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«НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ ИТМО»
Факультет инфокоммуникационных технологий

ОТЧЕТ
ПО ЛАБОРАТОРНОЙ РАБОТЕ № 4

по теме: Запросы на выборку данных к БД PostgreSQL.
по дисциплине: Проектирование и реализация баз данных

Специальность:
09.03.03: Мобильные и сетевые технологии

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ЦЕЛЬ РАБОТЫ

Овладеть практическими навыками создания представлений и запросов на выборку данных к базе данных PostgreSQL и использования подзапросов при модификации данных.

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.

СХЕМА БАЗЫ ДАННЫХ:

ВЫПОЛНЕНИЕ:

1. Составить список всех заданий каждого проекта с указанием организаций, отделов и исполнителей, занятых в его выполнении.

Job Accounting/postgres@PostgreSQL 13

Query Editor | Query History

```
1  SELECT task.task_id as "Task", project.name as "Project", organization.name as "Organization", department.name as "Department",
2  CONCAT(employee.first_name, ' ' , employee.last_name) as "Worker"
3  FROM j_acc.task
4  INNER JOIN j_acc.project ON project.project_id = task.project_id
5  INNER JOIN j_acc.employee ON project.project_id = employee.project_id
6  INNER JOIN j_acc.organization ON project.org_id = organization.org_id
7  INNER JOIN j_acc.department ON employee.dep_id = department.dep_id
8  ORDER BY task.task_id
```

Data Output | Explain | Messages | Notifications

	Task integer	Project text	Organization text	Department text	Worker text
12	4	Delivery service	INITI	Sales	Lev Korolyev
13	4	Delivery service	INITI	Sales	Olga Minaeva
14	5	Delivery service	INITI	General Managament	Marina Konovalova
15	5	Delivery service	INITI	Sales	Svetlana Pupirishkina
16	5	Delivery service	INITI	Sales	Lev Korolyev
17	5	Delivery service	INITI	Sales	Olga Minaeva
18	6	Delivery service	INITI	General Managament	Marina Konovalova
19	6	Delivery service	INITI	Sales	Svetlana Pupirishkina
20	6	Delivery service	INITI	Sales	Lev Korolyev
21	6	Delivery service	INITI	Sales	Olga Minaeva

2. Составить список проектов, работа над которыми была начата больше месяца назад.

Query Editor | Query History

```
1  SELECT project.project_id, project.name FROM j_acc.project
2  WHERE start_date < (NOW()-INTERVAL '1 month')
```

Data Output | Explain | Messages | Notifications

	project_id [PK] integer	name text
1	111	App "North"
2	222	Delivery service
3	333	Web-site "Magnit"

3. Вывести список сотрудников, оклад которых превышает средний оклад сотрудников своего отдела.

Query Editor | Query History

```
SELECT emp_id, CONCAT(employee.first_name, ' ', employee.last_name) as "Worker",
department.name as "Department", employee.salary as "Salary"
FROM j_acc.employee
JOIN j_acc.department ON employee.dep_id = department.dep_id
  WHERE  employee.salary > (
  SELECT AVG(salary)
  FROM j_acc.employee
  JOIN j_acc.department ON employee.dep_id = department.dep_id
)
ORDER BY employee.emp_id
```

Data Output | Explain | Messages | Notifications

	emp_id integer	Worker text	Department text	Salary double precision
1	1	Anastasia Vorobieva	Finance	85000
2	2	Olga Minaeva	Sales	95000
3	4	Anna Karavaeva	Finance	90000
4	5	Lev Korolyev	Sales	100000
5	7	Daniil Mironenko	Finance	110000
6	9	Marina Konovalova	General Managament	80000

4. Найти отдел, работающий над максимальным количеством проектов.

Query Editor | Query History

```
SELECT "Department"
FROM (SELECT employee.dep_id, COUNT(distinct employee.project_id), department.name as "Department"
FROM j_acc.employee
JOIN j_acc.department on employee.dep_id = department.dep_id
WHERE project_id IS NOT NULL
GROUP BY employee.dep_id, department.name
ORDER BY COUNT(distinct employee.project_id) desc) as row
WHERE count =
(SELECT MAX(count)
FROM
(SELECT employee.dep_id, COUNT(distinct employee.project_id), department.name as "Department"
FROM j_acc.employee
JOIN j_acc.department on employee.dep_id = department.dep_id
WHERE project_id IS NOT NULL
GROUP BY employee.dep_id, department.name
ORDER BY COUNT(distinct employee.project_id) desc) as row)
```

Data Output | Explain | Messages | Notifications

	Department text
1	General Managament

5. Составить список сотрудников, проектов, заданий, в выполнении которых они участвуют и дат предполагаемого выполнения ими заданий. Учесть сотрудников, не участвующих в проектах.

Query Editor | Query History

```
1  SELECT
2  CONCAT(employee.first_name, employee.last_name) as "Worker", project.name as "Project", task.task_id as "Task",
3  task.deadline as "Deadline"
4  FROM j_acc.task
5  INNER JOIN j_acc.project ON project.project_id = task.project_id
6  RIGHT JOIN j_acc.employee ON project.project_id = employee.project_id
7  INNER JOIN j_acc.department ON employee.dep_id = department.dep_id
8  ORDER BY task.task_id
```

Data Output | Explain | Notifications

	Worker text	Project text	Task integer	Deadline date
13	OlgaMinaeva	Delivery service	4	2022-03-24
14	MarinaKonovalova	Delivery service	5	2022-03-24
15	SvetlanaPupirishkina	Delivery service	5	2022-03-24
16	LevKorolyev	Delivery service	5	2022-03-24
17	OlgaMinaeva	Delivery service	5	2022-03-24
18	MarinaKonovalova	Delivery service	6	2022-03-24
19	SvetlanaPupirishkina	Delivery service	6	2022-03-24
20	LevKorolyev	Delivery service	6	2022-03-24
21	OlgaMinaeva	Delivery service	6	2022-03-24
22	OlegKorotkov	[null]	[null]	[null]

Messages

```
Successfu
120 msec.
22 rows a
```

6. Составить список сотрудников, не выполнивших задания в срок с указанием проектов и заданий, которые они должны были выполнить и количества дней просрочки выполнения заданий.

Query Editor | Query History

```
SELECT
CONCAT(employee.first_name,' ', employee.last_name) as "Worker",
project.name as "Project",
task.task_id as "Task",
(NOW() - task.deadline) as "Overdue"
FROM j_acc.task
JOIN j_acc.employee on employee.project_id = employee.project_id
JOIN j_acc.project on task.project_id = project.project_id
WHERE task.task_status IN ('In work', 'in work', 'suspended', 'Suspended') AND task.deadline < NOW()
AND project.execution_status NOT IN ('Canceled', 'canceled', 'finished', 'Finished')
```

Data Output | Explain | Notifications | Messages

	Worker text	Project text	Task integer	Overdue interval
1	Anastasia Vorobieva	App "North"	1	28 days 19:55:07....
2	Olga Minaeva	App "North"	1	28 days 19:55:07....
3	Alex Kross	App "North"	1	28 days 19:55:07....
4	Anna Karavaeva	App "North"	1	28 days 19:55:07....
5	Lev Korolyev	App "North"	1	28 days 19:55:07....
6	Andrey Smirnov	App "North"	1	28 days 19:55:07....
7	Daniil Mironenko	App "North"	1	28 days 19:55:07....
8	Svetlana Pupirishkina	App "North"	1	28 days 19:55:07....
9	Marina Konovalova	App "North"	1	28 days 19:55:07....

7. Составить список проектов, в выполнении которого участвует более трех человек.

Job Accounting/postgres@PostgreSQL 13

Query Editor | Query History

```
SELECT project.project_id, project.name as "Project"
FROM j_acc.project
JOIN j_acc.employee on project.project_id = employee.project_id
GROUP BY project.name, project.project_id
HAVING COUNT(employee.emp_id) > 3
```

Data Output | Explain | Notifications | Messages

	project_id [PK] integer	Project text
1	222	Delivery service
2	111	App "North"

ВЫПОЛНЕНИЕ: представления

1. Для руководителей проектов, содержащее сведения об исполнителях, отделах, сроках выполнения заданий, включенных в проект.

Query Editor | Query History

```
1  CREATE VIEW j_acc.table_for_leaders AS
2  SELECT department.name as "Department", CONCAT(employee.first_name, ' ', employee.last_name) as "Worker",
3  project.name as "Project", task.task_id as "Task", task.deadline as "Deadline"
4  FROM j_acc.task
5  JOIN j_acc.project ON project.project_id = task.project_id
6  JOIN j_acc.employee ON project.project_id = employee.project_id
7  JOIN j_acc.department ON employee.dep_id = department.dep_id
8  ORDER BY department.name
```

Data Output | Explain | Notifications | Messages

```
CREATE VIEW

Query returned successfully in 121 msec.
```

Query Editor | Query History

```
1  SELECT * FROM j_acc.table_for_leaders
```

Data Output | Explain | Notifications | Messages

	Department text	Worker text	Project text	Task integer	Deadline date
1	Finance	Anna Karavaeva	App "North"	1	2022-02-24
2	Finance	Daniil Mironenko	App "North"	1	2022-02-24
3	Finance	Anastasia Vorobieva	App "North"	1	2022-02-24
4	General Managament	Andrey Smirnov	Web-site "Magnit"	3	2022-01-24
5	General Managament	Marina Konovalova	Delivery service	2	2022-03-24
6	General Managament	Marina Konovalova	Delivery service	4	2022-03-24
7	General Managament	Marina Konovalova	Delivery service	5	2022-03-24
8	General Managament	Marina Konovalova	Delivery service	6	2022-03-24
9	General Managament	Alex Kross	App "North"	1	2022-02-24
10	Sales	Lev Korolyev	Delivery service	2	2022-03-24

2. Список проектов, срок выполнения которых истекает сегодня, и которые включают больше трех невыполненных заданий.

Query Editor Query History

```
1  CREATE VIEW j_acc.projects_list AS
2  SELECT project.project_id, project.name as "Project"
3  FROM j_acc.project
4  JOIN j_acc.task ON project.project_id = task.project_id
5  WHERE project.expiration_date = NOW()::date and task.task_status IN ('In work', 'in work')
6  GROUP BY project.project_id, project.name
7  HAVING COUNT(task.task_id) > 3
```

Data Output Explain Notifications Messages

```
CREATE VIEW

Query returned successfully in 84 msec.
```

Query Editor Query History

```
1  SELECT * FROM j_acc.projects_list
```

Data Output Explain Notifications Messag

	project_id integer	Project text
1	444	"Game in live"

ВЫПОЛНЕНИЕ: модификация данных

1. Запрос с UPDATE

До выполнения:

Data Output | Explain | Notifications | Messages

	project_id [PK] integer	name text	leader text	start_date date	expiration_date date	factual_date date	payment_status text
1	111	App "North"	Oleg Ivanov	2021-10-24	2022-03-24	[null]	Unpaid
2	222	Delivery service	Nikolas Luff	2021-06-12	2021-10-14	2021-10-12	Paid
3	333	Web-site "Magnit"	Svetlana Korsakova	2022-01-20	2022-05-27	[null]	Processing
4	444	"Game in live"	Karina Tretiakova	2021-10-14	2022-03-24	[null]	Paid

Запрос: изменить статус оплаты у проектов, находящихся в работе

Query Editor | Query History

```
1  UPDATE j_acc.project
2  SET payment_status = 'Paid'
3  WHERE project.execution_status IN
4  (SELECT project.execution_status
5  FROM j_acc.project
6  WHERE execution_status = 'In work')
```

После:

Data Output | Explain | Notifications | Messages

	project_id [PK] integer	name text	leader text	start_date date	expiration_date date	factual_date date	payment_status text	execution_status text
1	111	App "North"	Oleg Ivanov	2021-10-24	2022-03-24	[null]	Paid	In work
2	222	Delivery service	Nikolas Luff	2021-06-12	2021-10-14	2021-10-12	Paid	Finished
3	333	Web-site "Magnit"	Svetlana Korsakova	2022-01-20	2022-05-27	[null]	Paid	In work
4	444	"Game in live"	Karina Tretiakova	2021-10-14	2022-03-24	[null]	Paid	In work

2. Запрос с DELETE

До выполнения:

Data Output | Explain | Notifications | Messages

	emp_id [PK] integer	pos_id integer	first_name text	last_name text	middle_name text	dep_id integer	contacts text	project_id integer	salary double precision
1	1	1	Anastasia	Vorobieva	Alexandrovna	1	sbssu@mail.ru	111	85000
2	2	2	Olga	Minaeva	Igorevna	2	hjkaw@gmail.com	222	95000
3	3	3	Alex	Kross	[null]	3	dguws@ya.ru	111	60000
4	4	2	Anna	Karavaeva	Dmitrievna	1	tefas@mail.ru	111	90000
5	5	1	Lev	Korolyev	[null]	2	huhd@ya.ru	222	100000
6	6	3	Andrey	Smirnov	Alexandrovich	3	egysv@gmail.com	333	50000
7	7	2	Daniil	Mironenko	Fedorovich	1	dwuid@mail.ru	111	110000
8	8	3	Svetlana	Pupirishkina	Gennadievna	2	feuhi@mail.ru	222	55000
9	9	1	Marina	Konovalova	Danilovna	3	kcjae@gmail.com	222	80000
10	10	2	Oleg	Korotkov	Igorevich	2	rdjnxzs@ya.ru	[null]	40000

Запрос: увольнение работника с зарплатой ниже 50000

Query Editor | Query History

```
1  DELETE FROM j_acc.employee
2  WHERE salary IN (SELECT employee.salary FROM j_acc.project WHERE employee.salary < 50000)
```

После:

	emp_id [PK] integer	pos_id integer	first_name text	last_name text	middle_name text	dep_id integer	contacts text	project_id integer	salary double precision
1	1	1	Anastasia	Vorobieva	Alexandrovna	1	sbssu@mail.ru	111	85000
2	2	2	Olga	Minaeva	Igorevna	2	hjkaw@gmail.com	222	95000
3	3	3	Alex	Kross	[null]	3	dguws@ya.ru	111	60000
4	4	2	Anna	Karavaeva	Dmitrievna	1	tefas@mail.ru	111	90000
5	5	1	Lev	Korolyev	[null]	2	huhd@ya.ru	222	100000
6	6	3	Andrey	Smirnov	Alexandrovich	3	egysv@gmail.com	333	50000
7	7	2	Daniil	Mironenko	Fedorovich	1	dwuid@mail.ru	111	110000
8	8	3	Svetlana	Pupirishkina	Gennadievna	2	feuhi@mail.ru	222	55000
9	9	1	Marina	Konovalova	Danilovna	3	kcjae@gmail.com	222	80000

3. Запрос с INSERT

До:

Data Output | Explain | Notifications | Messages

	emp_id [PK] integer	pos_id integer	first_name text	last_name text	middle_name text	dep_id integer	contacts text	project_id integer	salary double precision
1	1	1	Anastasia	Vorobieva	Alexandrovna	1	sbssu@mail.ru	111	85000
2	2	2	Olga	Minaeva	Igorevna	2	hjkaw@gmail.com	222	95000
3	3	3	Alex	Kross	[null]	3	dguws@ya.ru	111	60000
4	4	2	Anna	Karavaeva	Dmitrievna	1	tefas@mail.ru	111	90000
5	5	1	Lev	Korolyev	[null]	2	huhd@ya.ru	222	100000
6	6	3	Andrey	Smirnov	Alexandrovich	3	egysv@gmail.com	333	50000
7	7	2	Daniil	Mironenko	Fedorovich	1	dwuid@mail.ru	111	110000
8	8	3	Svetlana	Pupirishkina	Gennadievna	2	feuhi@mail.ru	222	55000
9	9	1	Marina	Konovalova	Danilovna	3	kcjae@gmail.com	222	80000

Запрос: добавить работника

Query Editor | Query History

```
INSERT INTO j_acc.employee(emp_id, pos_id, first_name, last_name, middle_name, dep_id, contacts, project_id, salary)
VALUES
(10,
 1,
 'Igor',
 'Sivaev',
 'Sergeevich',
 '2',
 'wafcz@gmail.com',
 (select project.project_id FROM j_acc.project WHERE project.name = 'Game in life'),
 105000)
```

Data Output | Explain | Notifications | **Messages**

```
INSERT 0 1
```

После:

Data Output | Explain | Notifications | Messages

	emp_id [PK] integer	pos_id integer	first_name text	last_name text	middle_name text	dep_id integer	contacts text	project_id integer	salary double precision
2	2	2	Olga	Minaeva	Igorevna	2	hjkaw@gmail.com	222	95000
3	3	3	Alex	Kross	[null]	3	dguws@ya.ru	111	60000
4	4	2	Anna	Karavaeva	Dmitrievna	1	tefas@mail.ru	111	90000
5	5	1	Lev	Korolyev	[null]	2	huhd@ya.ru	222	100000
6	6	3	Andrey	Smirnov	Alexandrovich	3	egysv@gmail.com	333	50000
7	7	2	Daniil	Mironenko	Fedorovich	1	dwuid@mail.ru	111	110000
8	8	3	Svetlana	Pupirishkina	Gennadievna	2	feuhi@mail.ru	222	55000
9	9	1	Marina	Konovalova	Danilovna	3	kcjae@gmail.com	222	80000
10	10	1	Igor	Sivaev	Sergeevich	2	wafcz@gmail.com	[null]	105000

ВЫПОЛНЕНИЕ: создание индексов

1. Запросы без индексов

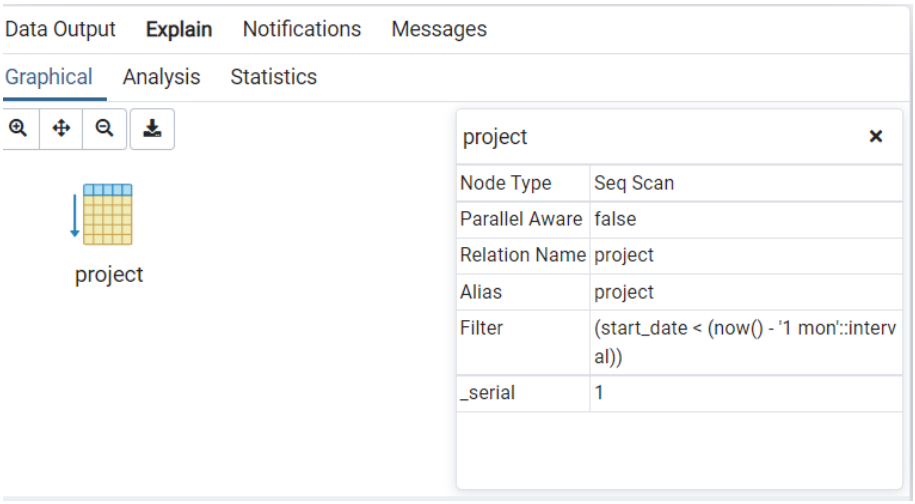
Query Editor | Query History

```
EXPLAIN SELECT project.project_id, project.name
FROM j_acc.project
WHERE start_date < (NOW()-INTERVAL '1 month')
```

1й:

Data Output | Explain | Notifications | Messages

	QUERY PLAN text
1	Seq Scan on project (cost=0.00..1.05 rows=1 width=36)
2	[...] Filter: (start_date < (now() - '1 mon'::interval))



Data Output Explain Notifications **Messages**

```
Successfully run. Total query runtime: 71 msec.
2 rows affected.
```

2й:

```
EXPLAIN SELECT project.project_id, project.name as "Project"
FROM j_acc.project
JOIN j_acc.employee on project.project_id = employee.project_id
GROUP BY project.name, project.project_id
HAVING COUNT (employee.emp_id) > 3
```

Data Output Explain Notifications Messages

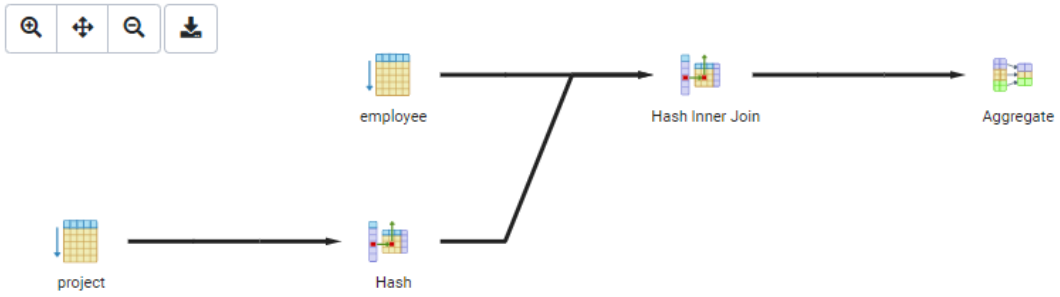
	QUERY PLAN text
1	HashAggregate (cost=2.13..2.17 rows=1 width=36)
2	[...] Group Key: project.project_id
3	[...] Filter: (count(employee.emp_id) > 3)
4	[...] -> Hash Join (cost=1.07..2.12 rows=3 width=40)
5	[...] Hash Cond: (employee.project_id = project.project_id)
6	[...] -> Seq Scan on employee (cost=0.00..1.03 rows=3 width=8)
7	[...] -> Hash (cost=1.03..1.03 rows=3 width=36)
8	[...] -> Seq Scan on project (cost=0.00..1.03 rows=3 width=36)

Graphical Analysis Statistics

1.	→ Aggregate (rows=2 loops=1) **Filter**: (count(employee.emp_id) > 3) **Rows Removed by Filter**: 1 **Buckets**: **Batches**: **Memory Usage**: 24 kB	2	
2.	→ Hash Inner Join (rows=9 loops=1) **Hash Cond**: (employee.project_id = project.project_id)	9	
3.	→ Seq Scan on employee as employee (rows=11...	11	
4.	→ Hash (rows=4 loops=1) **Buckets**: 1024 **Batches**: 1 **Memory Usage**: 9 kB	4	
5.	→ Seq Scan on project as project (rows=4 l...	4	

Data Output **Explain** Notifications Messages

Graphical Analysis Statistics



Data Output Explain Notifications **Messages**

```
Successfully run. Total query runtime: 103 msec.
8 rows affected.
```

2. Запросы с индексами

Создание простого индекса для 1го запроса:

CREATE INDEX project_index ON j_acc.project(name)

Запрос с индексом:

Data Output Explain Notifications **Messages**

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

Data Output Explain Notifications Messages

	QUERY PLAN text
1	Seq Scan on project (cost=0.00..1.07 rows=1 width=36)
2	[...] Filter: (start_date < (now() - '1 mon'::interval))

Создание составного индекса для 2го запроса:
CREATE UNIQUE INDEX project_compos_index
on j_acc.project (project_id, name)
Запрос с индексом:

Data Output Explain Notifications **Messages**

```
Successfully run. Total query runtime: 146 msec.
8 rows affected.
```

Data Output Explain Notifications Messages

	QUERY PLAN text
1	HashAggregate (cost=2.17..2.20 rows=1 width=36)
2	[...] Group Key: project.project_id
3	[...] Filter: (count(employee.emp_id) > 3)
4	[...] -> Hash Join (cost=1.07..2.15 rows=3 width=40)
5	[...] Hash Cond: (project.project_id = employee.project_id)
6	[...] -> Seq Scan on project (cost=0.00..1.04 rows=4 width=36)
7	[...] -> Hash (cost=1.03..1.03 rows=3 width=8)
8	[...] -> Seq Scan on employee (cost=0.00..1.03 rows=3 width=8)

Индексы:

Data Output Explain Notifications Messages

indexname name	tablespace name	indexdef text
Project_pkey	[null]	CREATE UNIQUE INDEX "Project_pkey" ON j_acc.project USING btree (project_id)
project_index	[null]	CREATE INDEX project_index ON j_acc.project USING btree (name)
project_comp...	[null]	CREATE UNIQUE INDEX project_compos_index ON j_acc.project USING btree (pro...

ВЫВОДЫ

В данной лабораторной работе я создала запросы и представления на выборку данных, запросы на модификацию данных (INSERT, UPDATE, DELETE) с использованием подзапросов. Изучила графическое представление запросов. Создала простой и составной индексы для двух запросов и сравнила время выполнения запросов без индексов и с индексами: с индексами время выполнения больше, так как моя база данных маленькая.