Experiment No 11
Aim: Implementation and demonstration of Transaction and Concurrency control techniques using locks
Class: SE Comp
Year: 2020-21
Performed by: Danyl Fernandes, 72
Performance Date: 25-04-2021

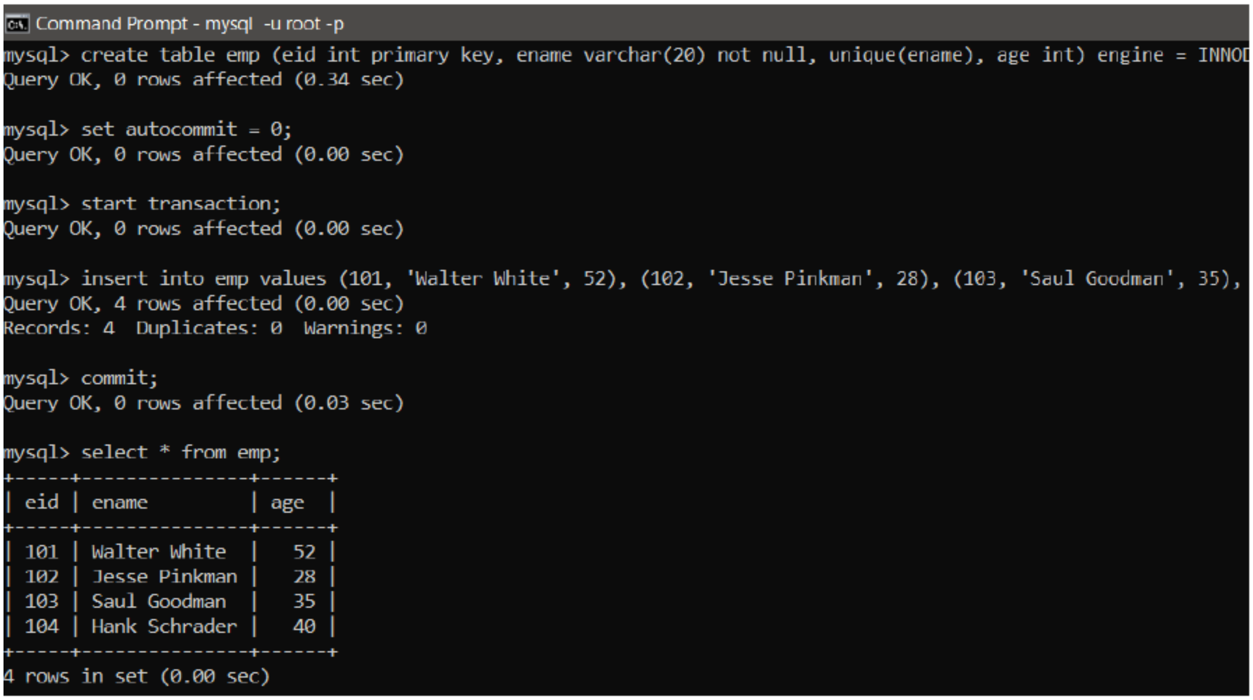
Transactions:

- A transaction is a sequential group of database manipulation operations,which is performed as if it were one single work unit.
- A transaction will never be complete unless each individual operation within the group is successful.
- If any operation within the transaction fails, the entire transaction will fail.
- ACID Properties:
    - Atomicity - This ensures that all operations within the work unit are completed successfully; otherwise, the transaction is aborted at the point of failure and previous operations are rolled back to their former state.
    - Consistency - This ensures that the database properly changes states upon a successfully committed transaction.
    - Isolation - This enables transactions to operate independently and transparently.
    - Durability - This ensures that the result or effect of a committed transaction persists in case of a system failure.
- A transaction begins with the BEGIN WORK statement and ends with either a COMMIT or ROLLBACK clause.
- The SQL commands between these beginning and ending statements form the bulk of the transaction
- When a successful transaction is completed, the COMMIT clause should be fired so that changes made in the table(s) take effect.
- If a failure or an inaccuracy occurs, the ROLLBACK clause is fired to return every table referenced in the transaction to its previous state.
- The behaviour of a transaction can be controlled using the AUTOCOMMIT clause
    - When AUTOCOMMIT is set to 1 (default), each SQL statement is considered a complete transaction by default when it gets executed.
    - When AUTOCOMMIT is set to 0, each SQL statement following subsequently is an incomplete transaction, until an explicit COMMIT is fired.

Concurrency Control:

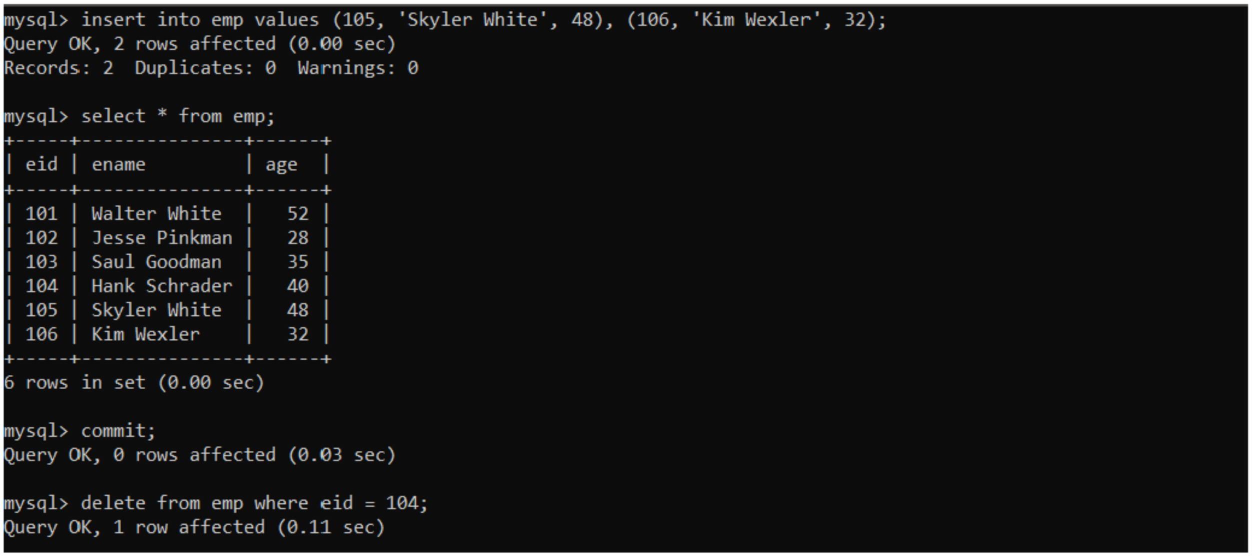
- Table Locking is used in MySQL for concurrency control, during running a transaction.
- A locking protocol is a set of rules followed by all transactions while requesting and releasing locks.
- This helps control concurrent access to data.
- MySQL provides two types of table locks :
    - READ Lock:
        - This lock only allows the user to read the table.
        - Other users can read the table as well, but can not perform any other operations, until the table is unlocked.
        - Hence, the READ lock locks data in Shared (S) Mode.
    - WRITE Lock:
        - This lock allows the user to both read and write.
        - Other users can not read nor write the locked table, until it is unlocked.
        - Hence, the WRITE lock locks data in Exclusive (X) Mode.

Transactions:

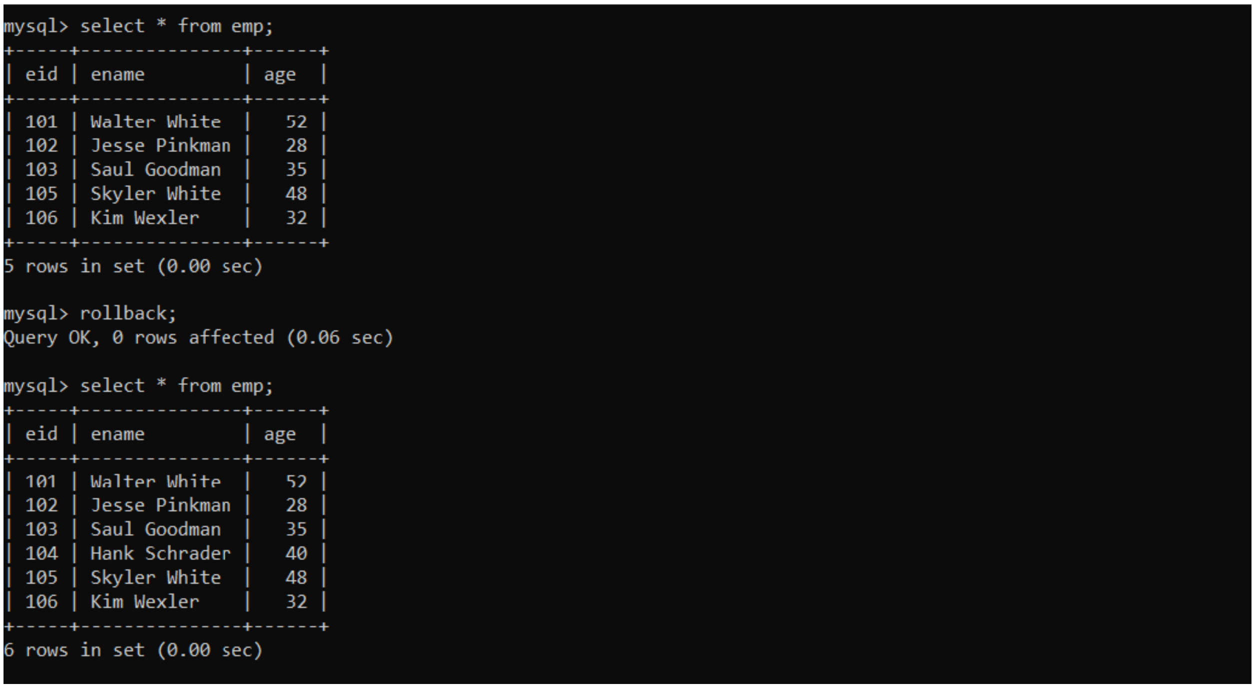


Command Prompt - mysql -u root -p

```
mysql> create table emp (eid int primary key, ename varchar(20) not null, unique(ename), age int) engine = INNOD
Query OK, 0 rows affected (0.34 sec)

mysql> set autocommit = 0;
Query OK, 0 rows affected (0.00 sec)

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

mysql> insert into emp values (101, 'Walter White', 52), (102, 'Jesse Pinkman', 28), (103, 'Saul Goodman', 35),
Query OK, 4 rows affected (0.00 sec)
Records: 4  Duplicates: 0  Warnings: 0

mysql> commit;
Query OK, 0 rows affected (0.03 sec)

mysql> select * from emp;
+-----+---------------+------+
| eid | ename         | age  |
+-----+---------------+------+
| 101 | Walter White  |   52 |
| 102 | Jesse Pinkman |   28 |
| 103 | Saul Goodman  |   35 |
| 104 | Hank Schrader |   40 |
+-----+---------------+------+
4 rows in set (0.00 sec)
```



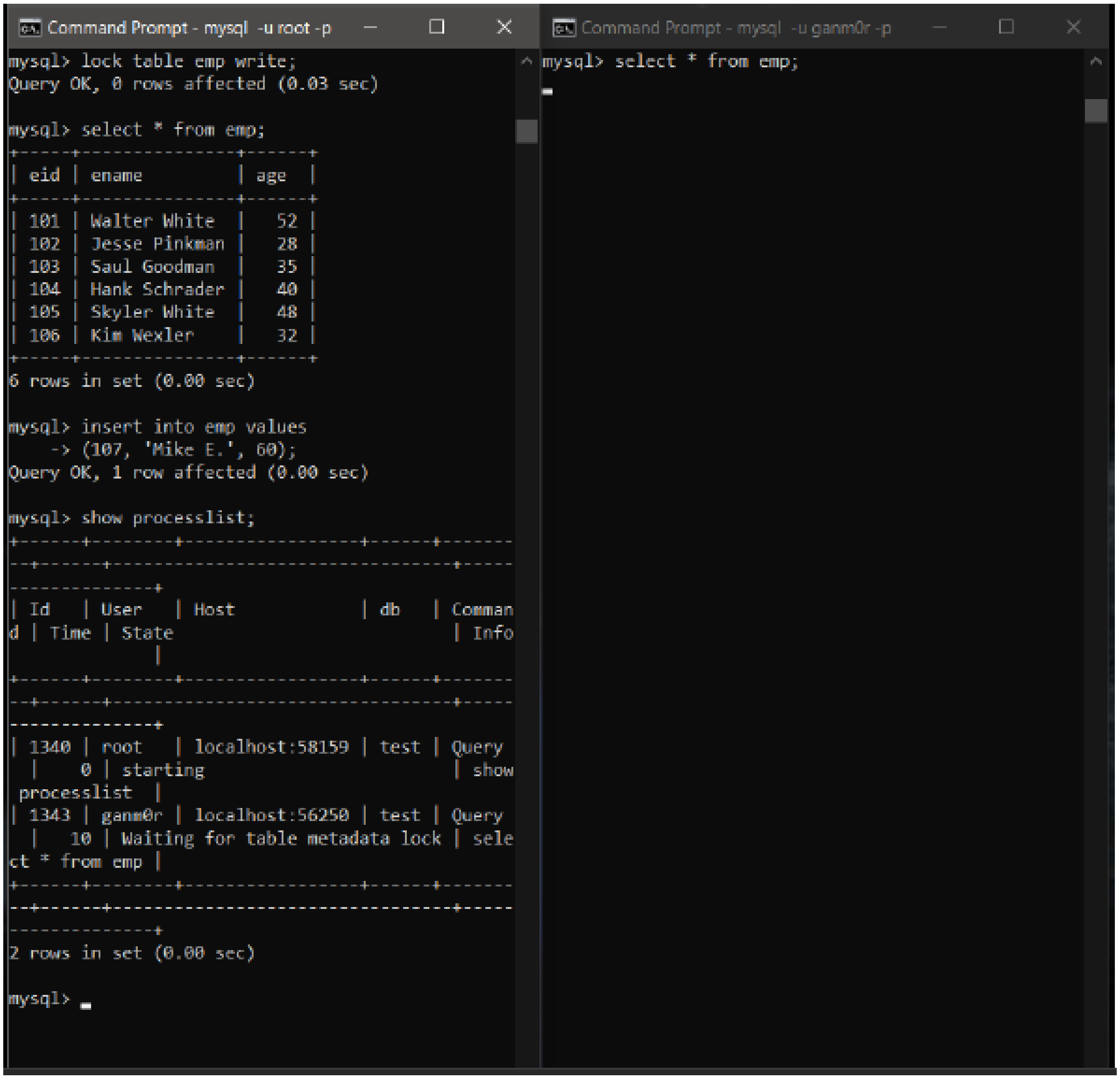
```
mysql> insert into emp values (105, 'Skyler White', 48), (106, 'Kim Wexler', 32);
Query OK, 2 rows affected (0.00 sec)
Records: 2  Duplicates: 0  Warnings: 0

mysql> select * from emp;
+-----+---------------+------+
| eid | ename         | age  |
+-----+---------------+------+
| 101 | Walter White  |   52 |
| 102 | Jesse Pinkman |   28 |
| 103 | Saul Goodman  |   35 |
| 104 | Hank Schrader |   40 |
| 105 | Skyler White  |   48 |
| 106 | Kim Wexler    |   32 |
+-----+---------------+------+
6 rows in set (0.00 sec)

mysql> commit;
Query OK, 0 rows affected (0.03 sec)

mysql> delete from emp where eid = 104;
Query OK, 1 row affected (0.11 sec)
```



```
mysql> select * from emp;
+-----+--------------+------+
| eid | ename        | age  |
+-----+--------------+------+
| 101 | Walter White |   52 |
| 102 | Jesse Pinkman |   28 |
| 103 | Saul Goodman |   35 |
| 105 | Skyler White |   48 |
| 106 | Kim Wexler   |   32 |
+-----+--------------+------+
5 rows in set (0.00 sec)

mysql> rollback;
Query OK, 0 rows affected (0.06 sec)

mysql> select * from emp;
+-----+--------------+------+
| eid | ename        | age  |
+-----+--------------+------+
| 101 | Walter White |   52 |
| 102 | Jesse Pinkman |   28 |
| 103 | Saul Goodman |   35 |
| 104 | Hank Schrader |   40 |
| 105 | Skyler White |   48 |
| 106 | Kim Wexler   |   32 |
+-----+--------------+------+
6 rows in set (0.00 sec)
```

Concurrency Control:

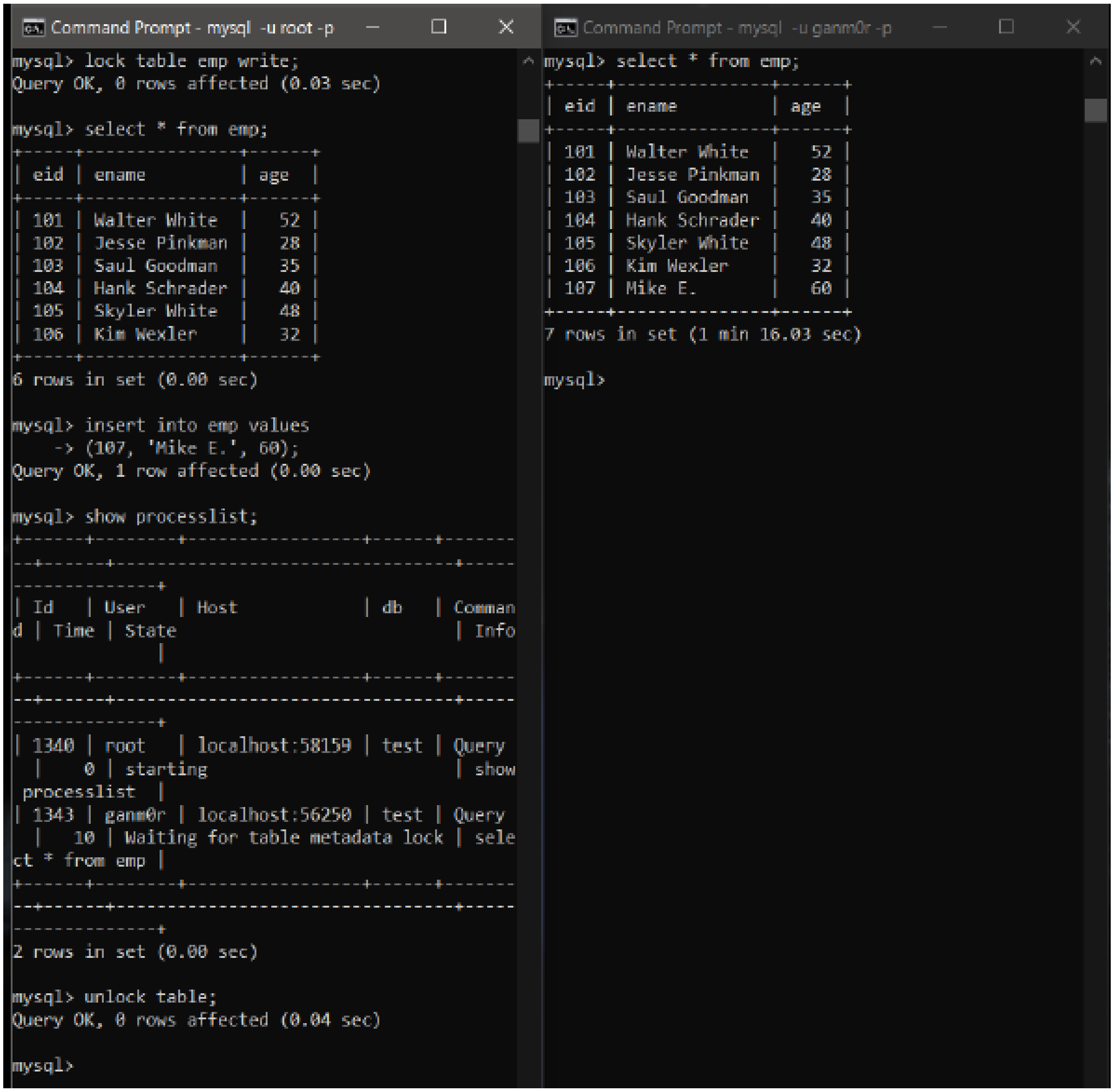
Write Lock:


Command Prompt - mysql -u root -p
Command Prompt - mysql -u ganm0r -p

```
mysql> lock table emp write;
Query OK, 0 rows affected (0.03 sec)

mysql> select * from emp;
+-----+---------------+-----+
| eid | ename         | age |
+-----+---------------+-----+
| 101 | Walter White  |  52 |
| 102 | Jesse Pinkman |  28 |
| 103 | Saul Goodman  |  35 |
| 104 | Hank Schrader |  40 |
| 105 | Skyler White  |  48 |
| 106 | Kim Wexler    |  32 |
+-----+---------------+-----+
6 rows in set (0.00 sec)

mysql> insert into emp values
    -> (107, 'Mike E.', 60);
Query OK, 1 row affected (0.00 sec)

mysql> show processlist;
+------+--------+-----------------+------+-------
--+------+---------------------------------+-----
--------------+
| Id   | User   | Host            | db   | Comman
d | Time | State                           | Info
              |
+------+--------+-----------------+------+-------
--+------+---------------------------------+-----
--------------+
| 1340 | root   | localhost:58159 | test | Query
  |    0 | starting                        | show
 processlist  |
| 1343 | ganm0r | localhost:56250 | test | Query
  |   10 | Waiting for table metadata lock | sele
ct * from emp |
+------+--------+-----------------+------+-------
--+------+---------------------------------+-----
--------------+
2 rows in set (0.00 sec)

mysql>
```

```
mysql> select * from emp;
```

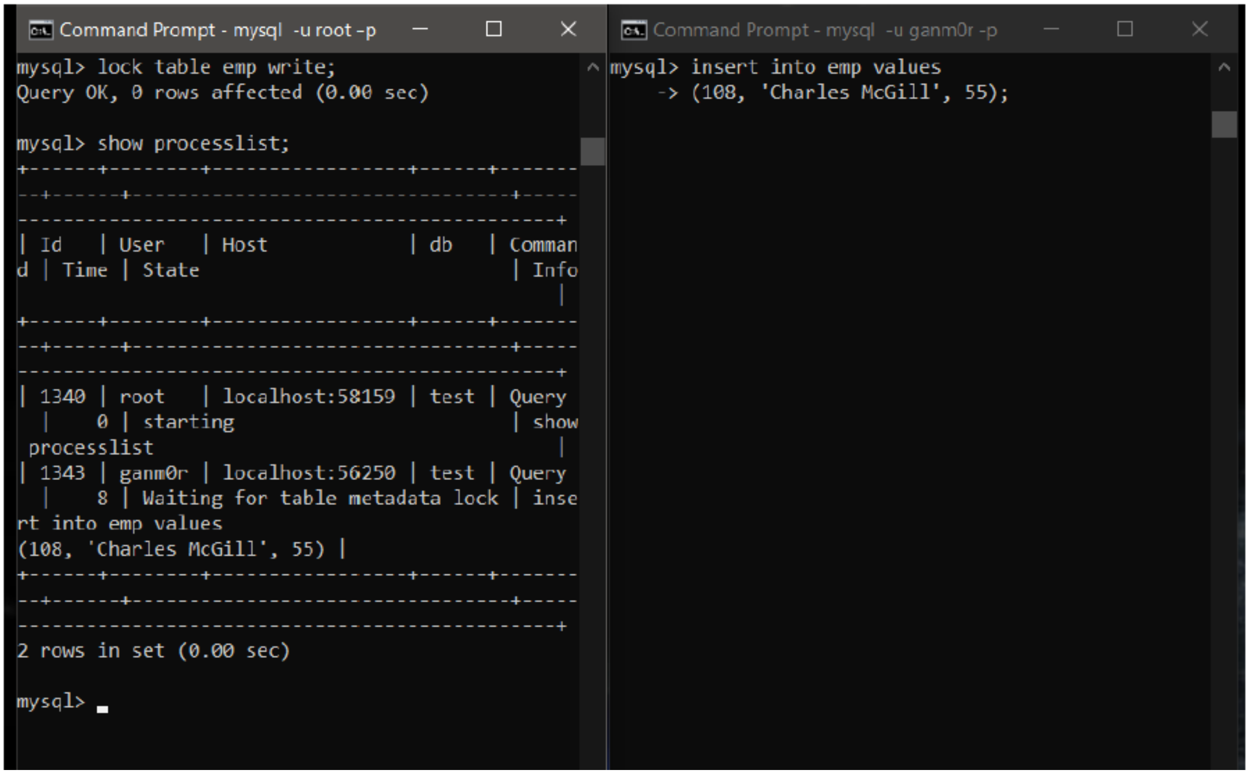
Write Unlock:


Command Prompt - mysql -u root -p
Command Prompt - mysql -u ganm0r -p

```
mysql> lock table emp write;
Query OK, 0 rows affected (0.03 sec)

mysql> select * from emp;
+-----+---------------+------+
| eid | ename         | age  |
+-----+---------------+------+
| 101 | Walter White  |   52 |
| 102 | Jesse Pinkman |   28 |
| 103 | Saul Goodman  |   35 |
| 104 | Hank Schrader |   40 |
| 105 | Skyler White  |   48 |
| 106 | Kim Wexler    |   32 |
+-----+---------------+------+
6 rows in set (0.00 sec)

mysql> insert into emp values
    -> (107, 'Mike E.', 60);
Query OK, 1 row affected (0.00 sec)

mysql> show processlist;
+------+--------+-----------------+------+-------
--+------+---------------------------------+-----
--------------+
| Id   | User   | Host            | db   | Comman
d | Time | State                           | Info
              |
+------+--------+-----------------+------+-------
--+------+---------------------------------+-----
--------------+
| 1340 | root   | localhost:58159 | test | Query
  |    0 | starting                        | show
 processlist  |
| 1343 | ganm0r | localhost:56250 | test | Query
  |   10 | Waiting for table metadata lock | sele
ct * from emp |
+------+--------+-----------------+------+-------
--+------+---------------------------------+-----
--------------+
2 rows in set (0.00 sec)

mysql> unlock table;
Query OK, 0 rows affected (0.04 sec)

mysql>
```

```
mysql> select * from emp;
+-----+---------------+------+
| eid | ename         | age  |
+-----+---------------+------+
| 101 | Walter White  |   52 |
| 102 | Jesse Pinkman |   28 |
| 103 | Saul Goodman  |   35 |
| 104 | Hank Schrader |   40 |
| 105 | Skyler White  |   48 |
| 106 | Kim Wexler    |   32 |
| 107 | Mike E.       |   60 |
+-----+---------------+------+
7 rows in set (1 min 16.03 sec)

mysql>
```

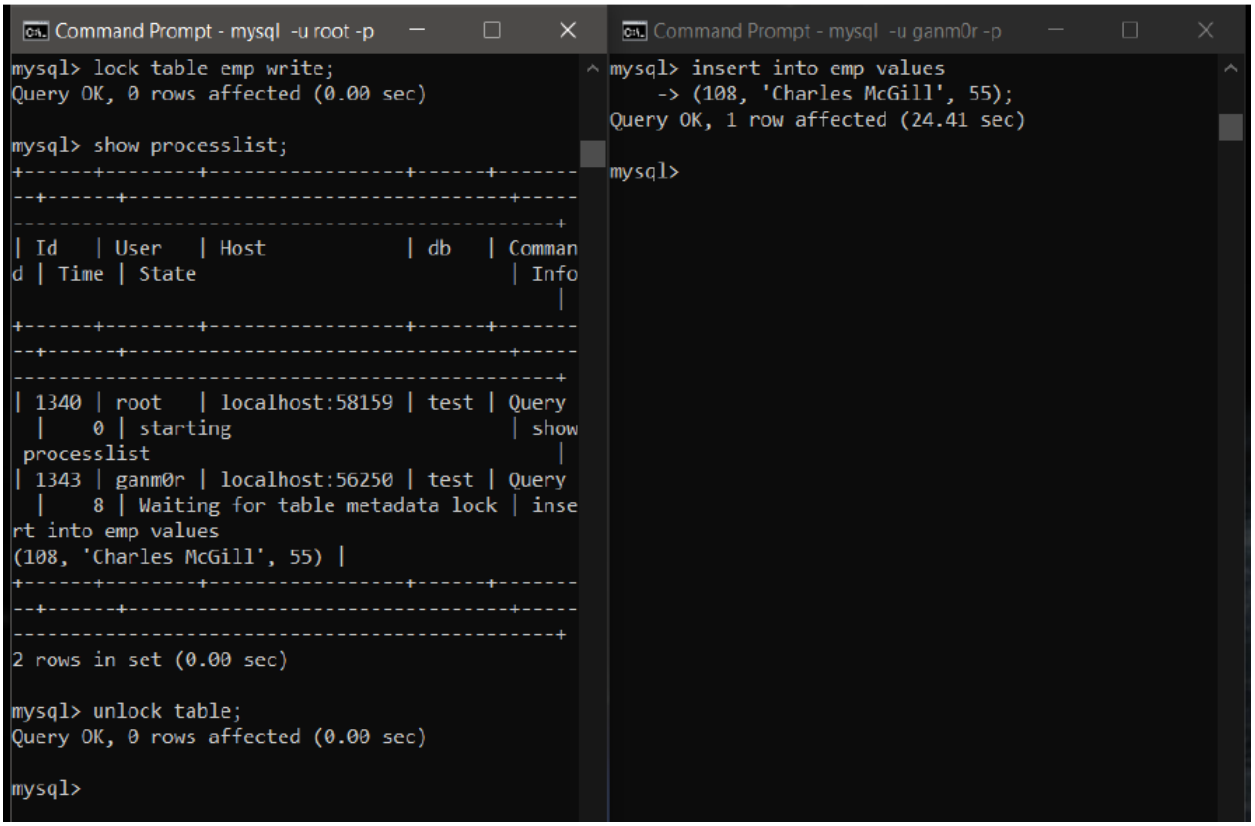
Write Lock:


Command Prompt - mysql -u root -p
Command Prompt - mysql -u ganm0r -p

```
mysql> lock table emp write;
Query OK, 0 rows affected (0.00 sec)

mysql> show processlist;
+------+--------+-----------------+------+-------
--+------+----------------------------------+-----
------------------------------------------------+
| Id   | User   | Host            | db   | Comman
d | Time | State                            | Info
                                                |
+------+--------+-----------------+------+-------
--+------+----------------------------------+-----
------------------------------------------------+
| 1340 | root   | localhost:58159 | test | Query
  |    0 | starting                         | show
 processlist                                    |
| 1343 | ganm0r | localhost:56250 | test | Query
  |    8 | Waiting for table metadata lock | inse
rt into emp values
(108, 'Charles McGill', 55) |
+------+--------+-----------------+------+-------
--+------+----------------------------------+-----
------------------------------------------------+
2 rows in set (0.00 sec)

mysql>
```

```
mysql> insert into emp values
    -> (108, 'Charles McGill', 55);
```

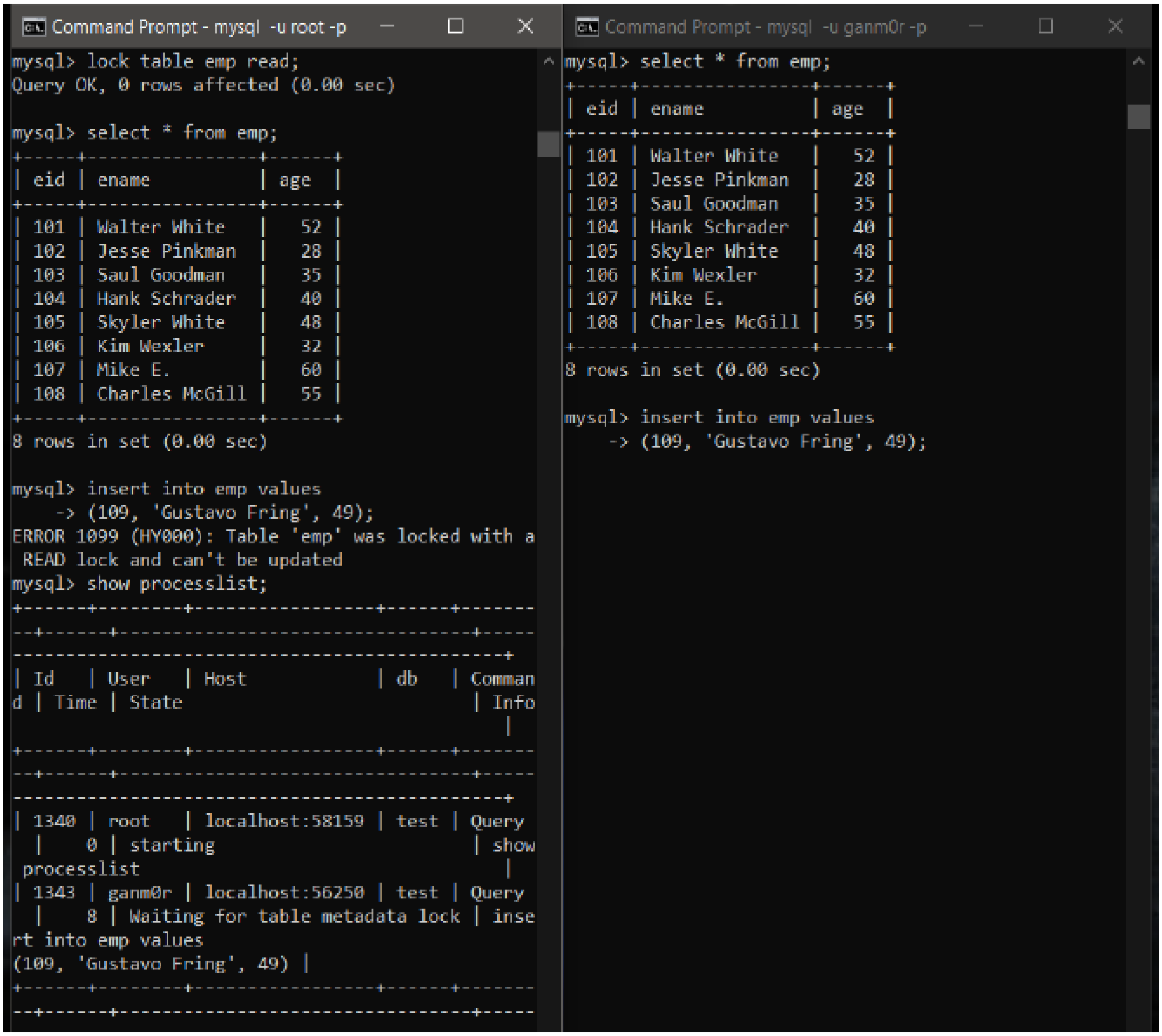
Write Unlock:


Command Prompt - mysql -u root -p
Command Prompt - mysql -u ganm0r -p

```
mysql> lock table emp write;
Query OK, 0 rows affected (0.00 sec)

mysql> show processlist;
+------+--------+-----------------+------+-------
--+------+----------------------------------+-----
------------------------------------------------+
| Id   | User   | Host            | db   | Comman
d | Time | State                            | Info
                                                |
+------+--------+-----------------+------+-------
--+------+----------------------------------+-----
------------------------------------------------+
| 1340 | root   | localhost:58159 | test | Query
  |    0 | starting                         | show
 processlist                                    |
| 1343 | ganm0r | localhost:56250 | test | Query
  |    8 | Waiting for table metadata lock | inse
rt into emp values
(108, 'Charles McGill', 55) |
+------+--------+-----------------+------+-------
--+------+----------------------------------+-----
------------------------------------------------+
2 rows in set (0.00 sec)

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

mysql>
```

```
mysql> insert into emp values
    -> (108, 'Charles McGill', 55);
Query OK, 1 row affected (24.41 sec)

mysql>
```

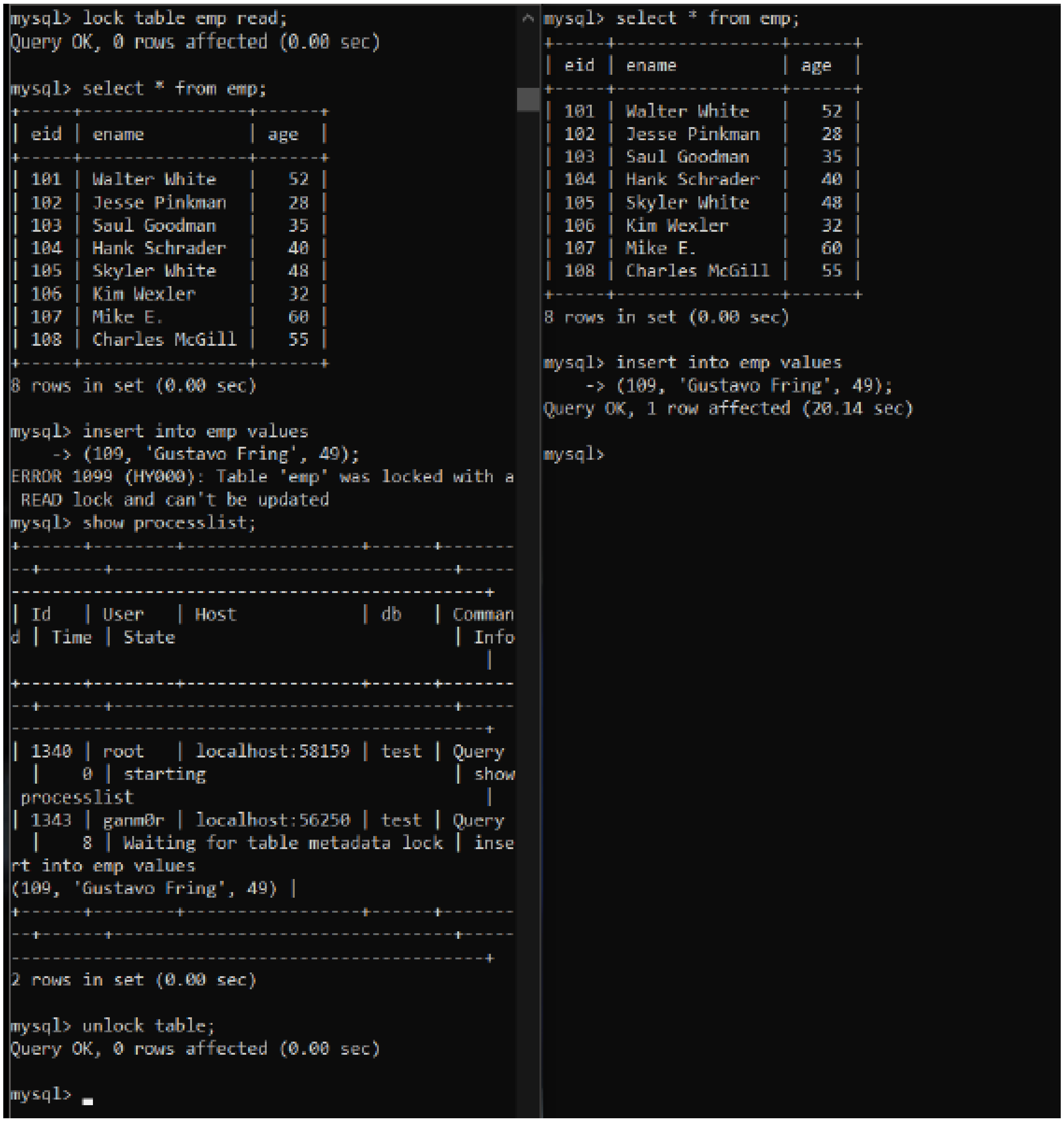
Read Lock:


Command Prompt - mysql -u root -p
Command Prompt - mysql -u ganm0r -p

```
mysql> lock table emp read;
Query OK, 0 rows affected (0.00 sec)

mysql> select * from emp;
+-----+----------------+------+
| eid | ename          | age  |
+-----+----------------+------+
| 101 | Walter White   |   52 |
| 102 | Jesse Pinkman  |   28 |
| 103 | Saul Goodman   |   35 |
| 104 | Hank Schrader  |   40 |
| 105 | Skyler White   |   48 |
| 106 | Kim Wexler     |   32 |
| 107 | Mike E.        |   60 |
| 108 | Charles McGill |   55 |
+-----+----------------+------+
8 rows in set (0.00 sec)

mysql> insert into emp values
    -> (109, 'Gustavo Fring', 49);
ERROR 1099 (HY000): Table 'emp' was locked with a
 READ lock and can't be updated
mysql> show processlist;
+------+--------+-----------------+------+-------
--+------+--------------------------------+-----
----------------------------------------------+
| Id   | User   | Host            | db   | Comman
d | Time | State                          | Info
                                              |
+------+--------+-----------------+------+-------
--+------+--------------------------------+-----
----------------------------------------------+
| 1340 | root   | localhost:58159 | test | Query
  |    0 | starting                       | show
 processlist                                  |
| 1343 | ganm0r | localhost:56250 | test | Query
  |    8 | Waiting for table metadata lock | inse
rt into emp values
(109, 'Gustavo Fring', 49) |
+------+--------+-----------------+------+-------
--+------+--------------------------------+-----
```

```
mysql> select * from emp;
+-----+----------------+------+
| eid | ename          | age  |
+-----+----------------+------+
| 101 | Walter White   |   52 |
| 102 | Jesse Pinkman  |   28 |
| 103 | Saul Goodman   |   35 |
| 104 | Hank Schrader  |   40 |
| 105 | Skyler White   |   48 |
| 106 | Kim Wexler     |   32 |
| 107 | Mike E.        |   60 |
| 108 | Charles McGill |   55 |
+-----+----------------+------+
8 rows in set (0.00 sec)

mysql> insert into emp values
    -> (109, 'Gustavo Fring', 49);
```

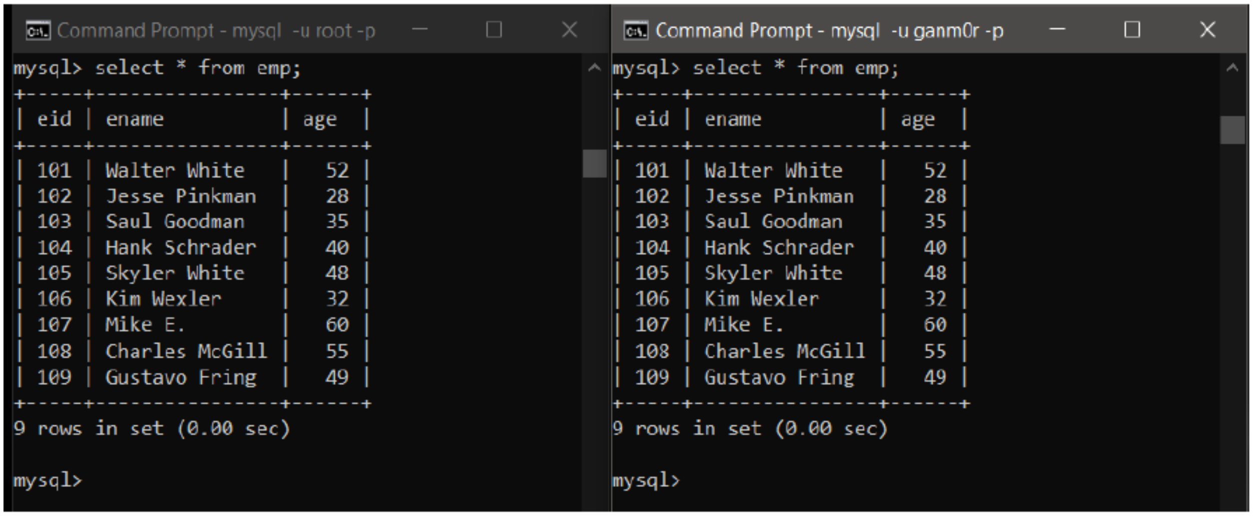
Read Unlock:



```
mysql> lock table emp read;
Query OK, 0 rows affected (0.00 sec)

mysql> select * from emp;
+-----+----------------+------+
| eid | ename          | age  |
+-----+----------------+------+
| 101 | Walter White   |   52 |
| 102 | Jesse Pinkman  |   28 |
| 103 | Saul Goodman   |   35 |
| 104 | Hank Schrader  |   40 |
| 105 | Skyler White   |   48 |
| 106 | Kim Wexler     |   32 |
| 107 | Mike E.        |   60 |
| 108 | Charles McGill |   55 |
+-----+----------------+------+
8 rows in set (0.00 sec)

mysql> insert into emp values
    -> (109, 'Gustavo Fring', 49);
ERROR 1099 (HY000): Table 'emp' was locked with a
 READ lock and can't be updated
mysql> show processlist;
+------+--------+-----------------+------+-------
--+------+--------------------------------+-----
----------------------------------------------+
| Id   | User   | Host            | db   | Comman
d | Time | State                          | Info
                                              |
+------+--------+-----------------+------+-------
--+------+--------------------------------+-----
----------------------------------------------+
| 1340 | root   | localhost:58159 | test | Query
  |    0 | starting                       | show
 processlist                                  |
| 1343 | ganm0r | localhost:56250 | test | Query
  |    8 | Waiting for table metadata lock | inse
rt into emp values
(109, 'Gustavo Fring', 49) |
+------+--------+-----------------+------+-------
--+------+--------------------------------+-----
----------------------------------------------+
2 rows in set (0.00 sec)

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

mysql>
```

```
mysql> select * from emp;
+-----+----------------+------+
| eid | ename          | age  |
+-----+----------------+------+
| 101 | Walter White   |   52 |
| 102 | Jesse Pinkman  |   28 |
| 103 | Saul Goodman   |   35 |
| 104 | Hank Schrader  |   40 |
| 105 | Skyler White   |   48 |
| 106 | Kim Wexler     |   32 |
| 107 | Mike E.        |   60 |
| 108 | Charles McGill |   55 |
+-----+----------------+------+
8 rows in set (0.00 sec)

mysql> insert into emp values
    -> (109, 'Gustavo Fring', 49);
Query OK, 1 row affected (20.14 sec)

mysql>
```

Final Result in the Table:


Command Prompt - mysql -u root -p
Command Prompt - mysql -u ganm0r -p

```
mysql> select * from emp;
+-----+----------------+------+
| eid | ename          | age  |
+-----+----------------+------+
| 101 | Walter White   |   52 |
| 102 | Jesse Pinkman  |   28 |
| 103 | Saul Goodman   |   35 |
| 104 | Hank Schrader  |   40 |
| 105 | Skyler White   |   48 |
| 106 | Kim Wexler     |   32 |
| 107 | Mike E.        |   60 |
| 108 | Charles McGill |   55 |
| 109 | Gustavo Fring  |   49 |
+-----+----------------+------+
9 rows in set (0.00 sec)

mysql>
```

```
mysql> select * from emp;
+-----+----------------+------+
| eid | ename          | age  |
+-----+----------------+------+
| 101 | Walter White   |   52 |
| 102 | Jesse Pinkman  |   28 |
| 103 | Saul Goodman   |   35 |
| 104 | Hank Schrader  |   40 |
| 105 | Skyler White   |   48 |
| 106 | Kim Wexler     |   32 |
| 107 | Mike E.        |   60 |
| 108 | Charles McGill |   55 |
| 109 | Gustavo Fring  |   49 |
+-----+----------------+------+
9 rows in set (0.00 sec)

mysql>
```

Conclusion:

We studied Transactions and Concurrency Control and implemented them successfully.