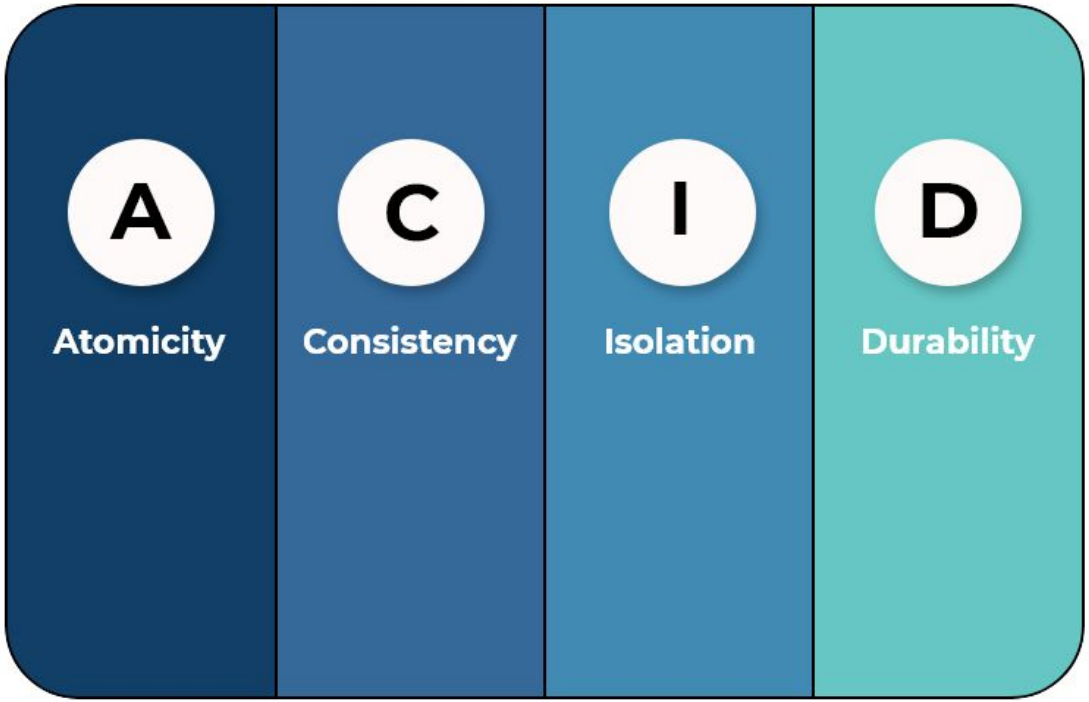
Obrada transakcija, planovi izvršenja transakcija, izolacija i zaključavanje u MySQL-u

Sistemi za upravljanje bazama podataka

Mila Mirović, 1525

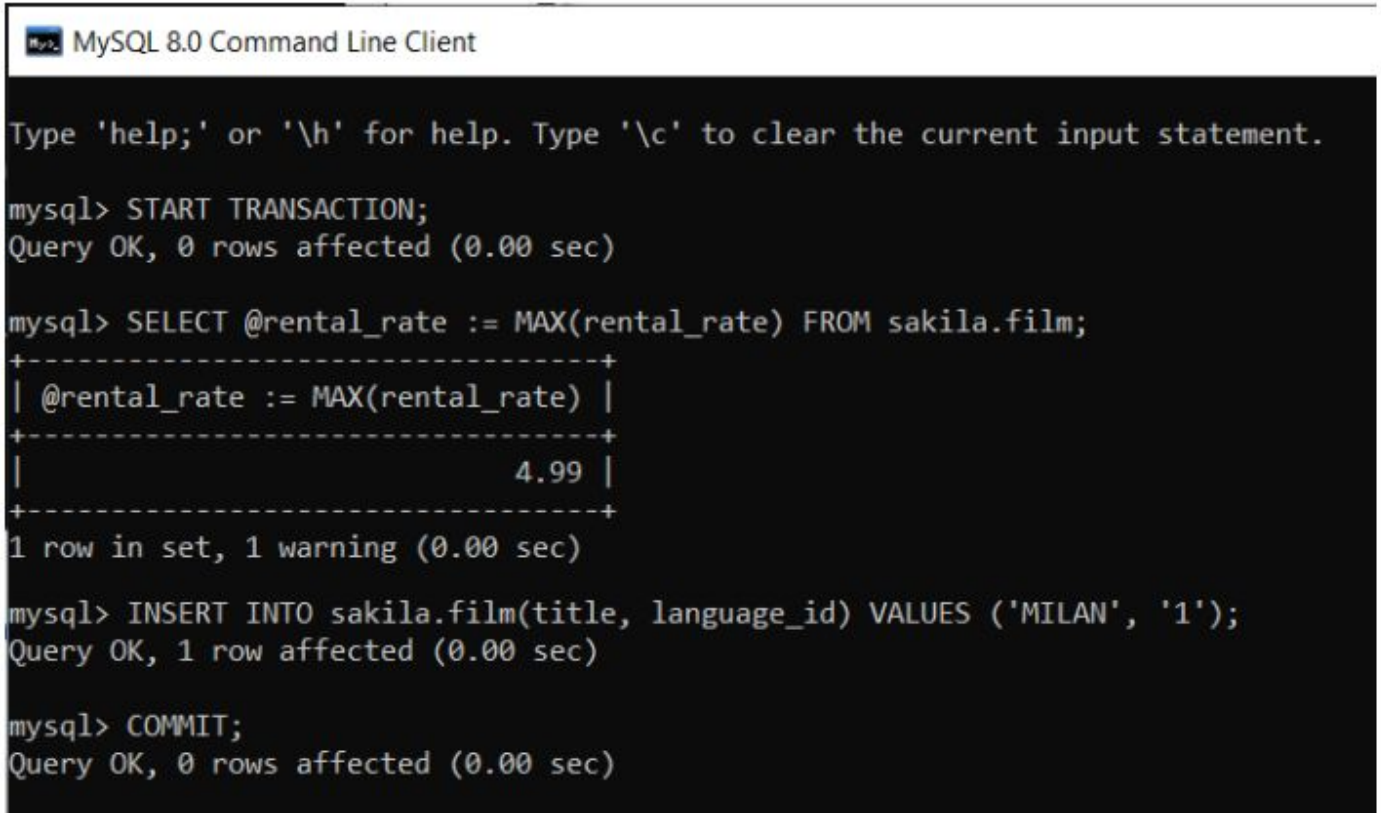
Transakcije u MySQL-u



Obrada transakcija

- **START TRANSACTION** - označava početak transakcije
- **COMMIT** - potvrđuje trenutnu transakciju
- **ROLLBACK** - poništava trenutnu transakciju
- **SET autocommit** - omogućuje ili poništava automatsko potvrđivanje transakcija
- **SAVEPOINT** - kreira tačnu unutar transakcije i omogućava nam da podelimo transakciju na manje segmente koje možemo da potvrđujemo ili poništavamo
- **ROLLBACK TO** - naredba za vraćanje transakcije na prethodno stanje tj. na neku od savepoint-a
- **RELEASE SAVEPOINT** - naredba za otpuštanje savepoint-a tj. uklanjanje

Transakciju započinjemo START TRANSACTION naredbom, zatim vršimo SELECT upit i insert-ujemo novi record u tabelu. Korišćenjem COMMIT naredbe transakcija je kompletirana.



Sesija 1

```
mysql>
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)

mysql> DELETE from sakila.student;
Query OK, 0 rows affected (0.00 sec)
```

```
mysql> SELECT * FROM sakila.student;
+-----------+------+--------+-------+
| idstudent | name | gender | grade |
+-----------+------+--------+-------+
|         1 | Milan | Male   | 1     |
|         2 | Mila  | Female | 2     |
+-----------+------+--------+-------+
2 rows in set (0.00 sec)
```

```
mysql> ROLLBACK;
Query OK, 0 rows affected (0.00 sec)

mysql> SELECT * FROM sakila.student;
+-----------+------+--------+-------+
| idstudent | name | gender | grade |
+-----------+------+--------+-------+
|         1 | Milan | Male   | 1     |
|         2 | Mila  | Female | 2     |
+-----------+------+--------+-------+
2 rows in set (0.00 sec)
```

Sesija 2

```
mysql> SELECT * FROM sakila.student;
+-----------+------+--------+-------+
| idstudent | name | gender | grade |
+-----------+------+--------+-------+
|         1 | Milan | Male   | 1     |
|         2 | Mila  | Female | 2     |
+-----------+------+--------+-------+
2 rows in set (0.00 sec)
```

MySQL 8.0 Command Line Client - Unicode

```
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)

mysql> SELECT * FROM sakila.student;
+-----------+-------+--------+-------+
| idstudent | name  | gender | grade |
+-----------+-------+--------+-------+
|         1 | Milan | Male   | 1     |
|         2 | Mila  | Female | 2     |
|         3 | Ana   | Female | 1     |
|         4 | Milos | Male   | 1     |
+-----------+-------+--------+-------+
4 rows in set (0.00 sec)

mysql> INSERT INTO sakila.student(idstudent, name, gender, grade) VALUES ('5', 'Igor',
    -> 'Male', '4');
Query OK, 1 row affected (0.00 sec)

mysql> SAVEPOINT a;
Query OK, 0 rows affected (0.00 sec)

mysql> INSERT INTO sakila.student(idstudent, name, gender, grade) VALUES ('6', 'Marija', 'Female', '2');
Query OK, 1 row affected (0.00 sec)

mysql> ROLLBACK TO SAVEPOINT a;
Query OK, 0 rows affected (0.00 sec)

mysql> INSERT INTO sakila.student(idstudent, name, gender, grade) VALUES ('7', 'Aca', 'Male', '2');
Query OK, 1 row affected (0.00 sec)

mysql> COMMIT;
Query OK, 0 rows affected (0.00 sec)

mysql> SELECT * FROM sakila.student;
+-----------+-------+--------+-------+
| idstudent | name  | gender | grade |
+-----------+-------+--------+-------+
|         1 | Milan | Male   | 1     |
|         2 | Mila  | Female | 2     |
|         3 | Ana   | Female | 1     |
|         4 | Milos | Male   | 1     |
|         5 | Igor  | Male   | 4     |
|         7 | Aca   | Male   | 2     |
+-----------+-------+--------+-------+
6 rows in set (0.00 sec)
```

```
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)

mysql> INSERT INTO sakila.student(idstudent, name, gender, grade) VALUES ('8', 'Nina', 'Female', '2');
Query OK, 1 row affected (0.00 sec)

mysql> SAVEPOINT b;
Query OK, 0 rows affected (0.00 sec)

mysql> UPDATE sakila.student SET grade = '1' WHERE idstudent = 8;
Query OK, 1 row affected (0.00 sec)
Rows matched: 1  Changed: 1  Warnings: 0

mysql> RELEASE SAVEPOINT b;
Query OK, 0 rows affected (0.00 sec)

mysql> COMMIT;
Query OK, 0 rows affected (0.00 sec)

mysql> SELECT * FROM sakila.student;
+-----------+-------+--------+-------+
| idstudent | name  | gender | grade |
+-----------+-------+--------+-------+
|         1 | Milan | Male   | 1     |
|         2 | Mila  | Female | 2     |
|         3 | Ana   | Female | 1     |
|         4 | Milos | Male   | 1     |
|         5 | Igor  | Male   | 4     |
|         7 | Aca   | Male   | 2     |
|         8 | Nina  | Female | 1     |
+-----------+-------+--------+-------+
7 rows in set (0.00 sec)
```

Izolacija u MySQL-u

Anomalije koje se javljaju

- **Dirty reads** - kada 1 transakcija čita nepotvrđene promene podataka koje je druga transakcija izvršila
- **Non-repeatable reads** - kada 1 transakcija čita isti podatak više puta tokom izvršavanja transakcije, a vrednost tog podatka se menja u drugim transakcijama za to vreme.
- **Phantom reads** - kada 1 transakcija izvrši upit koji vraća skup rezultata, a zatim druga transakcija izvrši promene u podacima koji utiču na taj skup rezultata. Kada prva transakcija ponovo izvrši upit, može se pojaviti dodatni fantomski zapis koji nije bio pristuan prilikom prvog izvršavanja upita.

Nivoi izolacije

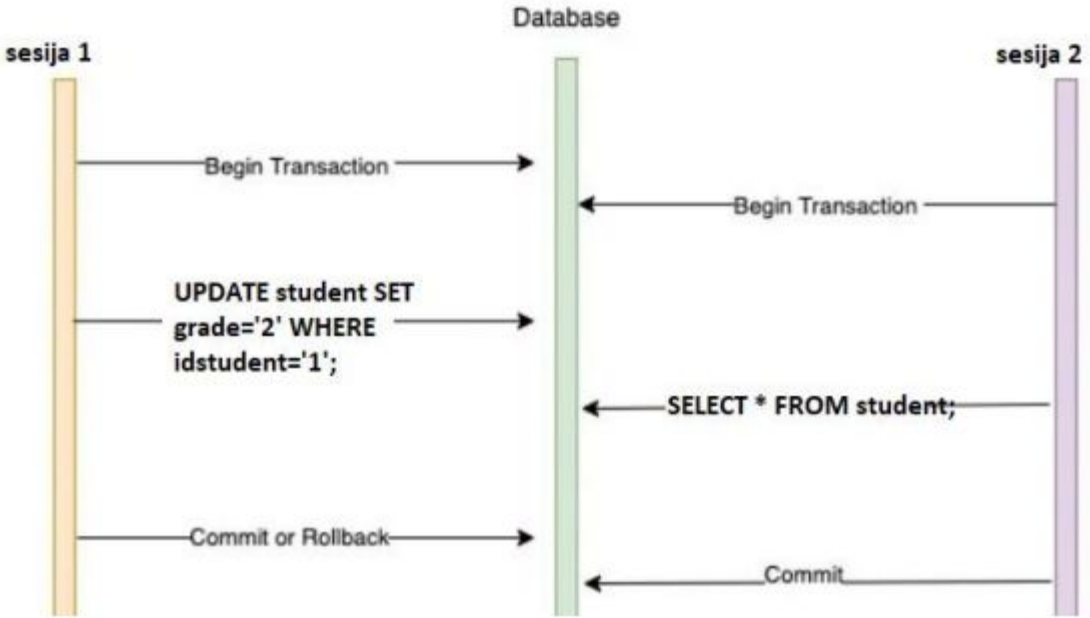
1. **READ UNCOMMITTED**
2. **READ COMITTED**
3. **REPEATABLE READ**
4. **SERIALIZABLE**

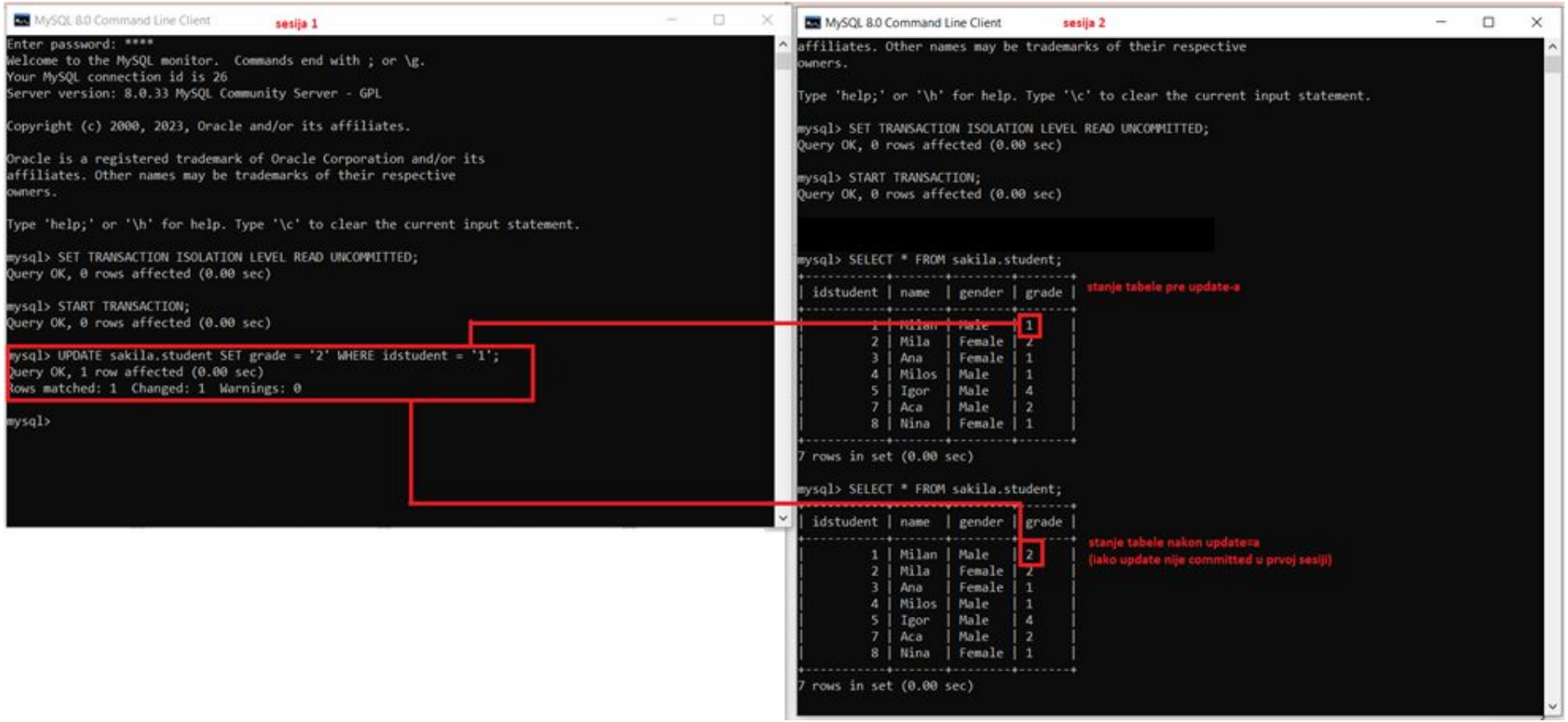
Nivo izolacije	Dirty reads	Non-repeatable reads	Phantom reads
READ UNCOMMITTED	✓	✓	✓
READ COMMITTED	✗	✓	✓
REPEATABLE READ	✗	✗	✓
SERIALIZABLE	✗	✗	✗

SET TRANSACTION ISOLATION LEVEL <naziv nivoa>

READ UNCOMMITTED

```
mysql>>SET GLOBAL TRANSACTION ISOLATION LEVEL READ UNCOMMITTED
```




MySQL 8.0 Command Line Client
sesija 1
Enter password: ****
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 26
Server version: 8.0.33 MySQL Community Server - GPL
Copyright (c) 2000, 2023, Oracle and/or its affiliates.
Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective
owners.
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql> SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
Query OK, 0 rows affected (0.00 sec)
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)
mysql> UPDATE sakila.student SET grade = '2' WHERE idstudent = '1';
Query OK, 1 row affected (0.00 sec)
Rows matched: 1 Changed: 1 Warnings: 0
mysql>
MySQL 8.0 Command Line Client
sesija 2
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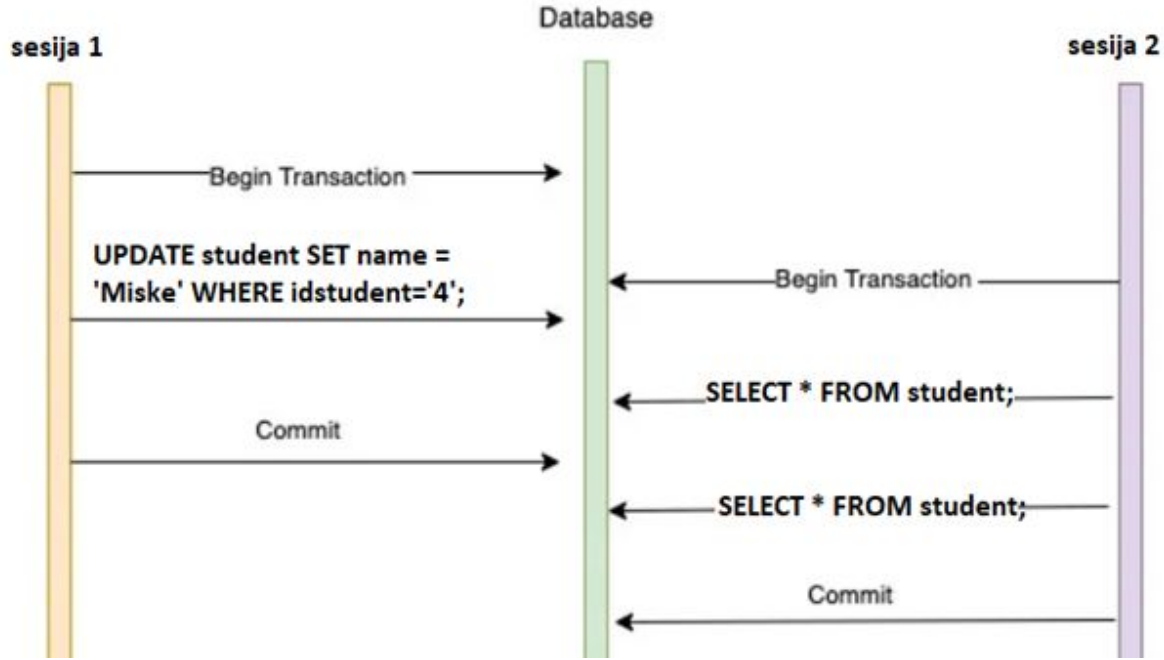
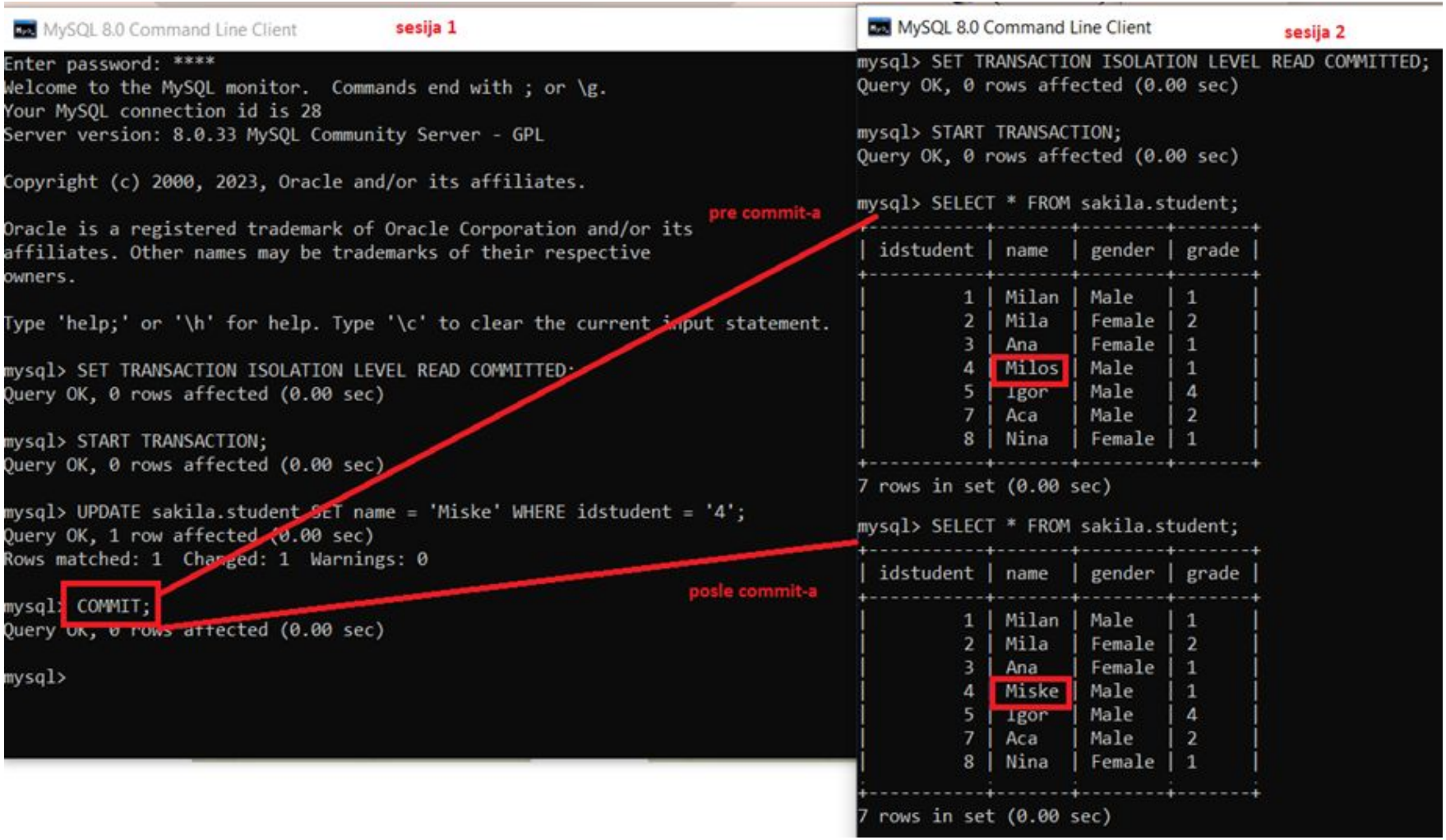
owners.
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql> SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
Query OK, 0 rows affected (0.00 sec)
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)
mysql> SELECT * FROM sakila.student;
stanje tabele pre update-a
idstudent	name	gender	grade
1	Milan	Male	1
2	Mila	Female	2
3	Ana	Female	1
4	Milos	Male	1
5	Igor	Male	4
7	Aca	Male	2
8	Nina	Female	1
7 rows in set (0.00 sec)
mysql> SELECT * FROM sakila.student;
stanje tabele nakon update-a
(iako update nije committed u prvoj sesiji)
idstudent	name	gender	grade
1	Milan	Male	2
2	Mila	Female	2
3	Ana	Female	1
4	Milos	Male	1
5	Igor	Male	4
7	Aca	Male	2
8	Nina	Female	1
7 rows in set (0.00 sec)

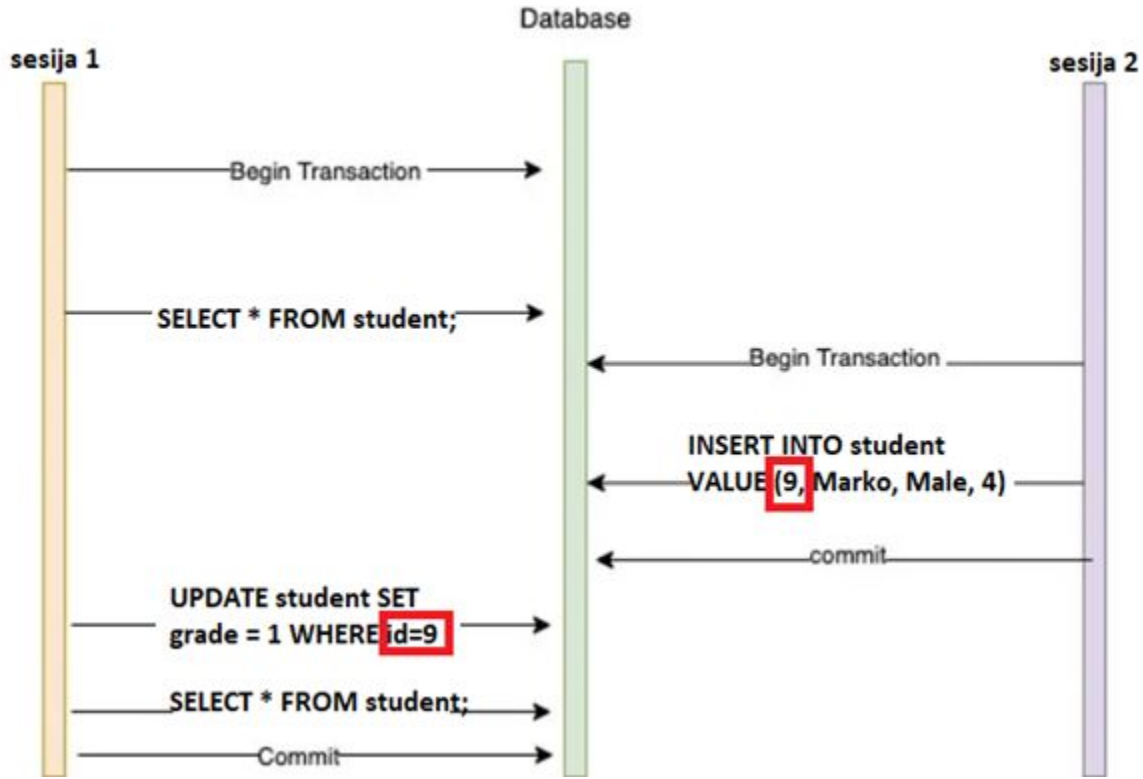
READ COMMITTED

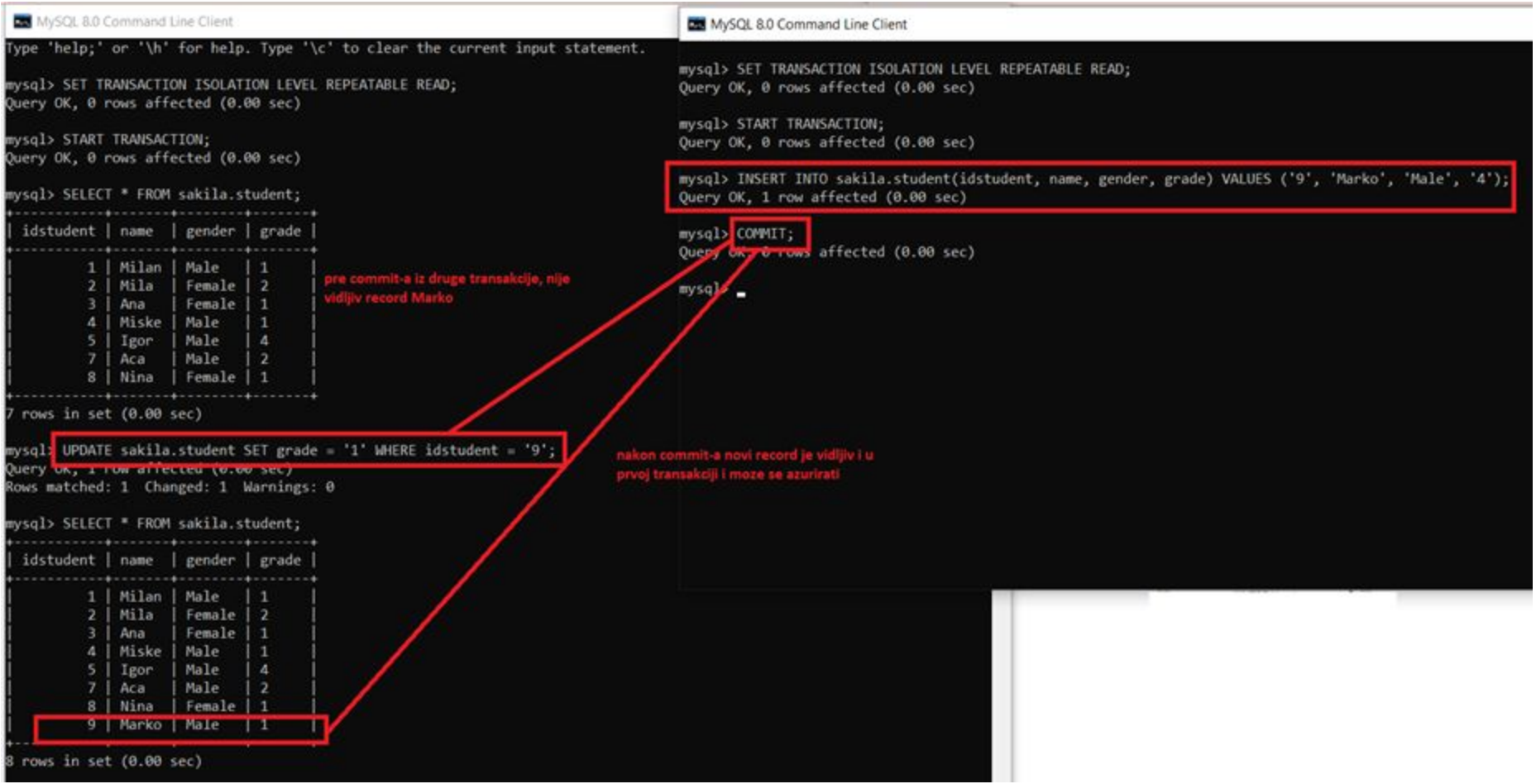
```
mysql>>SET GLOBAL TRANSACTION ISOLATION LEVEL READ COMMITTED
```



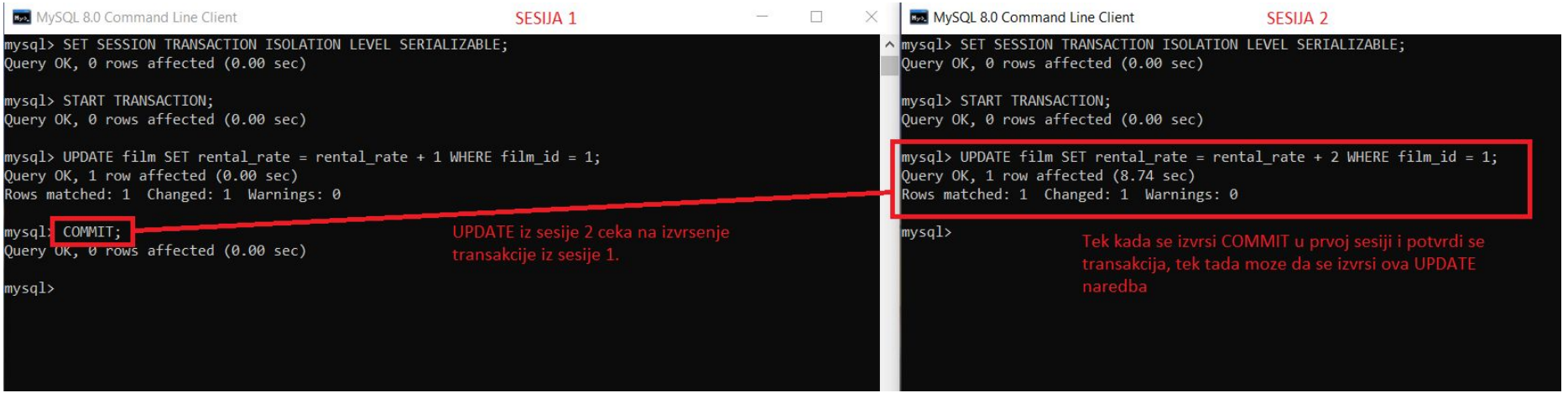

MySQL 8.0 Command Line Client
sesija 1
Enter password: ****
Welcome to the MySQL monitor. Commands end with ; or \g.
Your MySQL connection id is 28
Server version: 8.0.33 MySQL Community Server - GPL
Copyright (c) 2000, 2023, Oracle and/or its affiliates.
Oracle is a registered trademark of Oracle Corporation and/or its affiliates. Other names may be trademarks of their respective owners.
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql> SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Query OK, 0 rows affected (0.00 sec)
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)
mysql> UPDATE sakila.student SET name = 'Miske' WHERE idstudent = '4';
Query OK, 1 row affected (0.00 sec)
Rows matched: 1 Changed: 1 Warnings: 0
mysql> COMMIT;
Query OK, 0 rows affected (0.00 sec)
mysql>
pre commit-a
posle commit-a
MySQL 8.0 Command Line Client
sesija 2
mysql> SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Query OK, 0 rows affected (0.00 sec)
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)
mysql> SELECT * FROM sakila.student;
idstudent	name	gender	grade
1	Milan	Male	1
2	Mila	Female	2
3	Ana	Female	1
4	Milos	Male	1
5	Igor	Male	4
7	Aca	Male	2
8	Nina	Female	1
7 rows in set (0.00 sec)
mysql> SELECT * FROM sakila.student;
idstudent	name	gender	grade
1	Milan	Male	1
2	Mila	Female	2
3	Ana	Female	1
4	Miske	Male	1
5	Igor	Male	4
7	Aca	Male	2
8	Nina	Female	1
7 rows in set (0.00 sec)

REPEATABLE READ




MySQL 8.0 Command Line Client
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql> SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Query OK, 0 rows affected (0.00 sec)
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)
mysql> SELECT * FROM sakila.student;
idstudent	name	gender	grade
1	Milan	Male	1
2	Mila	Female	2
3	Ana	Female	1
4	Miske	Male	1
5	Igor	Male	4
7	Aca	Male	2
8	Nina	Female	1
7 rows in set (0.00 sec)
pre commit-a iz druge transakcije, nije vidljiv record Marko
mysql> UPDATE sakila.student SET grade = '1' WHERE idstudent = '9';
Query OK, 1 row affected (0.00 sec)
Rows matched: 1 Changed: 1 Warnings: 0
mysql> SELECT * FROM sakila.student;
idstudent	name	gender	grade
1	Milan	Male	1
2	Mila	Female	2
3	Ana	Female	1
4	Miske	Male	1
5	Igor	Male	4
7	Aca	Male	2
8	Nina	Female	1
9	Marko	Male	1
8 rows in set (0.00 sec)
nakon commit-a novi record je vidljiv i u prvoj transakciji i moze se azurirati
MySQL 8.0 Command Line Client
mysql> SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Query OK, 0 rows affected (0.00 sec)
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)
mysql> INSERT INTO sakila.student(idstudent, name, gender, grade) VALUES ('9', 'Marko', 'Male', '4');
Query OK, 1 row affected (0.00 sec)
mysql> COMMIT;
Query OK, 0 rows affected (0.00 sec)
mysql>

SERIALIZABLE




Zaključavanje

READ LOCK

- Omogućava transakcijama da čitaju podatke bez ometanja drugih transakcija
- Transakcija koja postavi READ LOCK za određene podatke sprečava drudge transakcije da vrše operacije koje bi mogle menjati te podatke sve dok je LOCK aktivan
- Više transakcija može imati READ LOCK nad istim podacima u isto vreme

WRITE LOCK

- Omogućava transakcijama da izvrše operacije pisanja nad podacima, dok istovremeno sprečava drudge transakcije da pristupe ili menjaju te iste podatke
- Kada transakcija postavi WRITE LOCK nad određenim podacima, druge transakcije neće moći da čitaju ili upisiju u te podatke dok zaključavanje nije oslobođeno.

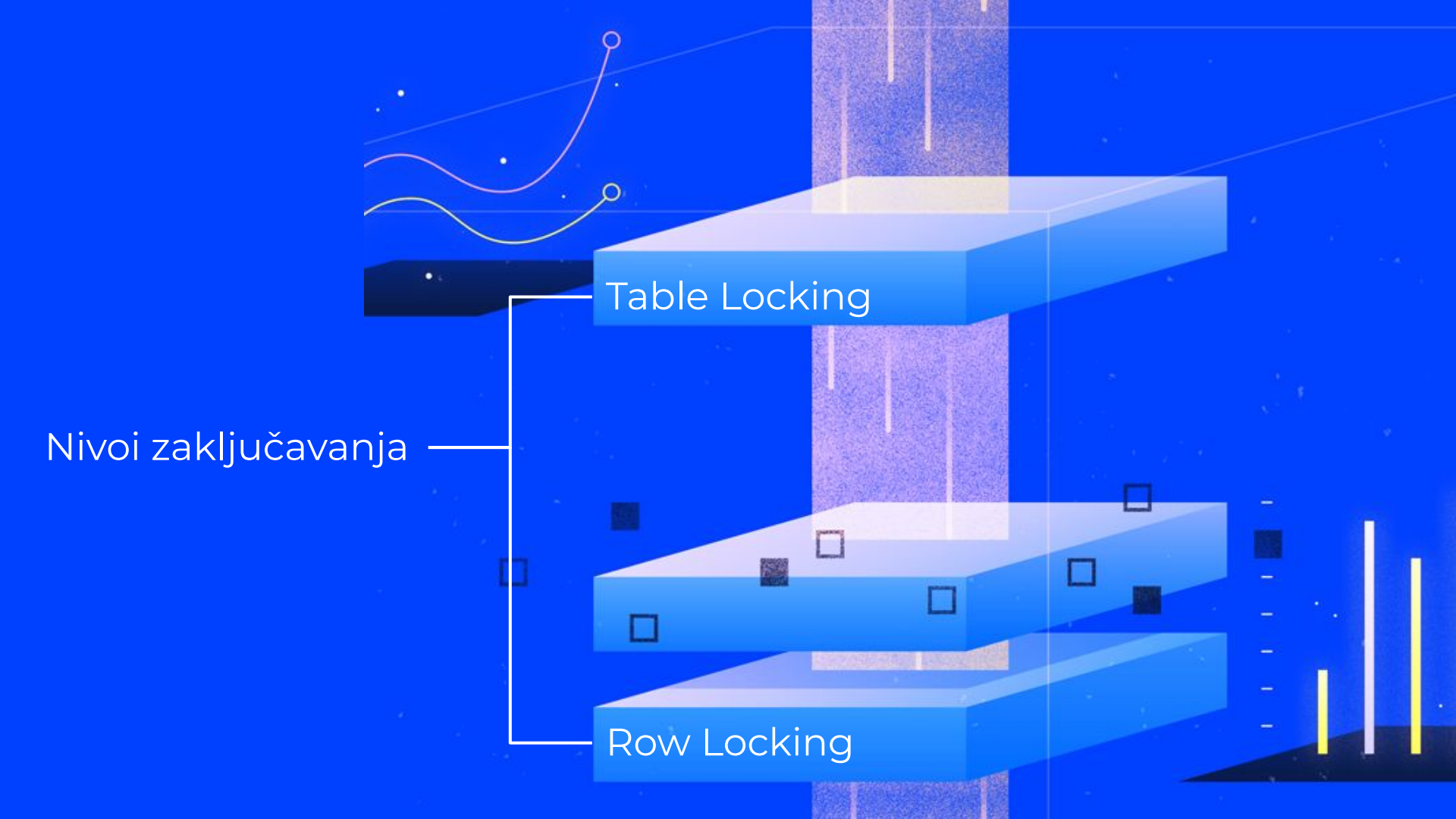

Nivoi zaključavanja
Table Locking
Row Locking

Table Locking

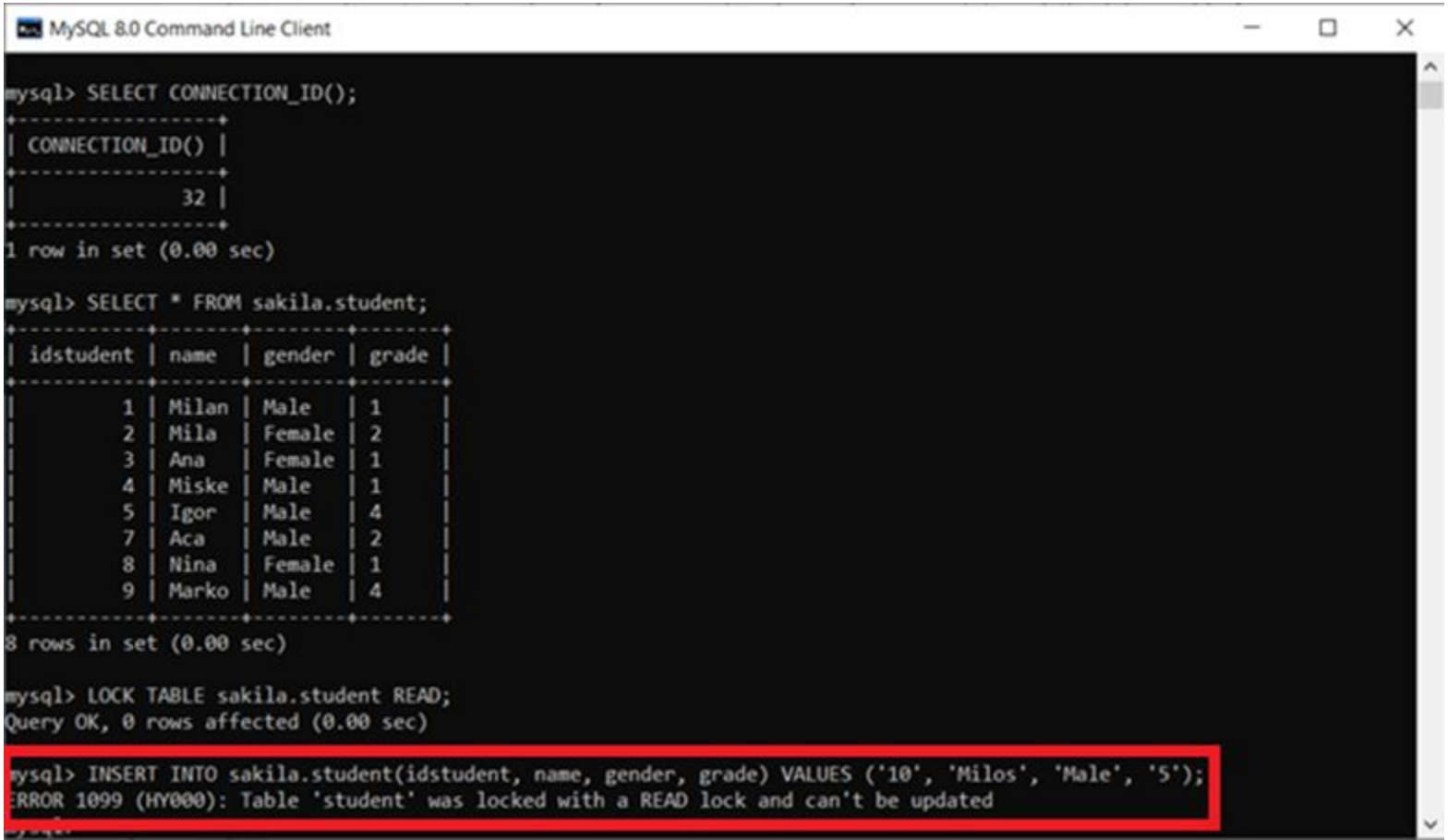
Ovom naredbom vršimo eksplicitno zaključavanje tabela tokom izvršavanja upita.

LOCK TABLES ime_tabele {READ | [WRITE]} [, ime_tabele2 {READ | [WRITE]} ...];

Da bi se otključale zaključane tabele i omogućio pristup drugim sesijama, koristi se sledeća naredba:

UNLOCK TABLES;

Table Locking - READ LOCK



MySQL 8.0 Command Line Client

```
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owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> SELECT CONNECTION_ID();
+-----------------+
| CONNECTION_ID() |
+-----------------+
|              35 |
+-----------------+
1 row in set (0.00 sec)

mysql> SELECT * FROM sakila.student;
+-----------+-------+--------+-------+
| idstudent | name  | gender | grade |
+-----------+-------+--------+-------+
|         1 | Milan | Male   | 1     |
|         2 | Mila  | Female | 2     |
|         3 | Ana   | Female | 1     |
|         4 | Miske | Male   | 1     |
|         5 | Igor  | Male   | 4     |
|         7 | Aca   | Male   | 2     |
|         8 | Nina  | Female | 1     |
|         9 | Marko | Male   | 4     |
+-----------+-------+--------+-------+
8 rows in set (0.00 sec)

mysql> INSERT INTO sakila.student(idstudent, name, gender, grade) VALUES ('10', 'Milos', 'Male', '5');
```
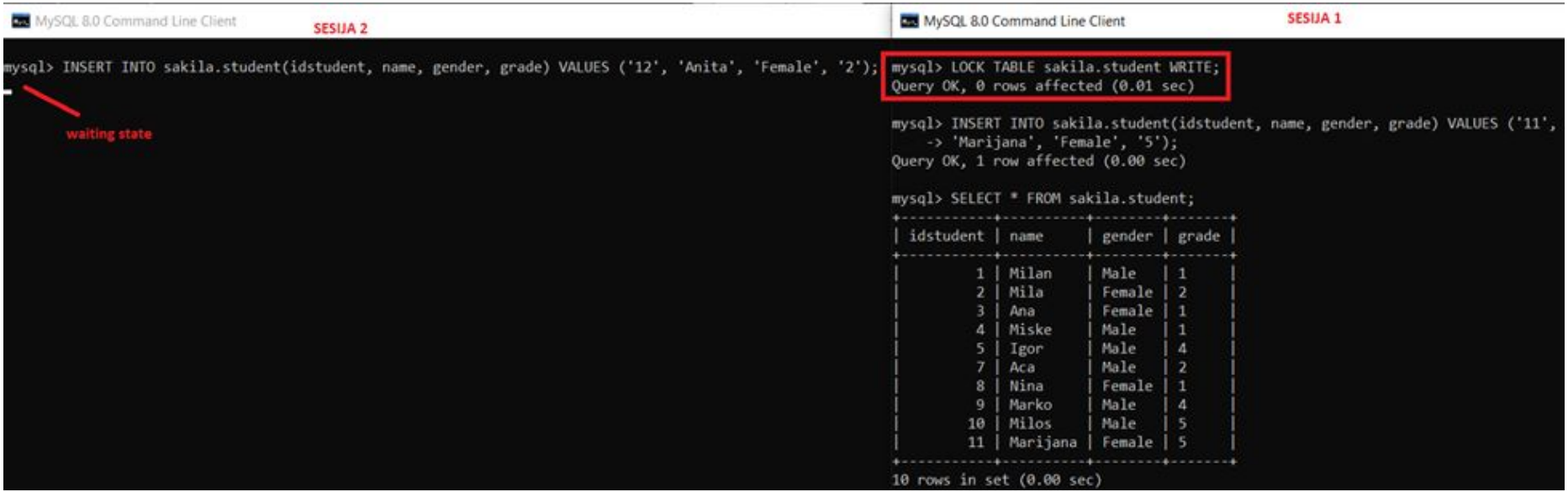

Table Locking - WRITE LOCK



Row Locking

1. **Shared Locking (S Lock)** - omogućava sesijama da istovremeno pristupaju vrstama u read only modu. Sesija koja ima shared lock može čitati podatke, ali ne može vršiti modifikacije.

   SELECT ... FROM table_name WHERE ... **LOCK IN SHARE MODE**;

2. **Exclusive Locking (X Lock)** - omogućava samo jednoj sesiji da izvršava operacije čitanja i pisanja nad vrstom. Kada sesija ima exclusive lock na redu, nijedna druga sesija ne može pristupiti redu sve dok se ne oslobodi zaključavanje.

   SELECT ... FROM table_name WHERE ... **FOR UPDATE**;

Shared Row Locking

Sesija 1 ima shared lock nad vrstom sa film_id = 1 i može čitati podatke:

```
START TRANSACTION;

SELECT * FROM film WHERE film_id = 1 LOCK IN SHARE MODE;
```

Sesija 2 ima shared lock nad vrstom sa film_id = 1 i također može čitati podatke

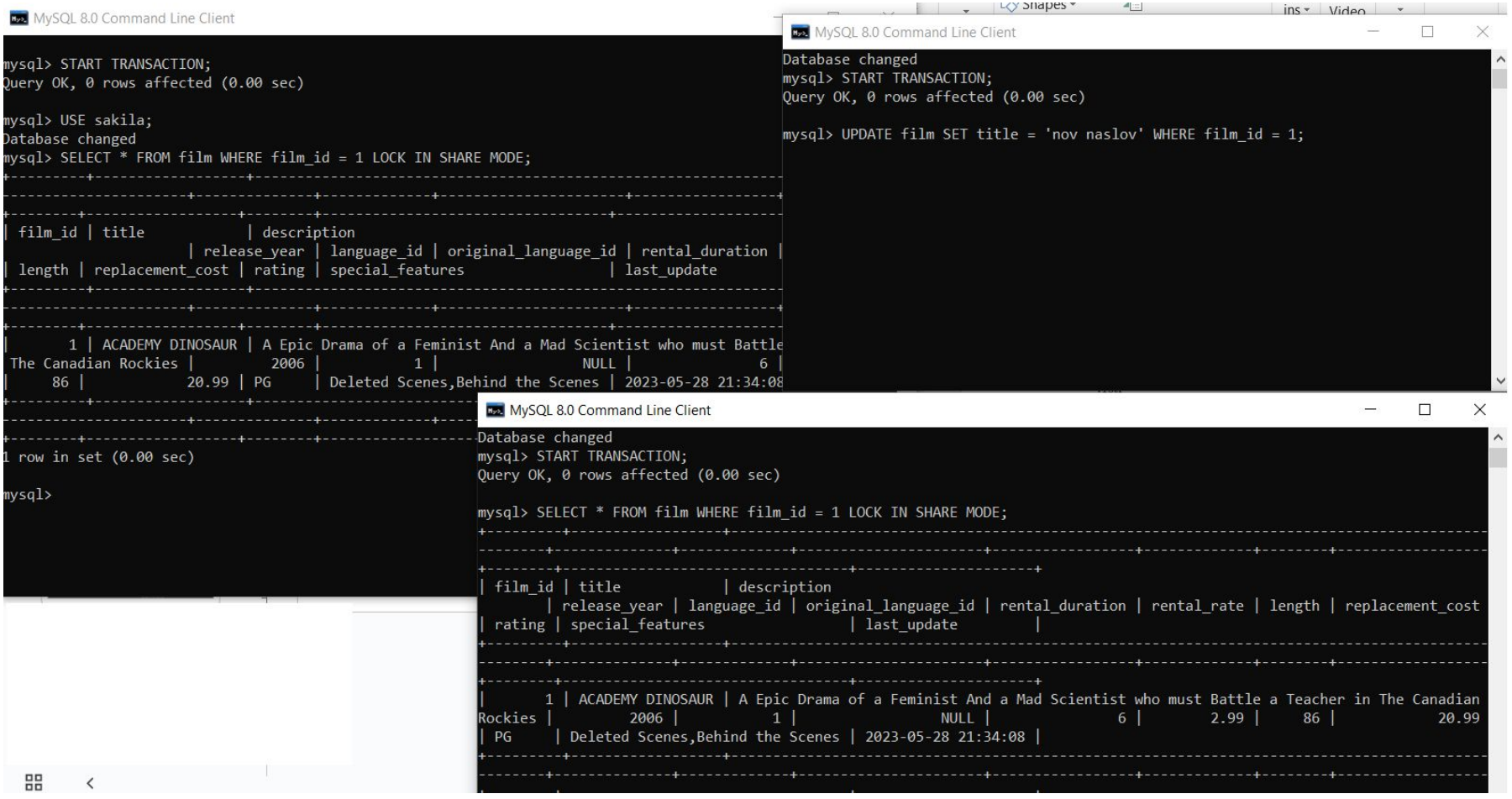
```
START TRANSACTION;

SELECT * FROM film WHERE film_id = 1 LOCK IN SHARE MODE;
```

Works

Sesija 3 ne može izvršiti UPDATE operaciju jer sesija 1 i sesija 2 već drže shared lock na vrsti

```
START TRANSACTION;

UPDATE film SET title = 'novi naslov' WHERE film_id = 1;
```

Not working…


MySQL 8.0 Command Line Client
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)
mysql> USE sakila;
Database changed
mysql> SELECT * FROM film WHERE film_id = 1 LOCK IN SHARE MODE;
| film_id | title | description | release_year | language_id | original_language_id | rental_duration | length | replacement_cost | rating | special_features | last_update |
| 1 | ACADEMY DINOSAUR | A Epic Drama of a Feminist And a Mad Scientist who must Battle The Canadian Rockies | 2006 | 1 | NULL | 6 | 86 | 20.99 | PG | Deleted Scenes,Behind the Scenes | 2023-05-28 21:34:08 |
1 row in set (0.00 sec)
mysql>
MySQL 8.0 Command Line Client
Database changed
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)
mysql> UPDATE film SET title = 'nov naslov' WHERE film_id = 1;
MySQL 8.0 Command Line Client
Database changed
mysql> START TRANSACTION;
Query OK, 0 rows affected (0.00 sec)
mysql> SELECT * FROM film WHERE film_id = 1 LOCK IN SHARE MODE;
| film_id | title | description | release_year | language_id | original_language_id | rental_duration | rental_rate | length | replacement_cost | rating | special_features | last_update |
| 1 | ACADEMY DINOSAUR | A Epic Drama of a Feminist And a Mad Scientist who must Battle a Teacher in The Canadian Rockies | 2006 | 1 | NULL | 6 | 2.99 | 86 | 20.99 | PG | Deleted Scenes,Behind the Scenes | 2023-05-28 21:34:08 |

Exclusive Row Locking

Sesija 1 ima exclusive lock nad vrstom sa film_id = 1 i može čitati i pisati podatke:

```
START TRANSACTION;

SELECT * FROM film WHERE film_id = 1 FOR UPDATE;
```

Sesija 2 pokušava dobiti exclusive lock nad vrstom sa film_id = 1, ali čeka zbog sesije 1:

```
START TRANSACTION;

SELECT * FROM film WHERE film_id = 1 FOR UPDATE;        Waiting...
```

Sesija 3 ne može izvršiti UPDATE operaciju jer sesija 1 drži exclusive lock nad vrstom:

```
START TRANSACTION;

UPDATE film SET description = 'novi opis filma' WHERE film_id = 1;

Not working...
```


SET TRANSACTION naredba

SET [scope] TRANSACTION transaction_characteristics

Hvala na pažnji!