Министерство науки и высшего образования Российской Федерации
федеральное государственное автономное образовательное учреждение высшего образования
«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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Оглавление

Цель работы и практическое задание

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

Оборудование: компьютерный класс.

Программное обеспечение: СУБД PostgreSQL, pgadmin 4.

Практическое задание:

1. Создать запросы и представления на выборку данных к базе данных PostgreSQL (согласно индивидуальному заданию, часть 2 и 3).
2. Составить 3 запроса на модификацию данных (INSERT, UPDATE, DELETE) **с использованием подзапросов**.
3. Изучить графическое представление запросов и просмотреть историю запросов.
4. 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.

1. Запросы к БД
    - Список книг, изданных в текущем году и относящихся к категории «Базы данных».

      Листинг:

```
SELECT *
FROM "publishing house".book
WHERE EXTRACT(YEAR FROM release_date) = EXTRACT(YEAR FROM CURRENT_DATE)
AND type = 'Database';
```

```
1  SELECT *
2  FROM "publishing house".book
3  WHERE EXTRACT(YEAR FROM release_date) = EXTRACT(YEAR FROM CURRENT_DATE)
4  AND type = 'Database';
5
```

Data Output | Messages | Notifications

	title character varying (100)	release_date date	type character varying (50)	isbn_key [PK] character varying
1	Modern Database Management	2024-03-01	Database	978-0321994164

- Список покупателей, заказавших книг на сумму, превышающую среднюю сумму заказа за год. Листинг:

```
SELECT
   c.name AS client_name,
   SUM(r.sum) AS total_order_amount
FROM
   "publishing house"."receipt" r
JOIN
   "publishing house"."order" o ON r.order_id = o.order_id
JOIN
   "publishing house"."client" c ON o.client_id = c.client_id
WHERE
   o.date >= CURRENT_DATE - INTERVAL '1 year' -- за последний год
GROUP BY
   c.client_id, c.name
HAVING
   SUM(r.sum) > (SELECT AVG(sum) FROM "publishing house"."receipt" WHERE date >=
```

CURRENT_DATE - INTERVAL '1 year');

```
SELECT
    c.name AS client_name,
    SUM(r.sum) AS total_order_amount
FROM
    "publishing house"."receipt" r
JOIN
    "publishing house"."order" o ON r.order_id = o.order_id
JOIN
    "publishing house"."client" c ON o.client_id = c.client_id
WHERE
    o.date >= CURRENT_DATE - INTERVAL '1 year' -- за последний год
GROUP BY
    c.client_id, c.name
HAVING
    SUM(r.sum) > (SELECT AVG(sum) FROM "publishing house".receipt WHERE billing_date >= CURRENT_DATE - INTERVAL '1 year
```

Data Output | Messages | Notifications

	client_name character varying (100)	total_order_amount double precision
1	Elena Kuznetsova	200
2	Sergey Morozov	140
3	Ivan Ivanov	150
4	Artem Nikolaev	170

- Список книг, которые не заказывались в течение последних двух кварталов.
  Листинг:

```
SELECT
    b.title AS book_title
FROM
    "publishing house"."book" b
LEFT JOIN
    "publishing house"."specification" s ON b.isbn_key = s.isbn_key
LEFT JOIN
    "publishing house"."appeal" a ON s.spec_id = a.spec_id
LEFT JOIN
    "publishing house"."include" i ON a.appeal_id = i.appeal_id
LEFT JOIN
    "publishing house"."order" o ON i.order_id = o.order_id
WHERE
    o.date IS NULL OR o.date < CURRENT_DATE - INTERVAL '6 months';
```

Query | Query History

```sql
SELECT
    b.title AS book_title
FROM
    "publishing house"."book" b
LEFT JOIN
    "publishing house"."specification" s ON b.isbn_key = s.isbn_key
LEFT JOIN
    "publishing house"."appeal" a ON s.spec_id = a.spec_id
LEFT JOIN
    "publishing house"."include" i ON a.appeal_id = i.appeal_id
LEFT JOIN
    "publishing house"."order" o ON i.order_id = o.order_id
WHERE
    o.date IS NULL OR o.date < CURRENT_DATE - INTERVAL '6 months';
```

Data Output | Messages | Notifications

	book_title character varying (100)
1	Artificial Intelligence: A Modern Approach
2	The Pragmatic Programmer: Your Journey to Mastery
3	Head First Design Patterns: A Brain-Friendly Guide
4	Structure and Interpretation of Computer Programs
5	Introduction to Algorithms
6	Machine Learning: A Probabilistic Perspective
7	Artificial Intelligence: A Modern Approach
8	Modern Database Management
9	Python Crash Course
10	Big Data: Principles and best practices of scalable realtime data syste…

- Список авторов, не написавших ни одной книги, относящейся к категории “Языки программирования“.
  Листинг:

```
SELECT
   a.name
FROM
   "publishing house"."author" a
WHERE
   NOT EXISTS (
      SELECT 1
      FROM
         "publishing house"."authorship" ash
      JOIN
         "publishing house"."book" b ON ash.isbn_key = b.isbn_key
      WHERE
         b.type = 'Programming' AND ash.author_id = a.author_id
      );
```

Query | Query History

```
1  SELECT
2      a.name
3  FROM
4      "publishing house"."author" a
5  WHERE
6      NOT EXISTS (
7          SELECT 1
8          FROM
9              "publishing house"."authorship" ash
10         JOIN
11             "publishing house"."book" b ON ash.isbn_key = b.isbn_key
12         WHERE
13             b.type = 'Programming' AND ash.author_id = a.author_id
14     );
15
```

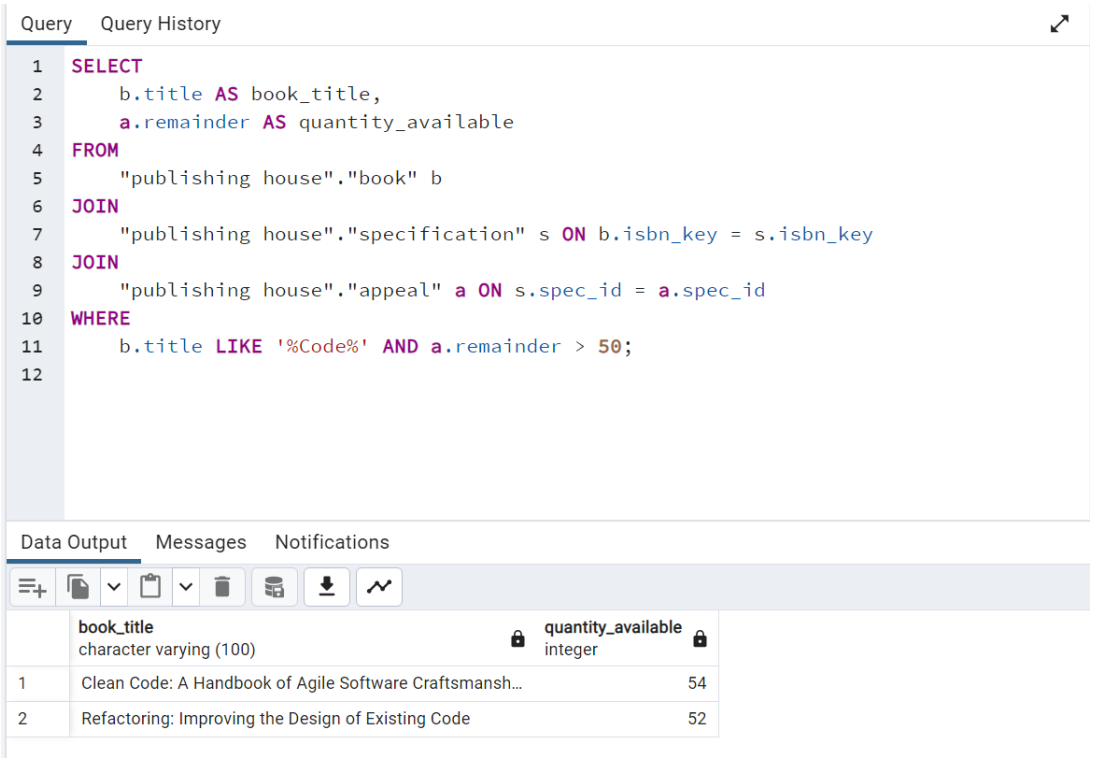
Data Output | Messages | Notifications

	name character varying (100)
1	John Smith
2	Emily Johnson
3	Michael Brown
4	Christopher Wilson
5	Jessica Martinez
6	Matthew Anderson
7	Ava Taylor
8	Daniel Thomas
9	Olivia Jackson

- Список книг, в названиях которых содержится слово “Code“ и которые присутствуют на базе в количестве, превышающем 50 экземпляров.

Листинг:

```
SELECT
   b.title AS book_title,
   a.remainder AS quantity_available
FROM
   "publishing house"."book" b
JOIN
   "publishing house"."specification" s ON b.isbn_key = s.isbn_key
JOIN
   "publishing house"."appeal" a ON s.spec_id = a.spec_id
WHERE
   b.title LIKE '%Code%' AND a.remainder > 50;
```



- Покупателя, сделавшего заказ на максимальную сумму за последний месяц.

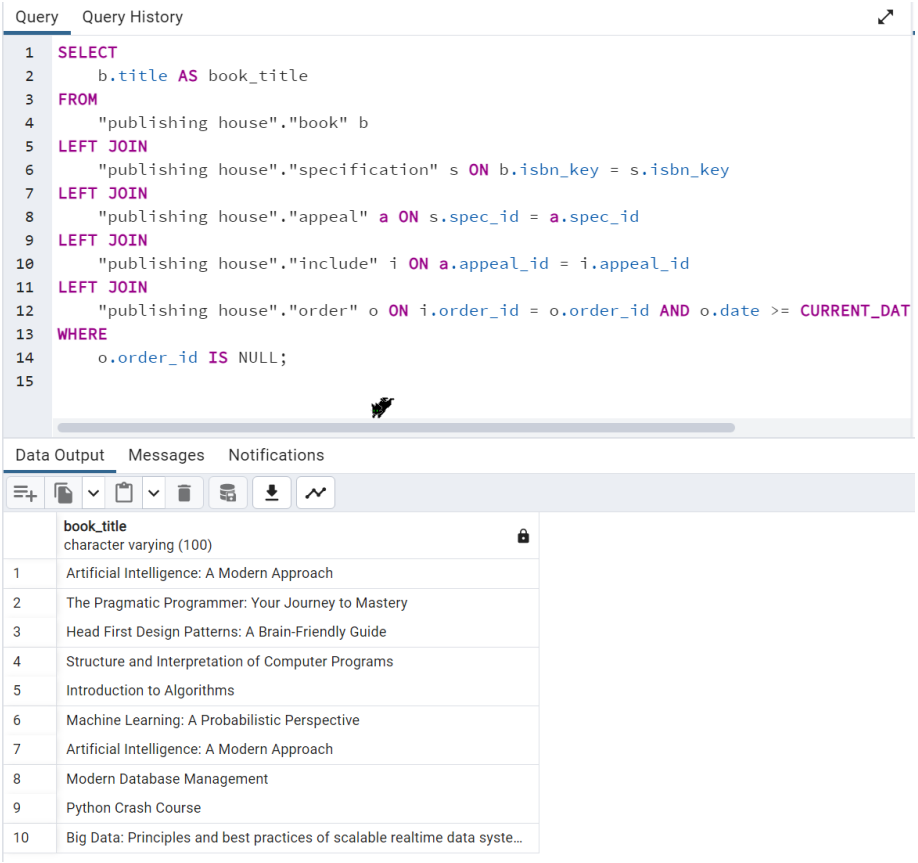
Листинг:

```
SELECT
   c.name AS customer_name,
   SUM(r.sum) AS total_order_amount
FROM
   "publishing house"."order" o
JOIN
   "publishing house"."client" c ON o.client_id = c.client_id
JOIN
   "publishing house"."receipt" r ON o.order_id = r.order_id
WHERE
   o.date >= CURRENT_DATE - INTERVAL '1 month' AND
   o.date < CURRENT_DATE
GROUP BY
   c.client_id, c.name
HAVING
   SUM(r.sum) >= ALL (
      SELECT
         SUM(r2.sum) AS sum_total
      FROM
         "publishing house"."order" o2
      JOIN
         "publishing house"."receipt" r2 ON o2.order_id = r2.order_id
      WHERE
         o2.date >= CURRENT_DATE - INTERVAL '1 month' AND
         o2.date < CURRENT_DATE
      GROUP BY
         o2.client_id
   )
ORDER BY
```

total_order_amount DESC;

```sql
SELECT
    c.name AS customer_name,
    SUM(r.sum) AS total_order_amount
FROM
    "publishing house"."order" o
JOIN
    "publishing house"."client" c ON o.client_id = c.client_id
JOIN
    "publishing house"."receipt" r ON o.order_id = r.order_id
WHERE
    o.date >= CURRENT_DATE - INTERVAL '1 month' AND
    o.date < CURRENT_DATE
GROUP BY
    c.client_id, c.name
HAVING
    SUM(r.sum) >= ALL (
        SELECT
            SUM(r2.sum) AS sum_total
        FROM
            "publishing house"."order" o2
        JOIN
            "publishing house"."receipt" r2 ON o2.order_id = r2.order_id
        WHERE
            o2.date >= CURRENT_DATE - INTERVAL '1 month' AND
            o2.date < CURRENT_DATE
        GROUP BY
            o2.client_id
    )
ORDER BY
    total_order_amount DESC;
```

- Список книг, не попавших ни в один из заказов в течение последнего года.



Листинг:

```
SELECT
    b.title AS book_title
FROM
"publishing house"."book" b
LEFT JOIN
    "publishing house"."specification" s ON b.isbn_key = s.isbn_key
LEFT JOIN
    "publishing house"."appeal" a ON s.spec_id = a.spec_id
LEFT JOIN
    "publishing house"."include" i ON a.appeal_id = i.appeal_id
LEFT JOIN
    "publishing house"."order" o ON i.order_id = o.order_id AND o.date >= CURRENT_DATE - INTERVAL '1 year'
WHERE
```

o.order_id IS NULL;

2. Создание представлений
   - содержащее сведения о количестве заказанных экземпляров каждой книги, изданной в текущем году;

```sql
CREATE VIEW book_orders_current_year AS
SELECT
    b.title AS book_title,
    SUM(i.amount) AS copies_ordered
FROM
    "publishing house"."book" b
JOIN
    "publishing house"."specification" s ON b.isbn_key = s.isbn_key
JOIN
    "publishing house"."appeal" a ON s.spec_id = a.spec_id
JOIN
    "publishing house"."include" i ON a.appeal_id = i.appeal_id
JOIN
    "publishing house"."order" o ON i.order_id = o.order_id
WHERE
    EXTRACT(YEAR FROM o.date) = EXTRACT(YEAR FROM CURRENT_DATE)
GROUP BY
    b.title;
```

Query | Query History

```sql
SELECT * FROM book_orders_current_year
```

Data Output | Messages | Notifications

	book_title character varying (100)	copies_ordered bigint
1	Clean Code: A Handbook of Agile Software Craftsmanship	81
2	Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automat...	8
3	Design Patterns: Elements of Reusable Object-Oriented Software	17
4	Refactoring: Improving the Design of Existing Code	74
5	The Docker Book: Containerization Is the New Virtualization	37

- Количество заказов по покупателям за последний год.

Query | Query History

```sql
CREATE VIEW client_order_count_last_year AS
SELECT
    c.name AS client_name,
    COUNT(o.order_id) AS order_count
FROM
    "publishing house"."client" c
JOIN
    "publishing house"."order" o ON c.client_id = o.client_id
WHERE
    o.date >= CURRENT_DATE - INTERVAL '1 year'
GROUP BY
    c.name;
```

Data Output | Messages | Notifications

```
CREATE VIEW

Query returned successfully in 86 msec.
```

```sql
SELECT * FROM client_order_count_last_year
```

Data Output | Messages | Notifications

	client_name character varying (100)	order_count bigint
1	Alexey Smirnov	1
2	Ivan Ivanov	6
3	Dmitry Vasilyev	1
4	Elena Kuznetsova	1
5	Anastasia Zakharova	6
6	Maria Petrova	6
7	Artem Nikolaev	1
8	Anna Kazakova	1
9	Ekaterina Solovyova	1
10	Sergey Morozov	1

3. Запросы на модификацию данных
   - INSERT – добавить заказ для клиента с именем Anna Zacharova

     Листинг:

INSERT INTO "publishing house"."order" (status, deadline, client_id, date, member_id)
VALUES ('Processing', CURRENT_DATE + INTERVAL '14 days',
(SELECT client_id FROM "publishing house"."client" WHERE name = 'Anastasia Zakharova'),
CURRENT_DATE, 1);

```sql
INSERT INTO "publishing house"."order" (status, deadline, client_id, date, member_id)
VALUES ('Processing', CURRENT_DATE + INTERVAL '14 days',
        (SELECT client_id FROM "publishing house"."client" WHERE name = 'Anastasia Zakharova'),
        CURRENT_DATE, 1);

```

   - UPDATE – обновить адрес клиента с id = 5

     Листинг:

```sql
UPDATE "publishing house"."client"
SET address = (
    SELECT 'Lomonosova, 14'
    FROM "publishing house"."client"
    WHERE client_id = 5
)
WHERE client_id = 5;

```

Data Output | Messages | Notifications

```
UPDATE 1

Query returned successfully in 69 msec.
```

- DELETE – удалить всех авторов, которые не состоят ни в одном авторстве книг нашего издательства
- Листинг:

Query Query History

```
1  DELETE FROM "publishing house"."author"
2  WHERE author_id NOT IN (
3      SELECT author_id
4      FROM "publishing house"."authorship"
5  );
6
```

Data Output Messages Notifications

```
DELETE 2

Query returned successfully in 69 msec.
```

4. Создание индексов

Запрос на выборку всех книг, выпущенных в 2024 году

Листинг:

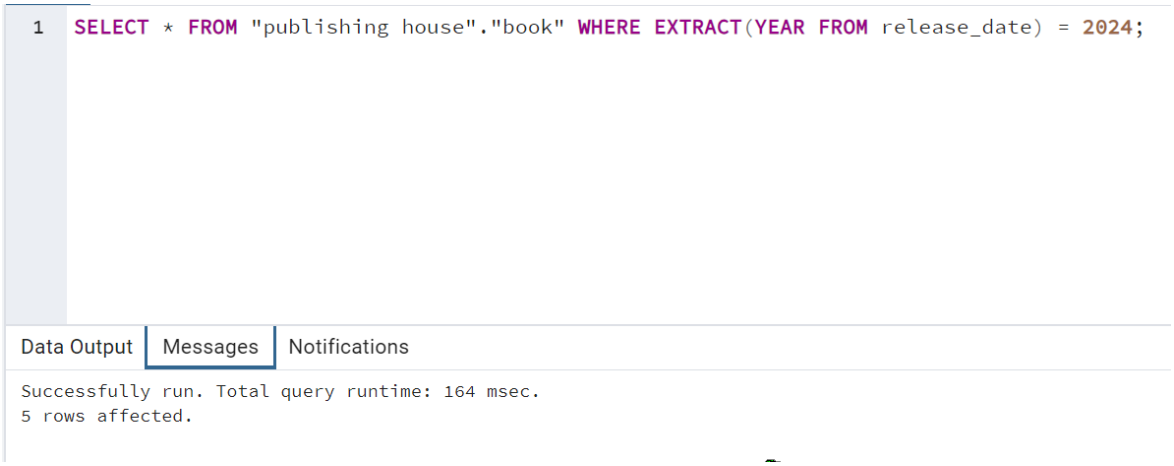
SELECT * FROM "publishing house"."book" WHERE

EXTRACT(YEAR FROM release_date) = 2024;

CREATE INDEX release_date_index ON "publishing house"."book"

(release_date);

Без индексов(164 ms):



С индексами(160 ms):

```
1  SELECT * FROM "publishing house"."book" WHERE EXTRACT(YEAR FROM release_date) = 2024;
```

Data Output | Messages | Notifications

```
Successfully run. Total query runtime: 160 msec.
5 rows affected.
```

Составной индекс:

- Вывести все книги, выпущенные в 2024 году, на тему «Programming»

Без индексов(143 ms):

Query | Query History

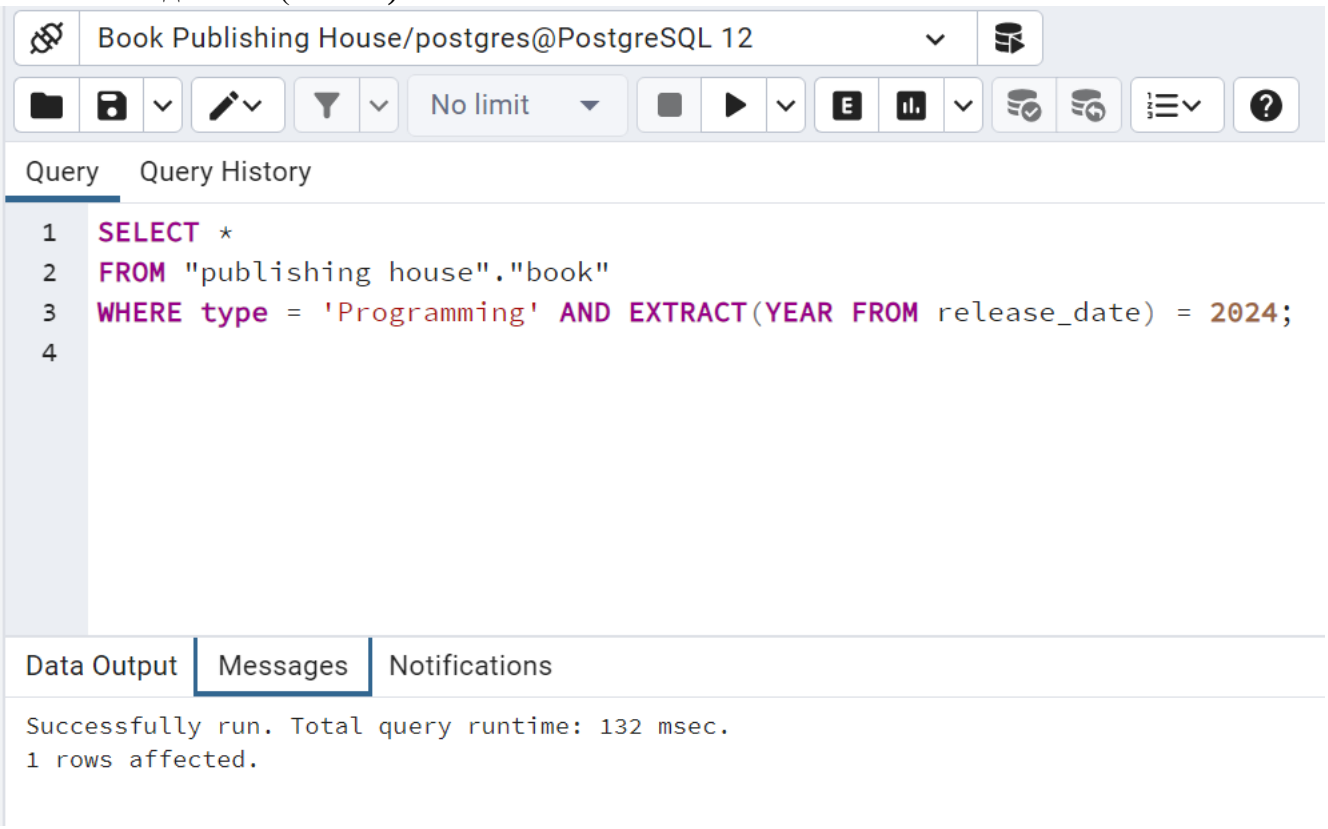
```
1  SELECT *
2  FROM "publishing house"."book"
3  WHERE type = 'Programming' AND EXTRACT(YEAR FROM release_date) = 2024;
4
```

Data Output | Messages | Notifications

```
Successfully run. Total query runtime: 143 msec.
1 rows affected.
```

CREATE INDEX genre_release_date_index ON "publishing house"."book" (type, release_date);

С индексами(132 ms):



Вывод

В ходе лабораторной работы я освоила работу с различными SQL-запросами к базе данных, также создание представлений и индексов. Также сравнила время работы SELECT запросов с индексами и без. С индексами запросы выполняются быстрее.