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Факультет «Информатика и системы управления»

Кафедра «Системы обработки информации и управления»



**Лабораторная работа №6 по дисциплине**

«Постреляционные базы данных»

**ИСПОЛНИТЕЛЬ:**

Березин И.С.

Группа ИУ5-23М

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"\_\_"\_\_\_\_\_\_\_\_\_\_\_ 2019 г.

Москва, 2019

**Задание 1.** **Создание БД (базовая часть)**

*1.1 Создать в среде CassandraDb свое пространство ключей. Использование cqlsh командной строки.*

cqlsh> CREATE KEYSPACE lab6 WITH REPLICATION = {'class': 'SimpleStrategy', 'replication\_factor': 3};

*1.2. Использовать новое пространство ключей:* cqlsh> Use lab6;

*1.3. Определить семейство столбцов по теме своего ДЗ. Добавить в семейство столбцов строки с данными. Продемонстрировать (вывести на экран) содержимое БД. (примеры и пояснения по типам ключей.*

cqlsh:lab6> CREATE TYPE address(street text, house int, flat int);

cqlsh:lab6> DESCRIBE TYPE address

CREATE TYPE lab6.address (

street text,

house int,

flat int

);

cqlsh:lab6> CREATE TYPE contacts(phone text, email text);

cqlsh:lab6> DESCRIBE TYPE contacts

CREATE TYPE lab6.contacts (

phone text,

email text

);

cqlsh:lab6> CREATE TABLE Clients(id\_client int, fio text, passport bigint, age int, city text, client\_address frozen<address>, client\_contacts frozen<contacts>, PRIMARY KEY (id\_client));

cqlsh:lab6> select \* from Clients;

id\_client | age | city | client\_address | client\_contacts | fio | passport

-----------+-----+------+----------------+-----------------+-----+----------

(0 rows)

cqlsh:lab6> insert into Clients(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (1,'Berezin Ivan Sergeevich', 4616240251, 22, 'Moscow region', {street:'First', house:22, flat:5}, {phone:'+79851740745', email:'uivan2009@rambler.ru'});

cqlsh:lab6> insert into Clients(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (2,'Sergeev Sergey Sergeevich', 4514277251, 42, 'Moscow', {street:'Second', house:3, flat:55}, {phone:'+79160984566', email:'serg55@mail.ru'});

cqlsh:lab6> insert into Clients(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (3,'Ivanov Ivan Petrovich', 4312555876, 34, 'Moscow', {street:'Third', house:73, flat:10}, {phone:'+79236785534', email:'ivani@ya.ru'});

cqlsh:lab6> select \* from Clients;

id\_client | age | city | client\_address | client\_contacts | fio | passport

-----------+-----+---------------+----------------------------------------+--------------------------------------------------------+---------------------------+------------

1 | 22 | Moscow region | {street: 'First', house: 22, flat: 5} | {phone: '+79851740745', email: 'uivan2009@rambler.ru'} | Berezin Ivan Sergeevich | 4616240251

2 | 42 | Moscow | {street: 'Second', house: 3, flat: 55} | {phone: '+79160984566', email: 'serg55@mail.ru'} | Sergeev Sergey Sergeevich | 4514277251

3 | 34 | Moscow | {street: 'Third', house: 73, flat: 10} | {phone: '+79236785534', email: 'ivani@ya.ru'} | Ivanov Ivan Petrovich | 4312555876

(3 rows)

**Задание 2.** **CRUD и работа с индексами** **(базовая часть)**

*2.1. Продемонстрировать добавление, изменение и удаление данных в БД, используя команды API и/или язык Cassandra Query Language.*

cqlsh:lab6> insert into Clients(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (4,'Alexeev Alexey Alexandrovich', 4719777345, 26, 'Moscow', {street:'Fourth', house:50, flat:100}, {phone:'+79267378900', email:'cl2@mail.ru'});

cqlsh:lab6> update Clients Set client\_contacts.(email)='aaa@ya.ru' where id\_client=4;

SyntaxException: line 1:35 no viable alternative at input '(' (update Clients Set client\_contacts.[(]...)

cqlsh:lab6> update Clients Set client\_contacts.[email]='aaa@ya.ru' where id\_client=4;

SyntaxException: line 1:35 no viable alternative at input '[' (update Clients Set client\_contacts.[[]...)

cqlsh:lab6> update Clients Set client\_contacts.{email}='aaa@ya.ru' where id\_client=4;

SyntaxException: line 1:35 no viable alternative at input '{' (update Clients Set client\_contacts.[{]...)

cqlsh:lab6> update Clients Set client\_contacts.email='aaa@ya.ru' where id\_client=4;

InvalidRequest: Error from server: code=2200 [Invalid query] message="Invalid operation (client\_contacts.email = 'aaa@ya.ru') for frozen UDT column client\_contacts"

cqlsh:lab6> update Clients Set client\_contacts={email:'aaa@ya.ru'} where id\_client=4;

cqlsh:lab6> delete client\_contacts={email} from Clients where id\_client=4;

SyntaxException: line 1:22 no viable alternative at input '=' (delete [client\_contacts]=...)

cqlsh:lab6> delete client\_contacts from Clients where id\_client=3;

cqlsh:lab6> select \* from Clients ;

id\_client | age | city | client\_address | client\_contacts | fio | passport

-----------+-----+---------------+------------------------------------------+--------------------------------------------------------+------------------------------+------------

1 | 22 | Moscow region | {street: 'First', house: 22, flat: 5} | {phone: '+79851740745', email: 'uivan2009@rambler.ru'} | Berezin Ivan Sergeevich | 4616240251

2 | 42 | Moscow | {street: 'Second', house: 3, flat: 55} | {phone: '+79160984566', email: 'serg55@mail.ru'} | Sergeev Sergey Sergeevich | 4514277251

4 | 26 | Moscow | {street: 'Fourth', house: 50, flat: 100} | {phone: null, email: 'aaa@ya.ru'} | Alexeev Alexey Alexandrovich | 4719777345

3 | 34 | Moscow | {street: 'Third', house: 73, flat: 10} | null | Ivanov Ivan Petrovich | 4312555876

(4 rows)

*2.2. Определить для семейства столбцов индекс(ы). Выполнить запросы к с фильтрацией по ключам и индексам. Продемонстрировать работу allow filtering.*

cqlsh:lab6> create index pass on Clients (passport);

cqlsh:lab6> describe Clients;

CREATE TABLE lab6.clients (

id\_client int PRIMARY KEY,

age int,

city text,

client\_address frozen<address>,

client\_contacts frozen<contacts>,

fio text,

passport bigint

) WITH bloom\_filter\_fp\_chance = 0.01

AND caching = {'keys': 'ALL', 'rows\_per\_partition': 'NONE'}

AND comment = ''

AND compaction = {'class': 'org.apache.cassandra.db.compaction.SizeTieredCompactionStrategy', 'max\_threshold': '32', 'min\_threshold': '4'}

AND compression = {'chunk\_length\_in\_kb': '64', 'class': 'org.apache.cassandra.io.compress.LZ4Compressor'}

AND crc\_check\_chance = 1.0

AND dclocal\_read\_repair\_chance = 0.1

AND default\_time\_to\_live = 0

AND gc\_grace\_seconds = 864000

AND max\_index\_interval = 2048

AND memtable\_flush\_period\_in\_ms = 0

AND min\_index\_interval = 128

AND read\_repair\_chance = 0.0

AND speculative\_retry = '99PERCENTILE';

CREATE INDEX pass ON lab6.clients (passport);

cqlsh:lab6> select \* from Clients where passport = 4616240251;

id\_client | age | city | client\_address | client\_contacts | fio | passport

-----------+-----+---------------+---------------------------------------+--------------------------------------------------------+-------------------------+------------

1 | 22 | Moscow region | {street: 'First', house: 22, flat: 5} | {phone: '+79851740745', email: 'uivan2009@rambler.ru'} | Berezin Ivan Sergeevich | 4616240251

(1 rows)

cqlsh:lab6> select \* from Clients where age > 25 allow filtering;

id\_client | age | city | client\_address | client\_contacts | fio | passport

-----------+-----+--------+------------------------------------------+--------------------------------------------------+------------------------------+------------

2 | 42 | Moscow | {street: 'Second', house: 3, flat: 55} | {phone: '+79160984566', email: 'serg55@mail.ru'} | Sergeev Sergey Sergeevich | 4514277251

4 | 26 | Moscow | {street: 'Fourth', house: 50, flat: 100} | {phone: null, email: 'aaa@ya.ru'} | Alexeev Alexey Alexandrovich | 4719777345

3 | 34 | Moscow | {street: 'Third', house: 73, flat: 10} | null | Ivanov Ivan Petrovich | 4312555876

(3 rows)

**Задание 3. Запросы к БД. (базовая часть)**

*3.1. Выполнить запросы к базе данных с селекцией и проекцией.*

cqlsh:lab6> select fio, age from Clients where city = 'Moscow' allow filtering;

fio | age

------------------------------+-----

Sergeev Sergey Sergeevich | 42

Alexeev Alexey Alexandrovich | 26

Ivanov Ivan Petrovich | 34

(3 rows)

cqlsh:lab6> select fio, age, city from Clients where id\_client IN(1,4);

fio | age | city

------------------------------+-----+---------------

Berezin Ivan Sergeevich | 22 | Moscow region

Alexeev Alexey Alexandrovich | 26 | Moscow

(2 rows)

*3.2. Выполнить запрос с использованием агрегатных функций.*

cqlsh:lab6> select count(\*) from Clients;

count

-------

4

(1 rows)

cqlsh:lab6> select max(age) as max\_age, min(age) as min\_age, avg(age) as avg\_age from Clients;

max\_age | min\_age | avg\_age

---------+---------+---------

42 | 22 | 31

(1 rows)

*3.3. Добавить строку с указанием TTL, продемонстрировать действие TTL (время существования значения в секундах).*

cqlsh:lab6> insert into Clients(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (5,'Andreev Andrey Urievich', 4719354123, 19, 'Moscow region', {street:'Fithh', house:13, flat:50}, {phone:'+79867891234', email:'dron29@google.com'}) USING TTL 30;

cqlsh:lab6> select \* from Clients;

id\_client | age | city | client\_address | client\_contacts | fio | passport

-----------+-----+---------------+------------------------------------------+--------------------------------------------------------+------------------------------+------------

5 | 19 | Moscow region | {street: 'Fithh', house: 13, flat: 50} | {phone: '+79867891234', email: 'dron29@google.com'} | Andreev Andrey Urievich | 4719354123

1 | 22 | Moscow region | {street: 'First', house: 22, flat: 5} | {phone: '+79851740745', email: 'uivan2009@rambler.ru'} | Berezin Ivan Sergeevich | 4616240251

2 | 42 | Moscow | {street: 'Second', house: 3, flat: 55} | {phone: '+79160984566', email: 'serg55@mail.ru'} | Sergeev Sergey Sergeevich | 4514277251

4 | 26 | Moscow | {street: 'Fourth', house: 50, flat: 100} | {phone: null, email: 'aaa@ya.ru'} | Alexeev Alexey Alexandrovich | 4719777345

3 | 34 | Moscow | {street: 'Third', house: 73, flat: 10} | null | Ivanov Ivan Petrovich | 4312555876

(5 rows)

cqlsh:lab6> update Clients USING TTL 30 SET client\_contacts={phone:'+79991234567', email:'threeA@mail.ru'} where id\_client=4;

cqlsh:lab6> select \* from Clients;

id\_client | age | city | client\_address | client\_contacts | fio | passport

-----------+-----+---------------+------------------------------------------+--------------------------------------------------------+------------------------------+------------

1 | 22 | Moscow region | {street: 'First', house: 22, flat: 5} | {phone: '+79851740745', email: 'uivan2009@rambler.ru'} | Berezin Ivan Sergeevich | 4616240251

2 | 42 | Moscow | {street: 'Second', house: 3, flat: 55} | {phone: '+79160984566', email: 'serg55@mail.ru'} | Sergeev Sergey Sergeevich | 4514277251

4 | 26 | Moscow | {street: 'Fourth', house: 50, flat: 100} | {phone: '+79991234567', email: 'threeA@mail.ru'} | Alexeev Alexey Alexandrovich | 4719777345

3 | 34 | Moscow | {street: 'Third', house: 73, flat: 10} | null | Ivanov Ivan Petrovich | 4312555876

(4 rows)

**Задание 4. Группировка и сортировка**  (**Хорошо**)

*4.1. Выполнить запросы с группировкой данных.*

cqlsh:lab6> CREATE TABLE Clients1(id\_client int, fio text, passport bigint, age int, city text, client\_address frozen<address>, client\_contacts frozen<contacts>, PRIMARY KEY (city, id\_client));

cqlsh:lab6> insert into Clients1(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (1,'Berezin Ivan Sergeevich', 4616240251, 22, 'Moscow region', {street:'First', house:22, flat:5}, {phone:'+79851740745', email:'uivan2009@rambler.ru'});

cqlsh:lab6> insert into Clients1(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (5,'Andreev Andrey Urievich', 4719354123, 19, 'Moscow region', {street:'Fithh', house:13, flat:50}, {phone:'+79867891234', email:'dron29@google.com'}) USING TTL 30;

cqlsh:lab6> insert into Clients1(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (5,'Andreev Andrey Urievich', 4719354123, 19, 'Moscow region', {street:'Fithh', house:13, flat:50}, {phone:'+79867891234', email:'dron29@google.com'}) ;

cqlsh:lab6> insert into Clients1(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (4,'Alexeev Alexey Alexandrovich', 4719777345, 26, 'Moscow', {street:'Fourth', house:50, flat:100}, {phone:'+79267378900', email:'cl2@mail.ru'});

cqlsh:lab6> insert into Clients1(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (3,'Ivanov Ivan Petrovich', 4312555876, 34, 'Moscow', {street:'Third', house:73, flat:10}, {phone:'+79236785534', email:'ivani@ya.ru'});

cqlsh:lab6> insert into Clients1(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (2,'Sergeev Sergey Sergeevich', 4514277251, 42, 'Moscow', {street:'Second', house:3, flat:55}, {phone:'+79160984566', email:'serg55@mail.ru'});

cqlsh:lab6> select id\_client, city, age from Clients1 GROUP BY city;

id\_client | city | age

-----------+---------------+-----

2 | Moscow | 42

1 | Moscow region | 22

(2 rows)

cqlsh:lab6> select \* from Clients1 where city = 'Moscow' GROUP BY id\_client;

city | id\_client | age | client\_address | client\_contacts | fio | passport

--------+-----------+-----+------------------------------------------+--------------------------------------------------+------------------------------+------------

Moscow | 2 | 42 | {street: 'Second', house: 3, flat: 55} | {phone: '+79160984566', email: 'serg55@mail.ru'} | Sergeev Sergey Sergeevich | 4514277251

Moscow | 3 | 34 | {street: 'Third', house: 73, flat: 10} | {phone: '+79236785534', email: 'ivani@ya.ru'} | Ivanov Ivan Petrovich | 4312555876

Moscow | 4 | 26 | {street: 'Fourth', house: 50, flat: 100} | {phone: '+79267378900', email: 'cl2@mail.ru'} | Alexeev Alexey Alexandrovich | 4719777345

(3 rows)

*4.2. Создать еще одно семейство столбцов по теме ДЗ, определить для него кластерный и распределительный ключи. Выполнить запросы к с фильтрацией по ключам.*

cqlsh:lab6> CREATE TABLE Orders(id\_order int, client\_id int, day date, time timestamp, summary int, PRIMARY KEY ((client\_id, day), time, id\_order));

cqlsh:lab6> insert into Orders (id\_order, client\_id, day, time, summary) values (1, 1, '2019-05-23', 3141657812365, 500);

cqlsh:lab6> insert into Orders (id\_order, client\_id, day, time, summary) values (2, 1, '2019-05-23', 3291657810925, 1000);

cqlsh:lab6> insert into Orders (id\_order, client\_id, day, time, summary) values (3, 2, '2019-05-23', 3291667811205, 1000);

cqlsh:lab6> select \* from Orders where day = '2019-05-23' and client\_id in (1,2) and time in(3141657812365, 3291667811205) and id\_order in (1,2);

client\_id | day | time | id\_order | summary

-----------+------------+---------------------------------+----------+---------

1 | 2019-05-23 | 2069-07-21 18:43:32.365000+0000 | 1 | 500

(1 rows)

*4.3. Продемонстрировать усечение таблицы и удаление таблицы/индекса*

cqlsh:lab6> TRUNCATE lab6.Orders;

cqlsh:lab6> select \* from Orders;

client\_id | day | time | id\_order | summary

-----------+-----+------+----------+---------

(0 rows)

cqlsh:lab6> DROP TABLE lab6.Orders;

cqlsh:lab6> DROP INDEX lab6.pass;

**Задание 5. Дополнительные возможности** (**Отлично**)

*5.1. Создать материализованное представление. Продемонстрировать работу с ним.*

cqlsh:lab6> CREATE MATERIALIZED VIEW clients\_in\_city AS select id\_client, fio, passport, age, city, client\_address, client\_contacts from Clients where id\_client is not null and fio is not null and passport is not null and city is not null and client\_address is not null PRIMARY KEY (city, id\_client);

cqlsh:lab6> select \* from clients\_in\_city;

city | id\_client | age | client\_address | client\_contacts | fio | passport

---------------+-----------+-----+------------------------------------------+--------------------------------------------------------+------------------------------+------------

Moscow | 2 | 42 | {street: 'Second', house: 3, flat: 55} | {phone: '+79160984566', email: 'serg55@mail.ru'} | Sergeev Sergey Sergeevich | 4514277251

Moscow | 3 | 34 | {street: 'Third', house: 73, flat: 10} | null | Ivanov Ivan Petrovich | 4312555876

Moscow | 4 | 26 | {street: 'Fourth', house: 50, flat: 100} | null | Alexeev Alexey Alexandrovich | 4719777345

Moscow region | 1 | 22 | {street: 'First', house: 22, flat: 5} | {phone: '+79851740745', email: 'uivan2009@rambler.ru'} | Berezin Ivan Sergeevich | 4616240251

(4 rows)

cqlsh:lab6> select \* from clients\_in\_city where city = 'Moscow region';

city | id\_client | age | client\_address | client\_contacts | fio | passport

---------------+-----------+-----+---------------------------------------+--------------------------------------------------------+-------------------------+------------

Moscow region | 1 | 22 | {street: 'First', house: 22, flat: 5} | {phone: '+79851740745', email: 'uivan2009@rambler.ru'} | Berezin Ivan Sergeevich | 4616240251

(1 rows)

*5.2. Продемонстрировать создание пакета запросов*

cqlsh:lab6> begin batch

... insert into Clients(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (6,'ClientFio6', 4312789125, 33, 'Moscow', {street:'Sixth', house:6, flat:66}, {phone:'+79813460091', email:'six6@rambler.ru'}); ... insert into Clients(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (7,'ClientFio7', 4416344908, 50, 'Moscow', {street:'Seventh', house:7, flat:77}, {phone:'+79845129901', email:'seven7@ya.ru'});

... insert into Clients(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (8,'ClientFio8', 3968123456, 61, 'Moscow', {street:'Eighth', house:8, flat:88}, {phone:'+79858881234', email:'eight8@ya.ru'});

... insert into Clients(id\_client, fio, passport, age, city, client\_address, client\_contacts) values (10,'ClientFio9', 4213000123, 37, 'Moscow', {street:'Nineth', house:9, flat:99}, {phone:'+79239991278', email:'nine9@ya.ru'});

... apply batch;

cqlsh:lab6> select \* from Clients;

id\_client | age | city | client\_address | client\_contacts | fio | passport

-----------+-----+---------------+------------------------------------------+--------------------------------------------------------+------------------------------+------------

10 | 37 | Moscow | {street: 'Nineth', house: 9, flat: 99} | {phone: '+79239991278', email: 'nine9@ya.ru'} | ClientFio9 | 4213000123

1 | 22 | Moscow region | {street: 'First', house: 22, flat: 5} | {phone: '+79851740745', email: 'uivan2009@rambler.ru'} | Berezin Ivan Sergeevich | 4616240251

8 | 61 | Moscow | {street: 'Eighth', house: 8, flat: 88} | {phone: '+79858881234', email: 'eight8@ya.ru'} | ClientFio8 | 3968123456

2 | 42 | Moscow | {street: 'Second', house: 3, flat: 55} | {phone: '+79160984566', email: 'serg55@mail.ru'} | Sergeev Sergey Sergeevich | 4514277251

4 | 26 | Moscow | {street: 'Fourth', house: 50, flat: 100} | null | Alexeev Alexey Alexandrovich | 4719777345

7 | 50 | Moscow | {street: 'Seventh', house: 7, flat: 77} | {phone: '+79845129901', email: 'seven7@ya.ru'} | ClientFio7 | 4416344908

6 | 33 | Moscow | {street: 'Sixth', house: 6, flat: 66} | {phone: '+79813460091', email: 'six6@rambler.ru'} | ClientFio6 | 4312789125

3 | 34 | Moscow | {street: 'Third', house: 73, flat: 10} | null | Ivanov Ivan Petrovich | 4312555876

(8 rows)

*5.3. Продемонстрировать изменение и удаление данных в БД, используя условия*

cqlsh:lab6> update Clients Set client\_contacts={phone:'+79858881234', email:null} where id\_client = 8 IF age > 50;

NoHostAvailable:

pos@pos-VirtualBox:~$ nodetool status

Datacenter: datacenter1

Status=Up/Down

-- Address Load Tokens Owns (effective) Host ID Rack

UN 127.0.0.1 250,48 KiB 256 100,0% 9a0571db-2edf-4720-90e3-9badc17a7303 rack1

cqlsh:lab6> CREATE KEYSPACE lab66 WITH REPLICATION = {'class': 'SimpleStrategy', 'replication\_factor': 1};

cqlsh> use lab66;

cqlsh:lab66> CREATE TYPE address(street text, house int, flat int);

cqlsh:lab66> CREATE TABLE Clients1(id\_client int, fio text, passport bigint, age int, city text, client\_address frozen<address>, PRIMARY KEY (id\_client));

cqlsh:lab66> insert into Clients1(id\_client, fio, passport, age, city, client\_address) values (1,'Berezin Ivan Sergeevich', 4616240251, 22, 'Moscow region', {street:'First', house:22, flat:5});

cqlsh:lab66> select \* from Clients1;

id\_client | age | city | client\_address | fio | passport

-----------+-----+---------------+---------------------------------------+-------------------------+------------

1 | 22 | Moscow region | {street: 'First', house: 22, flat: 5} | Berezin Ivan Sergeevich | 4616240251

(1 rows)

cqlsh:lab66> update Clients1 set client\_address = {street:'Second', house:7, flat:null} where id\_client=1 IF age > 20;

[applied]

-----------

True

cqlsh:lab66> select \* from Clients1;

id\_client | age | city | client\_address | fio | passport

-----------+-----+---------------+------------------------------------------+-------------------------+------------

1 | 22 | Moscow region | {street: 'Second', house: 7, flat: null} | Berezin Ivan Sergeevich | 4616240251

(1 rows)

cqlsh:lab66> delete from Clients1 where id\_client=1 IF EXISTS;

[applied]

-----------

True

cqlsh:lab66> select \* from Clients1;

id\_client | age | city | client\_address | fio | passport

-----------+-----+------+----------------+-----+----------

(0 rows)