	ПУ-1933	73	2023-11-15	2023-11-15	Регистрация
79	141	ПУ-3894	73	2023-11-15	2023-11-15	Регистрация
80	142	ПУ-2349	73	2023-11-15	2023-11-15	Регистрация
81	143	ПУ-2856	73	2023-11-15	2023-11-15	Регистрация
82	144	ПУ-843	73	2023-11-15	2023-11-15	Регистрация
83	145	ПУ-3538	73	2023-11-15	2023-11-15	Регистрация
84	146	ПУ-2663	73	2023-11-15	2023-11-15	Регистрация
85	147	ПУ-4052	73	2023-11-15	2023-11-15	Регистрация

Индексы

CREATE INDEX idx_plane_on_board_number

ON public."Plane" ("on-board_number");

CREATE INDEX idx_plane_model_number

ON public."Plane" ("model_number");

CREATE INDEX idx_aircraft_model_model_number

ON public."Aircraft_model" ("model_number");

Без индексов

Query Query History

```
1  SELECT
2      flight_id,
3      f."on-board_number",
4      f.schedule_id,
5      a.fuel_consumption * s.in_flight_time AS fuel_consumption_on_flight
6  FROM
7      public."Flight" f
8  JOIN
9      public."Plane" p ON f."on-board_number" = p."on-board_number"
10 JOIN
11     public."Aircraft_model" a ON p.model_number = a.model_number
12 JOIN
13     public."Schedule" s ON f.schedule_id = s.schedule_number;
```

Data Output | Messages | Explain | Notifications

```
Successfully run. Total query runtime: 119 msec.
85 rows affected.
```

С индексами

Query Query History

```sql
SELECT
    flight_id,
    f."on-board_number",
    f.schedule_id,
    a.fuel_consumption * s.in_flight_time AS fuel_consumption_on_flight
FROM
    public."Flight" f
JOIN
    public."Plane" p ON f."on-board_number" = p."on-board_number"
JOIN
    public."Aircraft_model" a ON p.model_number = a.model_number
JOIN
    public."Schedule" s ON f.schedule_id = s.schedule_number;
```

Data Output Messages Explain Notifications

```
Successfully run. Total query runtime: 77 msec.
1 rows affected.
```

Составной индекс

CREATE INDEX idx_schedule_number_in_flight_time

ON public."Schedule" (schedule_number, in_flight_time);

Без индекса

Query Query History

```
1  SELECT schedule_number,
2         in_flight_time
3  FROM public."Schedule";
```

Data Output Messages Explain Notifications

```
Successfully run. Total query runtime: 181 msec.
58 rows affected.
```

С индексом

```
1  SELECT schedule_number,
2         in_flight_time
3  FROM public."Schedule";
```

Data Output Messages Explain Notifications

```
Successfully run. Total query runtime: 77 msec.
1 rows affected.
```

Удаление индексов

```
DROP INDEX idx_plane_on_board_number;

DROP INDEX idx_plane_model_number;

DROP INDEX idx_aircraft_model_model_number;

DROP INDEX idx_schedule_number_in_flight_time;
```

Выводы:
В этой работе были изучены способы создания запросов, представлений и индексов.