# Lab 10. Anna Startseva BS19-04

#### Ex.1: read committed.

Transaction isolation level is read committed, and it prohibits dirty read (read of uncommitted changes), so, results after 4 steps are different because changes are uncommitted:

```
dvdrental=# begin;
BEGIN
dvdrental=*# show transaction_isolation;
transaction_isolation
read committed
(1 строка)
dvdrental=*# select * from lab10;
user_id | username | fullname
                                         | balance | group_id
       1 | jones | Alice Jones
2 | bitdiddl | Ben Bitdiddle
                                                82
                                                65
                                                             1
                     | Michael Dole
| Alyssa P. Hacker |
          mike
                                                73
          alyssa
                                                79
       4
           bbrown
                     Bob Brown
                                               100
(5 строк)
dvdrental=*# select * from lab10;
 user_id | username | fullname
                                         | balance | group_id
                     | Alice Jones
                                                82
                                                             1
           jones
           bitdiddl
       2
                      Ben Bitdiddle
                                                65
                                                             1
                                                73
           mike
                      Michael Dole
                                                79
                      Alyssa P. Hacker
           alyssa
       4
                     Bob Brown
           bbrown
                                               100
(5 строк)
```

Terminal 1

```
dvdrental=# begin;
BEGIN
dvdrental=*# show transaction isolation;
transaction_isolation
read committed
(1 строка)
dvdrental=*# update lab10 set username = 'ajones' where fullname = 'Alice Jones';
UPDATE 1
dvdrental=*# select * from lab10;
user_id | username | fullname
                                        | balance | group_id
       2 | bitdiddl | Ben Bitdiddle
                                              65 l
                                                           1
                    | Michael Dole
         mike
                                              73
                                                           2
                    | Alyssa P. Hacker |
| Bob Brown |
      4
           alyssa
                                              79
       5
          bbrown
                                              100
                    | Alice Jones
       1 | ajones
                                               82
                                                           1
(5 строк)
```

Terminal 2

After committing the changes results became the same because transaction isolation level was "read committed", and non-repeatable read appeared. Transaction from the first terminal read row that was modified by transaction from the second terminal:

	*# select ' username	* from lab10;   fullname	balance	group_id
2	bitdiddl	Ben Bitdiddle	65	1
3	mike	Michael Dole	73	2
4	alyssa	Alyssa P. Hacker	79	3
5	bbrown	Bob Brown	100	3
1	ajones	Alice Jones	82	1
(5 строк)				

Terminal 1

```
dvdrental=*# commit;
COMMIT
dvdrental=# select * from lab10;
user_id | username |
                         fullname
                                       | balance | group id
      2
          bitdiddl | Ben Bitdiddle
                                              65
                                                          1
      3
          mike
                     Michael Dole
                                                          2
                                              73
      4
                     Alyssa P. Hacker
                                                          3
          alyssa
                                              79
                    Bob Brown
      5
                                             100
                                                          3
          bbrown
                    | Alice Jones
                                                          1
      1
        ajones
                                              82
(5 строк)
```

Terminal 2

After step 8 second terminal was stuck - it was waiting for other changes to be committed. So, after committing changes from the first terminal "update" query from the second terminal was done. Since step 10 is rollback in the second terminal, only changes from the first terminal were saved, and final results after all steps are the same:

```
dvdrental=# begin;
BEGIN
dvdrental=*# update lab10 set balance = balance + 10 where fullname = 'Alice Jones';
UPDATE 1
dvdrental=*# select * from lab10;
 user_id | username | fullname
                                       | balance | group_id
       2 | bitdiddl | Ben Bitdiddle
                                             65 l
                                                          1
                    | Michael Dole |
| Alyssa P. Hacker |
                                                          2
      3 | mike
                                             73
      4 | alyssa
                                             79
                      Bob Brown
          bbrown
                                             100
      1 | ajones
                    | Alice Jones
                                              92 l
(5 строк)
dvdrental=*# commit;
COMMIT
dvdrental=# select * from lab10;
 user id | username | fullname
                                       | balance | group id
          bitdiddl | Ben Bitdiddle
                                              65
                    | Michael Dole
                                              73
          mike
                                                          2
                    | Alyssa P. Hacker
| Bob Brown
          alyssa
                                              79
          bbrown
                                              100
          ajones
                    | Alice Jones
                                              92
                                                           1
(5 строк)
```

Terminal 1

```
dvdrental=# begin;
dvdrental=*# update lab10 set balance = balance + 20 where fullname = 'Alice Jones';
UPDATE 1
dvdrental=*# select * from lab10;
user_id | username | fullname
                                                         | balance | group_id
         2 | bitdiddl | Ben Bitdiddle | 65 |
3 | mike | Michael Dole | 73 |
4 | alyssa | Alyssa P. Hacker | 79 |
5 | bbrown | Bob Brown | 100 |
1 | ajones | Alice Jones | 112 |
                                                                                        2
(5 строк)
dvdrental=*# rollback;
ROLLBACK
dvdrental=# select * from lab10;
 user_id | username | fullname | balance | group_id
         2 | bitdiddl | Ben Bitdiddle | 65 |

3 | mike | Michael Dole | 73 |

4 | alyssa | Alyssa P. Hacker | 79 |

5 | bbrown | Bob Brown | 100 |

1 | ajones | Alice Jones | 92 |
                                                                                         2
(5 строк)
```

Terminal 2

# Ex.1: repeatable read.

Results after 4 steps are the same as in "ex.1: read committed":

```
dvdrental=# begin;
BEGIN
dvdrental=*# set transaction isolation level repeatable read;
dvdrental=*# select * from lab10;
user_id | username | fullname | balance | group_id
       2 | bitdiddl | Ben Bitdiddle | 65 |
3 | mike | Michael Dole | 73 |
4 | alyssa | Alyssa P. Hacker | 79 |
5 | bbrown | Bob Brown | 100 |
                                                                      1
                                                                      2
                                                                      3
                        | Alice Jones
        1 jones
                                                      82
(5 строк)
dvdrental=*# select * from lab10;
user_id | username | fullname | balance | group_id
        2 | bitdiddl | Ben Bitdiddle
                                                                      1
       3 | mike | Michael Dole
4 | alyssa | Alyssa P. Hacker |
5 | bbrown | Bob Brown
                                                      73
                                                                      2
                                                    79
                                                                      3
                                                      100
        1 | jones | Alice Jones
                                                                      1
                                                      82
(5 строк)
```

Terminal 1

```
dvdrental=# begin;
dvdrental=*# set transaction isolation level repeatable read;
dvdrental=*# update lab10 set username = 'ajones' where fullname = 'Alice Jones';
UPDATE 1
dvdrental=*# select * from lab10;
user_id | username | fullname
                                      | balance | group_id
      2 | bitdiddl | Ben Bitdiddle
                                            65 l
      3 | mike
                   | Michael Dole
                                            73
                                                         2
                   | Alyssa P. Hacker
                                            79
         alyssa
                                                         3
                   | Bob Brown
         bbrown
                                            100
                                                         3
                   | Alice Jones
      1 | ajones
                                             82
                                                         1
(5 строк)
```

Terminal 2

Results after step 5 are also different because transaction isolation level is repeatable read, and non-repeatable read is prohibited, so, changes from the second terminal does not affect on the output of the first terminal:

		* from lab10;   fullname	balance	group_id
2   3   4   5   1   (5 строк)	bitdiddl mike alyssa bbrown jones	Ben Bitdiddle   Michael Dole   Alyssa P. Hacker   Bob Brown   Alice Jones	65 73 79 100 82	1 2 3 3 1

Terminal 1

```
dvdrental=*# commit;
COMMIT
dvdrental=# select * from lab10;
user_id | username |
                         fullname
                                       | balance | group id
      2 | bitdiddl | Ben Bitdiddle
                                             65
                                                         1
                   | Michael Dole
        mike
                                             73
      3
                                                         2
                    | Alyssa P. Hacker
      4
          alyssa
                                             79
      5
                     Bob Brown
                                            100
                                                         3
          bbrown
      1 | ajones
                    | Alice Jones
                                             82
                                                         1
(5 строк)
```

Terminal 2

After step 8 the second terminal was stuck, and after committing changes from the first terminal in terminal 2 error was displayed: "ERROR: failed to serialize access due to concurrent change". It occurs because of repeatable read level of transaction isolation which does not allow non-repeatable read:

```
dvdrental=# begin;
BEGIN

dvdrental=*# set transaction isolation level repeatable read;
SET

dvdrental=*# update lab10 set balance = balance + 10 where fullname = 'Alice Jones';
UPDATE 1
dvdrental=*# commit;
COMMIT
```

Terminal 1

```
dvdrental=# begin;
BEGIN
dvdrental=*# set transaction isolation level repeatable read;
SET
dvdrental=*# update lab10 set balance = balance + 20 where fullname = 'Alice Jones';
ОШИБКА: не удалось сериализовать доступ из-за параллельного изменения
dvdrental=!# rollback;
ROLLBACK
```

Terminal 2

#### Ex.2: read committed.

Moving Bob to group 2 in the second terminal does not affect transaction in the first terminal because it was uncommitted change, so, Bob's balance was not increased. But after committing this update, Bob is in the group 2 with the same balance. Lost update event occured in these transactions, and it was not prevented by read committed level.

```
dvdrental=# begin;
BEGIN
dvdrental=*# select * from lab10 where group_id = 2;
user_id | username | fullname | balance | group_id
       3 | mike | Michael Dole |
                                       73
(1 строка)
dvdrental=*# select * from lab10 where group id = 2;
user_id | username | fullname | balance | group_id
       3 | mike | Michael Dole | 73 |
(1 строка)
dvdrental=*# update lab10 set balance = balance + 15 where group id = 2;
UPDATE 1
dvdrental=*# commit;
COMMIT
dvdrental=# select * from lab10;
user_id | username | fullname | balance | group_id
       1 | jones | Alice Jones
                                             82
      2 | bitdiddl | Ben Bitdiddle | 4 | alyssa | Alyssa P. Hacker | 5 | bbrown | Bob Brown |
                                             65 l
                                                           1
                                             79
                                                           3
                                                           2
                                             100
                                                           2
       3
          mike
                    | Michael Dole
(5 строк)
```

Terminal 1

```
dvdrental=# begin;
BEGIN
dvdrental=*# update lab10 set group_id = 2 where fullname = 'Bob Brown';
dvdrental=*# commit;
COMMIT
dvdrental=# select * from lab10;
 user_id | username | fullname | balance | group_id
       1 | jones | Alice Jones
2 | bitdiddl | Ben Bitdiddle
4 | alyssa | Alyssa P. Hacker
5 | bbrown | Bob Brown
                                                    82
                                                                     1
                                                     65
                                                                     1
                                                     79
                                                     100
                                                                     2
                        | Michael Dole
                                                     88
        3 | mike
(5 строк)
```

Terminal 2

# Ex.2: repeatable read.

Results are the same as in the previous case, although the transaction isolation level was changed. Repeatable read also prohibits reading uncommitted data:

```
dvdrental=# begin;
BEGIN
dvdrental=*# set transaction isolation level repeatable read;
dvdrental=*# select * from lab10 where group_id = 2;
user_id | username | fullname | balance | group_id
      3 | mike | Michael Dole | 73 |
(1 строка)
dvdrental=*# select * from lab10 where group_id = 2;
user_id | username | fullname | balance | group_id
      3 | mike | Michael Dole | 73 |
(1 строка)
dvdrental=*# update lab10 set balance = balance + 15 where group_id = 2;
UPDATE 1
dvdrental=*# commit;
dvdrental=# select * from lab10;
user_id | username | fullname | balance | group_id
                                           82 |
      1 | jones | Alice Jones
      2 | bitdiddl | Ben Bitdiddle
                                            65
                                                         1
      4 | alyssa | Alyssa P. Hacker |
5 | bbrown | Bob Brown |
3 | mike | Michael Dole |
                                            79
                                                         3
                                            100
                                                          2
                                             88
                                                          2
(5 строк)
```

Terminal 1

```
dvdrental=# begin;
dvdrental=*# set transaction isolation level repeatable read;
dvdrental=*# update lab10 set group_id = 2 where fullname = 'Bob Brown';
UPDATE 1
dvdrental=*# commit;
dvdrental=# select * from lab10;
user_id | username | fullname | balance | group_id
       1 | jones | Alice Jones | 2 | bitdiddl | Ben Bitdiddle |
                                                    82
                                                   65 |
79 |
                                                                    1
       4 | alyssa | Alyssa P. Hacker |
5 | bbrown | Bob Brown |
3 | mike | Michael Dole
                                                                    3
                                                    100
                                                                    2
                                                    88 l
                                                                    2
(5 строк)
```

Terminal 2

## Ex.3: repeatable read.

Error occured: "ERROR: failed to serialize access due to concurrent change". It occured because of querying uncommitted data from database while doing update in the first terminal:

Terminal 1

```
dvdrental=# begin;
BEGIN
dvdrental=*# set transaction isolation level repeatable read;
SET
dvdrental=*# update lab10 set group id = 2 where fullname = 'Bob Brown';
UPDATE 1
dvdrental=*# commit;
COMMIT
dvdrental=# select * from lab10;
user_id | username | fullname
                                        | balance | group id
                    | Alice Jones
       1 jones
                                                            1
                                               82
       2 | bitdiddl | Ben Bitdiddle
                                               65
                                                            1
                    | Michael Dole
| Alyssa P. Hacker
       3
          mike
                                               73
                                                            2
           alyssa
                                               79
       4
       5
                    | Bob Brown
                                              100
                                                            2
           bbrown
(5 строк)
```

Terminal 2

### Ex.3: serializable.

Results are the same as in the previous case:

#### Terminal 1

```
dvdrental=# begin;
BEGIN
dvdrental=*# set transaction isolation level serializable;
SET
dvdrental=*# update lab10 set group_id = 2 where fullname = 'Bob Brown';
UPDATE 1
dvdrental=*# commit;
COMMIT
```

Terminal 2