E/16/156

H.A.D.T.T. Jayathilaka

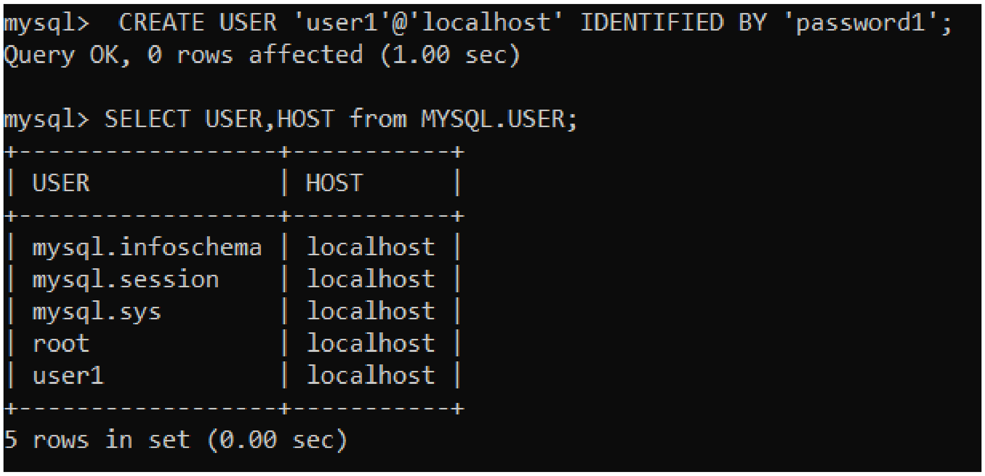
Department of Computer Engineering

University of Peradeniya

CO527 Advanced Database Systems

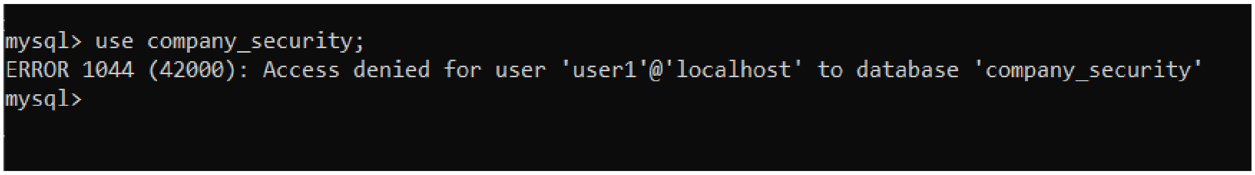
Exercise :

1. **Create database company security.**
2. **Load the given company security.sql file to the company security database.**
3. **Create a new user ‘user1’ within the MySQL shell.**



```
mysql>  CREATE USER 'user1'@'localhost' IDENTIFIED BY 'password1';
Query OK, 0 rows affected (1.00 sec)

mysql> SELECT USER,HOST from MYSQL.USER;
+------------------+-----------+
| USER             | HOST      |
+------------------+-----------+
| mysql.infoschema | localhost |
| mysql.session    | localhost |
| mysql.sys        | localhost |
| root             | localhost |
| user1            | localhost |
+------------------+-----------+
5 rows in set (0.00 sec)
```

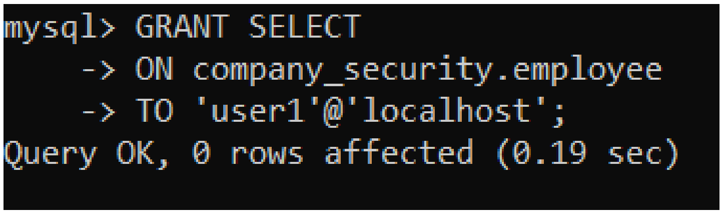
4. **Login to MySQL with a new user account and password and see if the new user has any authorities or privileges to the database.**



```
mysql> use company_security;
ERROR 1044 (42000): Access denied for user 'user1'@'localhost' to database 'company_security'
mysql>
```

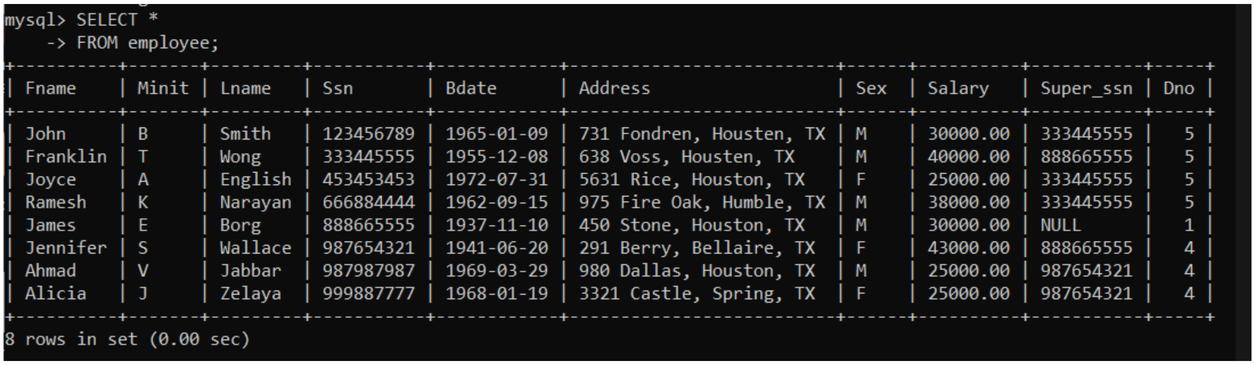
User1 don’t have any authorities or privileges to the database ‘company_security’.

5. **Make sure the new user has only read only permission to ‘Employee’ table.**



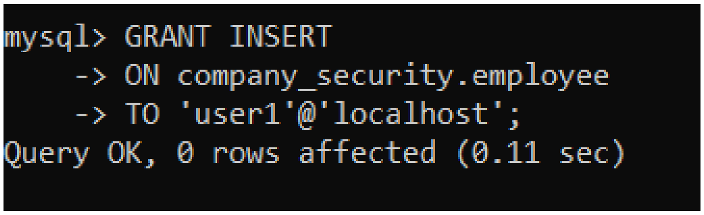
```
mysql> GRANT SELECT
    -> ON company_security.employee
    -> TO 'user1'@'localhost';
Query OK, 0 rows affected (0.19 sec)
```

6. **Now allow ‘user1’ to query the followings: SELECT * FROM Employee; INSERT into Employee(...)VALUES(...). What happens? Fix the problem.**



```
mysql> SELECT *
    -> FROM employee;
+----------+-------+---------+-----------+------------+--------------------------+------+----------+-----------+-----+
| Fname    | Minit | Lname   | Ssn       | Bdate      | Address                  | Sex  | Salary   | Super_ssn | Dno |
+----------+-------+---------+-----------+------------+--------------------------+------+----------+-----------+-----+
| John     | B     | Smith   | 123456789 | 1965-01-09 | 731 Fondren, Housten, TX | M    | 30000.00 | 333445555 |   5 |
| Franklin | T     | Wong    | 333445555 | 1955-12-08 | 638 Voss, Housten, TX    | M    | 40000.00 | 888665555 |   5 |
| Joyce    | A     | English | 453453453 | 1972-07-31 | 5631 Rice, Houston, TX   | F    | 25000.00 | 333445555 |   5 |
| Ramesh   | K     | Narayan | 666884444 | 1962-09-15 | 975 Fire Oak, Humble, TX | M    | 38000.00 | 333445555 |   5 |
| James    | E     | Borg    | 888665555 | 1937-11-10 | 450 Stone, Houston, TX   | M    | 30000.00 | NULL      |   1 |
| Jennifer | S     | Wallace | 987654321 | 1941-06-20 | 291 Berry, Bellaire, TX  | F    | 43000.00 | 888665555 |   4 |
| Ahmad    | V     | Jabbar  | 987987987 | 1969-03-29 | 980 Dallas, Houston, TX  | M    | 25000.00 | 987654321 |   4 |
| Alicia   | J     | Zelaya  | 999887777 | 1968-01-19 | 3321 Castle, Spring, TX  | F    | 25000.00 | 987654321 |   4 |
+----------+-------+---------+-----------+------------+--------------------------+------+----------+-----------+-----+
8 rows in set (0.00 sec)
```

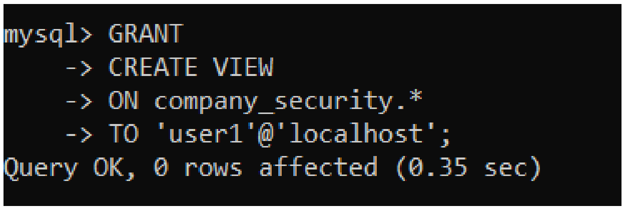
New record insertion was blocked for User 1. Giving user1 the ability to write (insert) data into the employees table as indicated below will resolve this issue.



```
mysql> GRANT INSERT
    -> ON company_security.employee
    -> TO 'user1'@'localhost';
Query OK, 0 rows affected (0.11 sec)
```

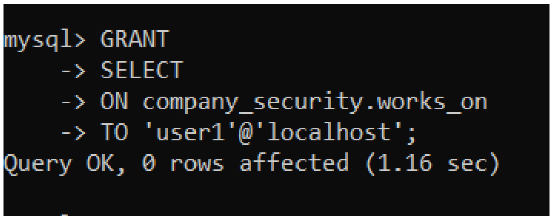
7. **From user1 create a view WORKS ON1(Fname,Lname,Pno) on EMPLOYEE and WORKS ON. (Note: You will have to give permission to user1 on CREATE VIEW). Give another user ‘user2’ permission to select tuples from WORKS ON1(Note: user2 will not be able to see WORKS ON or EMPLOYEE).**

Give permission to user1 on CREATE VIEW



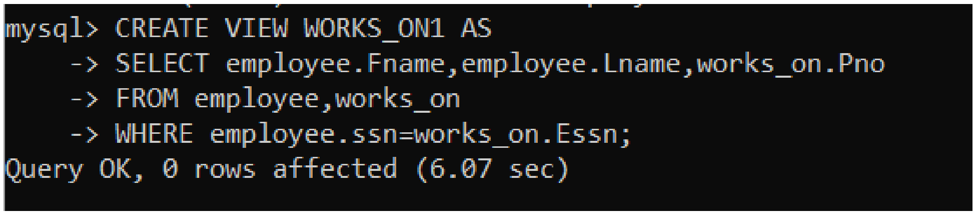
```
mysql> GRANT
    -> CREATE VIEW
    -> ON company_security.*
    -> TO 'user1'@'localhost';
Query OK, 0 rows affected (0.35 sec)
```

Give read only permission to user1 on works_on table.



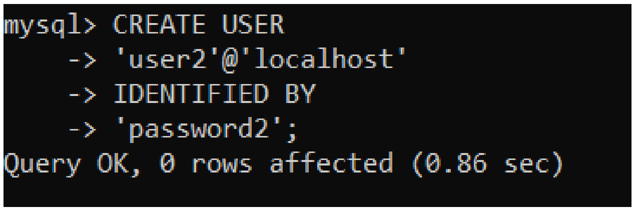
```
mysql> GRANT
    -> SELECT
    -> ON company_security.works_on
    -> TO 'user1'@'localhost';
Query OK, 0 rows affected (1.16 sec)
```

Creating the view works_on1.



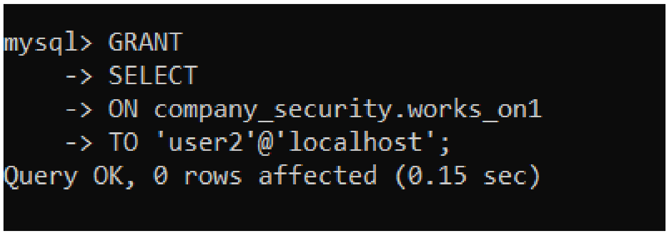
```
mysql> CREATE VIEW WORKS_ON1 AS
    -> SELECT employee.Fname,employee.Lname,works_on.Pno
    -> FROM employee,works_on
    -> WHERE employee.ssn=works_on.Essn;
Query OK, 0 rows affected (6.07 sec)
```

Create a new user 'user2'



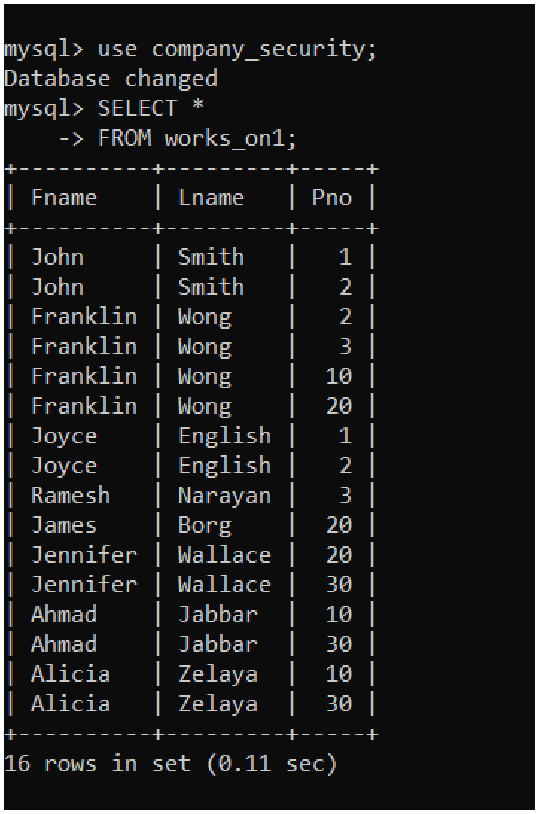
```
mysql> CREATE USER
    -> 'user2'@'localhost'
    -> IDENTIFIED BY
    -> 'password2';
Query OK, 0 rows affected (0.86 sec)
```

Give permission to user2 to select tuples from the view 'works_on1'



```
mysql> GRANT
    -> SELECT
    -> ON company_security.works_on1
    -> TO 'user2'@'localhost';
Query OK, 0 rows affected (0.15 sec)
```

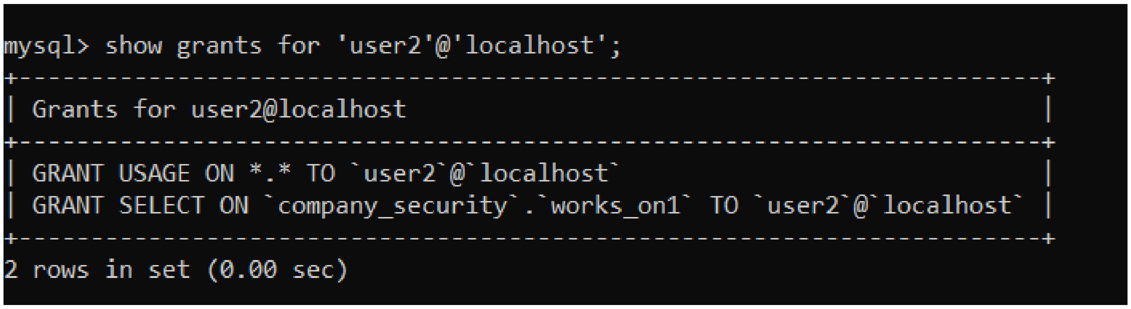
8. **Select tuples from user2 account. What happens?**



```
mysql> use company_security;
Database changed
mysql> SELECT *
    -> FROM works_on1;
+----------+---------+-----+
| Fname    | Lname   | Pno |
+----------+---------+-----+
| John     | Smith   |   1 |
| John     | Smith   |   2 |
| Franklin | Wong    |   2 |
| Franklin | Wong    |   3 |
| Franklin | Wong    |  10 |
| Franklin | Wong    |  20 |
| Joyce    | English |   1 |
| Joyce    | English |   2 |
| Ramesh   | Narayan |   3 |
| James    | Borg    |  20 |
| Jennifer | Wallace |  20 |
| Jennifer | Wallace |  30 |
| Ahmad    | Jabbar  |  10 |
| Ahmad    | Jabbar  |  30 |
| Alicia   | Zelaya  |  10 |
| Alicia   | Zelaya  |  30 |
+----------+---------+-----+
16 rows in set (0.11 sec)
```

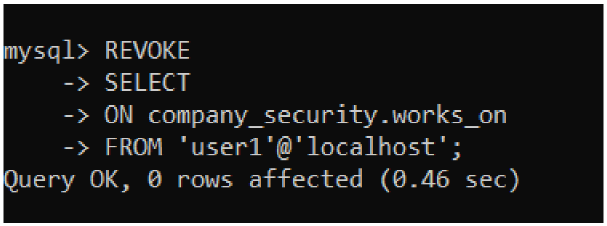
The records in the view "works on1" were all visible to User2. because user2 only had read access to that view.

Grants related to user2

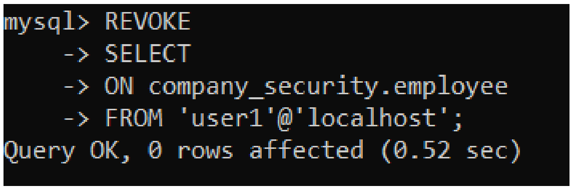


```
mysql> show grants for 'user2'@'localhost';
+----------------------------------------------------------------------+
| Grants for user2@localhost                                           |
+----------------------------------------------------------------------+
| GRANT USAGE ON *.* TO `user2`@`localhost`                            |
| GRANT SELECT ON `company_security`.`works_on1` TO `user2`@`localhost` |
+----------------------------------------------------------------------+
2 rows in set (0.00 sec)
```

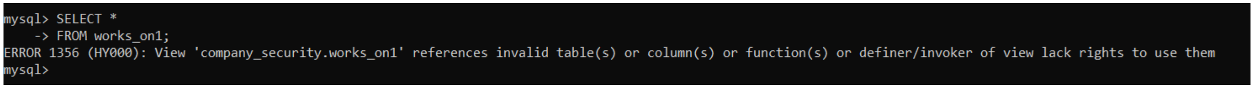
9. **Remove privileges of user1 on WORKS ON and EMPLOYEE. Can user1 still access WORKS ON1? What happened to WORKS ON1? Why?**



```
mysql> REVOKE
    -> SELECT
    -> ON company_security.works_on
    -> FROM 'user1'@'localhost';
Query OK, 0 rows affected (0.46 sec)
```



```
mysql> REVOKE
    -> SELECT
    -> ON company_security.employee
    -> FROM 'user1'@'localhost';
Query OK, 0 rows affected (0.52 sec)
```

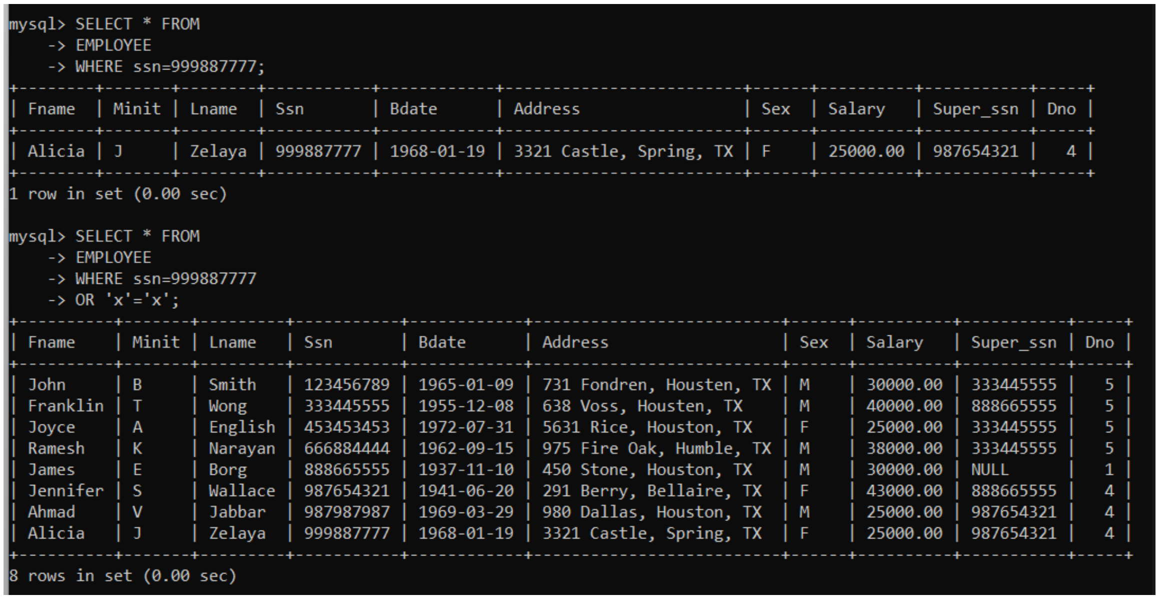


```
mysql> SELECT *
    -> FROM works_on1;
ERROR 1356 (HY000): View 'company_security.works_on1' references invalid table(s) or column(s) or function(s) or definer/invoker of view lack rights to use them
mysql>
```

The view "WORKS ON1" could not be accessed by User1. due to the fact that User1 was not granted read access to the view's linked tables.

SQL Injection Attacks:

Since you do not have any authentication related tables in your database, you can try the following two queries to see what happens in an SQL injection. SELECT * FROM employee WHERE ssn=999887777; SELECT * FROM employee WHERE ssn=999887777 or ’x’=’x’; Observe the result. What happens?

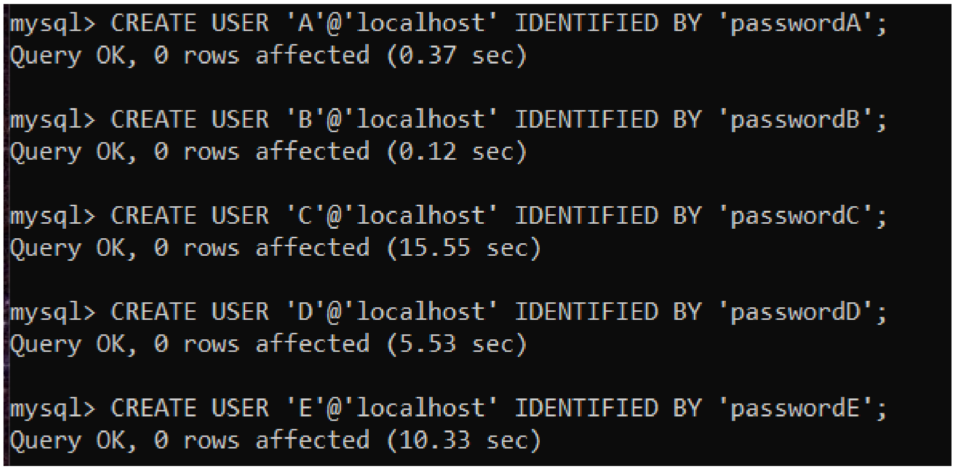


```
mysql> SELECT * FROM
    -> EMPLOYEE
    -> WHERE ssn=999887777;
+--------+-------+--------+-----------+------------+-------------------------+------+----------+-----------+-----+
| Fname  | Minit | Lname  | Ssn       | Bdate      | Address                 | Sex  | Salary   | Super_ssn | Dno |
+--------+-------+--------+-----------+------------+-------------------------+------+----------+-----------+-----+
| Alicia | J     | Zelaya | 999887777 | 1968-01-19 | 3321 Castle, Spring, TX | F    | 25000.00 | 987654321 |   4 |
+--------+-------+--------+-----------+------------+-------------------------+------+----------+-----------+-----+
1 row in set (0.00 sec)

mysql> SELECT * FROM
    -> EMPLOYEE
    -> WHERE ssn=999887777
    -> OR 'x'='x';
+----------+-------+---------+-----------+------------+--------------------------+------+----------+-----------+-----+
| Fname    | Minit | Lname   | Ssn       | Bdate      | Address                  | Sex  | Salary   | Super_ssn | Dno |
+----------+-------+---------+-----------+------------+--------------------------+------+----------+-----------+-----+
| John     | B     | Smith   | 123456789 | 1965-01-09 | 731 Fondren, Housten, TX | M    | 30000.00 | 333445555 |   5 |
| Franklin | T     | Wong    | 333445555 | 1955-12-08 | 638 Voss, Housten, TX    | M    | 40000.00 | 888665555 |   5 |
| Joyce    | A     | English | 453453453 | 1972-07-31 | 5631 Rice, Houston, TX   | F    | 25000.00 | 333445555 |   5 |
| Ramesh   | K     | Narayan | 666884444 | 1962-09-15 | 975 Fire Oak, Humble, TX | M    | 38000.00 | 333445555 |   5 |
| James    | E     | Borg    | 888665555 | 1937-11-10 | 450 Stone, Houston, TX   | M    | 30000.00 | NULL      |   1 |
| Jennifer | S     | Wallace | 987654321 | 1941-06-20 | 291 Berry, Bellaire, TX  | F    | 43000.00 | 888665555 |   4 |
| Ahmad    | V     | Jabbar  | 987987987 | 1969-03-29 | 980 Dallas, Houston, TX  | M    | 25000.00 | 987654321 |   4 |
| Alicia   | J     | Zelaya  | 999887777 | 1968-01-19 | 3321 Castle, Spring, TX  | F    | 25000.00 | 987654321 |   4 |
+----------+-------+---------+-----------+------------+--------------------------+------+----------+-----------+-----+
8 rows in set (0.00 sec)
```

The entire contents of the table "EMPLOYEE" were visible to the attacker. When user data is utilized to alter a SQL statement, a SQL injection attack takes place.

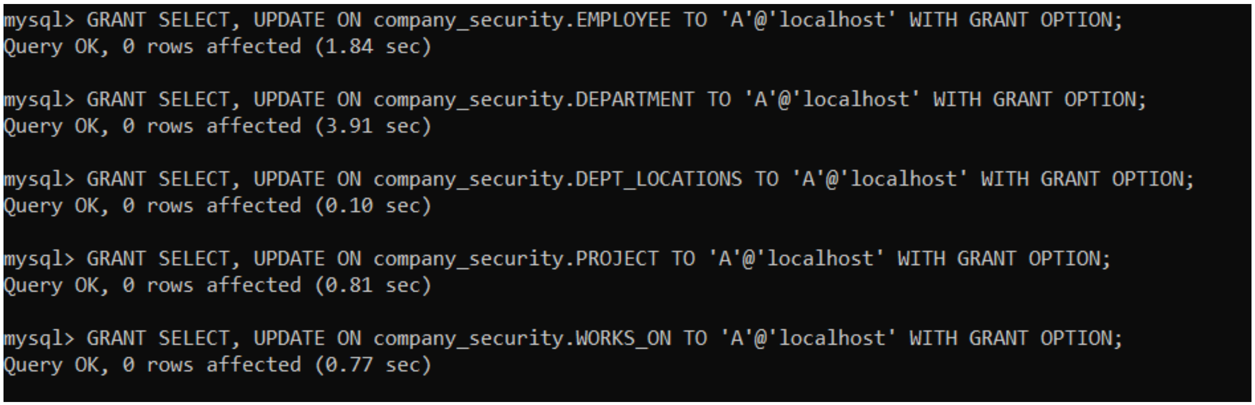
Assignment:

Consider the relational database schema provided. Suppose that all the relations were created by (and hence are owned by) user X, who wants to grant the following privileges to user accounts A, B, C, D, and E: Write SQL statements to grant these privileges. Use views where appropriate.

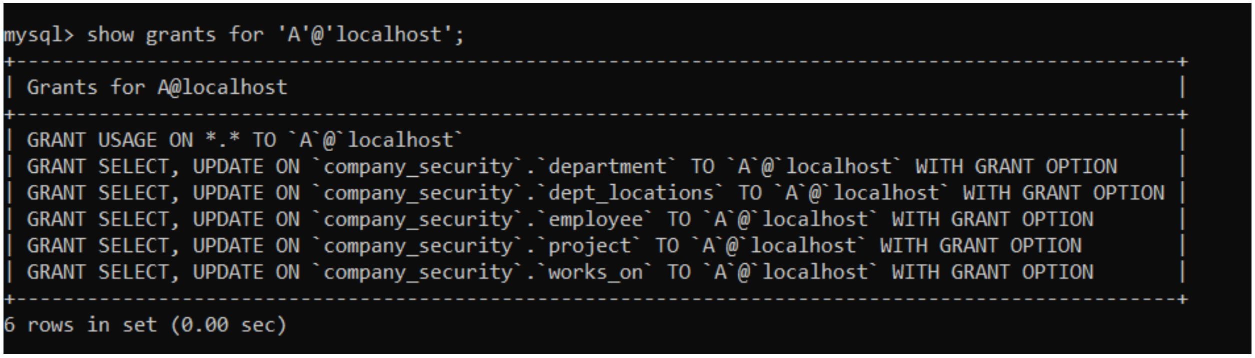


```
mysql> CREATE USER 'A'@'localhost' IDENTIFIED BY 'passwordA';
Query OK, 0 rows affected (0.37 sec)

mysql> CREATE USER 'B'@'localhost' IDENTIFIED BY 'passwordB';
Query OK, 0 rows affected (0.12 sec)

mysql> CREATE USER 'C'@'localhost' IDENTIFIED BY 'passwordC';
Query OK, 0 rows affected (15.55 sec)

mysql> CREATE USER 'D'@'localhost' IDENTIFIED BY 'passwordD';
Query OK, 0 rows affected (5.53 sec)

mysql> CREATE USER 'E'@'localhost' IDENTIFIED BY 'passwordE';
Query OK, 0 rows affected (10.33 sec)
```

I. **Account A can retrieve or modify any relation except DEPENDENT and can grant any of these privileges to other users.**

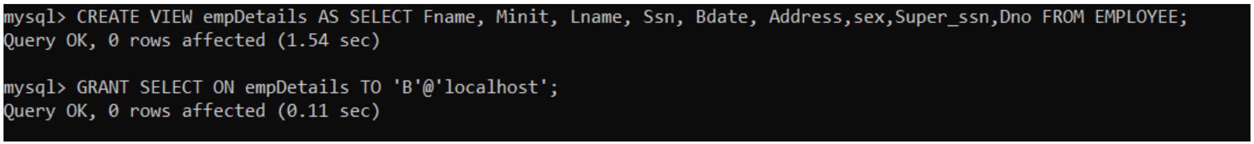


```
mysql> GRANT SELECT, UPDATE ON company_security.EMPLOYEE TO 'A'@'localhost' WITH GRANT OPTION;
Query OK, 0 rows affected (1.84 sec)

mysql> GRANT SELECT, UPDATE ON company_security.DEPARTMENT TO 'A'@'localhost' WITH GRANT OPTION;
Query OK, 0 rows affected (3.91 sec)

mysql> GRANT SELECT, UPDATE ON company_security.DEPT_LOCATIONS TO 'A'@'localhost' WITH GRANT OPTION;
Query OK, 0 rows affected (0.10 sec)

mysql> GRANT SELECT, UPDATE ON company_security.PROJECT TO 'A'@'localhost' WITH GRANT OPTION;
Query OK, 0 rows affected (0.81 sec)

mysql> GRANT SELECT, UPDATE ON company_security.WORKS_ON TO 'A'@'localhost' WITH GRANT OPTION;
Query OK, 0 rows affected (0.77 sec)
```

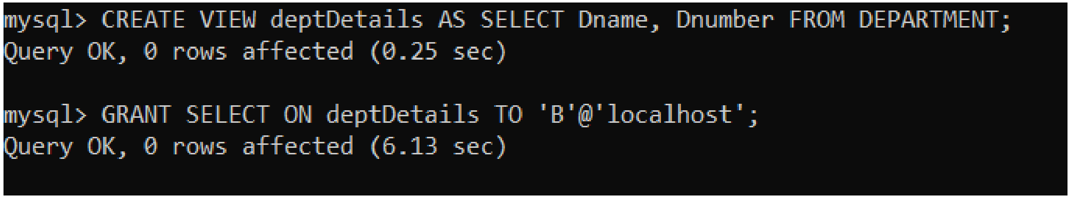


```
mysql> show grants for 'A'@'localhost';
+--------------------------------------------------------------------------------------------------+
| Grants for A@localhost                                                                           |
+--------------------------------------------------------------------------------------------------+
| GRANT USAGE ON *.* TO `A`@`localhost`                                                            |
| GRANT SELECT, UPDATE ON `company_security`.`department` TO `A`@`localhost` WITH GRANT OPTION     |
| GRANT SELECT, UPDATE ON `company_security`.`dept_locations` TO `A`@`localhost` WITH GRANT OPTION |
| GRANT SELECT, UPDATE ON `company_security`.`employee` TO `A`@`localhost` WITH GRANT OPTION       |
| GRANT SELECT, UPDATE ON `company_security`.`project` TO `A`@`localhost` WITH GRANT OPTION        |
| GRANT SELECT, UPDATE ON `company_security`.`works_on` TO `A`@`localhost` WITH GRANT OPTION       |
+--------------------------------------------------------------------------------------------------+
6 rows in set (0.00 sec)
```

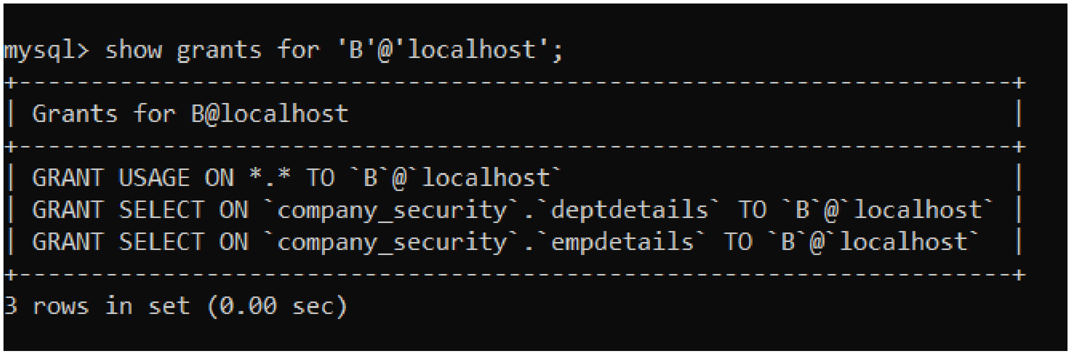
II. **Account B can retrieve all the attributes of EMPLOYEE and DEPARTMENT except for Salary, Mgr ssn, and Mgr start date.**



```
mysql> CREATE VIEW empDetails AS SELECT Fname, Minit, Lname, Ssn, Bdate, Address,sex,Super_ssn,Dno FROM EMPLOYEE;
Query OK, 0 rows affected (1.54 sec)

mysql> GRANT SELECT ON empDetails TO 'B'@'localhost';
Query OK, 0 rows affected (0.11 sec)
```

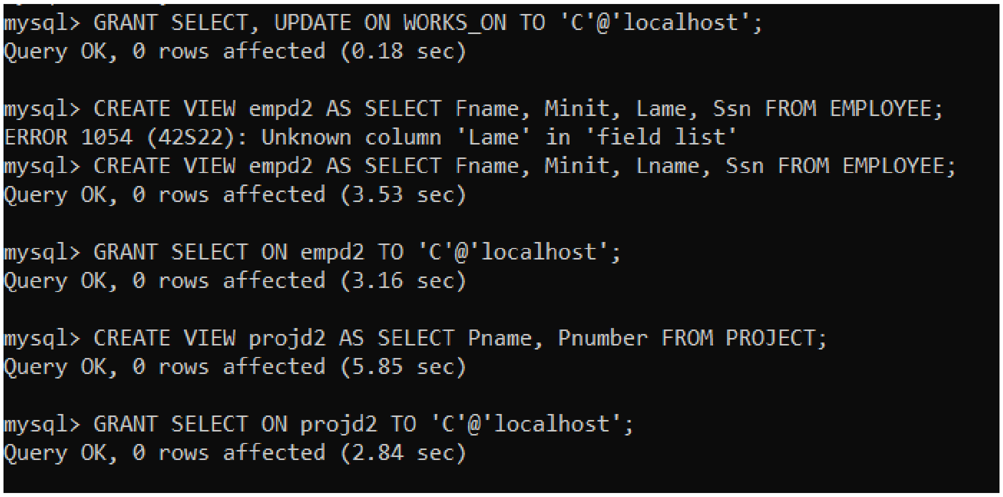


```
mysql> CREATE VIEW deptDetails AS SELECT Dname, Dnumber FROM DEPARTMENT;
Query OK, 0 rows affected (0.25 sec)

mysql> GRANT SELECT ON deptDetails TO 'B'@'localhost';
Query OK, 0 rows affected (6.13 sec)
```

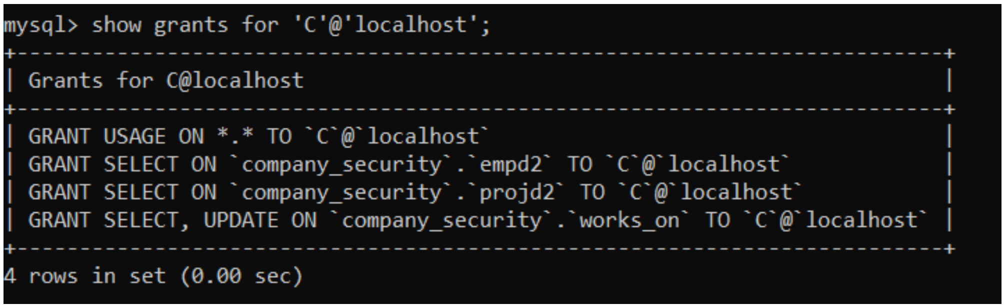


```
mysql> show grants for 'B'@'localhost';
+---------------------------------------------------------------------+
| Grants for B@localhost                                              |
+---------------------------------------------------------------------+
| GRANT USAGE ON *.* TO `B`@`localhost`                               |
| GRANT SELECT ON `company_security`.`deptdetails` TO `B`@`localhost` |
| GRANT SELECT ON `company_security`.`empdetails` TO `B`@`localhost`  |
+---------------------------------------------------------------------+
3 rows in set (0.00 sec)
```

III. Account C can retrieve or modify WORKS ON but can only retrieve the Fname, Minit, Lname, and Ssn attributes of EMPLOYEE and the Pname and Pnumber attributes of PROJECT.

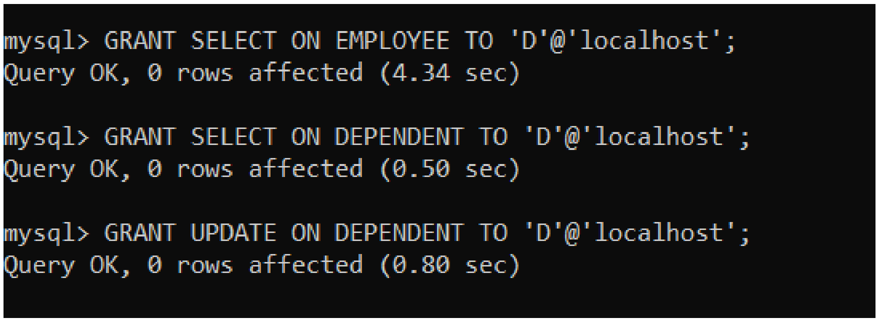


```
mysql> GRANT SELECT, UPDATE ON WORKS_ON TO 'C'@'localhost';
Query OK, 0 rows affected (0.18 sec)

mysql> CREATE VIEW empd2 AS SELECT Fname, Minit, Lame, Ssn FROM EMPLOYEE;
ERROR 1054 (42S22): Unknown column 'Lame' in 'field list'
mysql> CREATE VIEW empd2 AS SELECT Fname, Minit, Lname, Ssn FROM EMPLOYEE;
Query OK, 0 rows affected (3.53 sec)

mysql> GRANT SELECT ON empd2 TO 'C'@'localhost';
Query OK, 0 rows affected (3.16 sec)

mysql> CREATE VIEW projd2 AS SELECT Pname, Pnumber FROM PROJECT;
Query OK, 0 rows affected (5.85 sec)

mysql> GRANT SELECT ON projd2 TO 'C'@'localhost';
Query OK, 0 rows affected (2.84 sec)
```

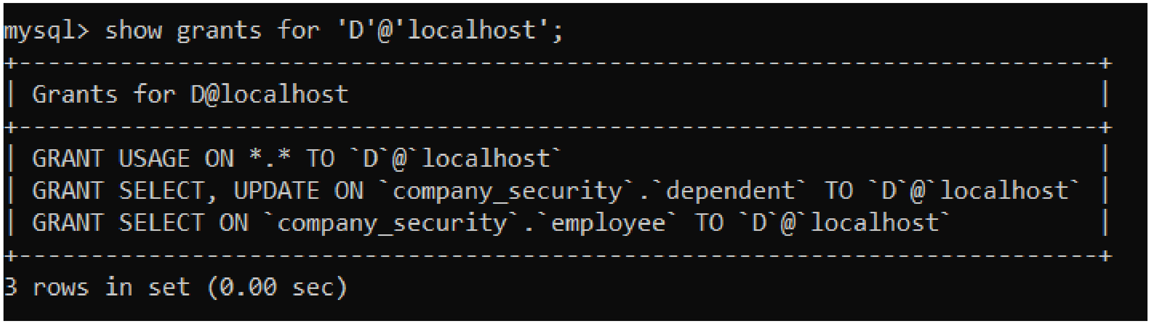


```
mysql> show grants for 'C'@'localhost';
+--------------------------------------------------------------------------+
| Grants for C@localhost                                                   |
+--------------------------------------------------------------------------+
| GRANT USAGE ON *.* TO `C`@`localhost`                                    |
| GRANT SELECT ON `company_security`.`empd2` TO `C`@`localhost`            |
| GRANT SELECT ON `company_security`.`projd2` TO `C`@`localhost`           |
| GRANT SELECT, UPDATE ON `company_security`.`works_on` TO `C`@`localhost` |
+--------------------------------------------------------------------------+
4 rows in set (0.00 sec)
```

IV. **Account D can retrieve any attribute of EMPLOYEE or DEPENDENT and can modify DEPENDENT.**

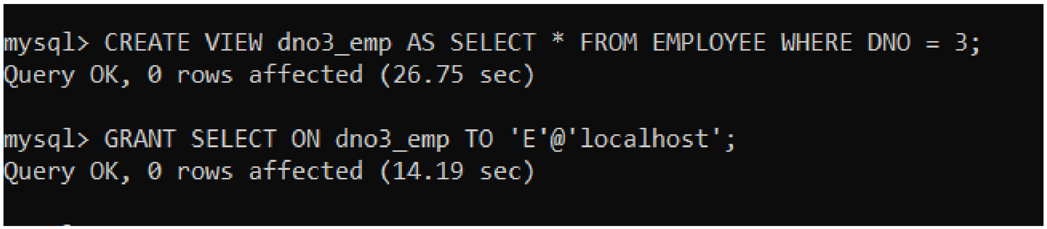


```
mysql> GRANT SELECT ON EMPLOYEE TO 'D'@'localhost';
Query OK, 0 rows affected (4.34 sec)

mysql> GRANT SELECT ON DEPENDENT TO 'D'@'localhost';
Query OK, 0 rows affected (0.50 sec)

mysql> GRANT UPDATE ON DEPENDENT TO 'D'@'localhost';
Query OK, 0 rows affected (0.80 sec)
```

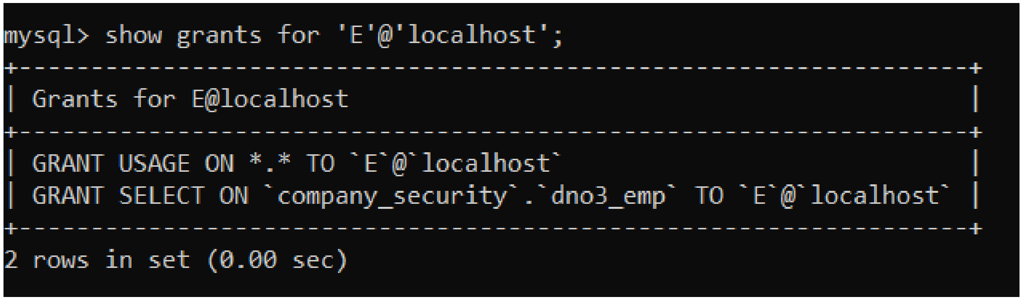


```
mysql> show grants for 'D'@'localhost';
+---------------------------------------------------------------------------+
| Grants for D@localhost                                                    |
+---------------------------------------------------------------------------+
| GRANT USAGE ON *.* TO `D`@`localhost`                                     |
| GRANT SELECT, UPDATE ON `company_security`.`dependent` TO `D`@`localhost` |
| GRANT SELECT ON `company_security`.`employee` TO `D`@`localhost`          |
+---------------------------------------------------------------------------+
3 rows in set (0.00 sec)
```

V. **Account E can retrieve any attribute of EMPLOYEE but only for EMPLOYEE tuples that have Dno = 3.**



```
mysql> CREATE VIEW dno3_emp AS SELECT * FROM EMPLOYEE WHERE DNO = 3;
Query OK, 0 rows affected (26.75 sec)

mysql> GRANT SELECT ON dno3_emp TO 'E'@'localhost';
Query OK, 0 rows affected (14.19 sec)
```



```
mysql> show grants for 'E'@'localhost';
+------------------------------------------------------------------+
| Grants for E@localhost                                           |
+------------------------------------------------------------------+
| GRANT USAGE ON *.* TO `E`@`localhost`                            |
| GRANT SELECT ON `company_security`.`dno3_emp` TO `E`@`localhost` |
+------------------------------------------------------------------+
2 rows in set (0.00 sec)
```