

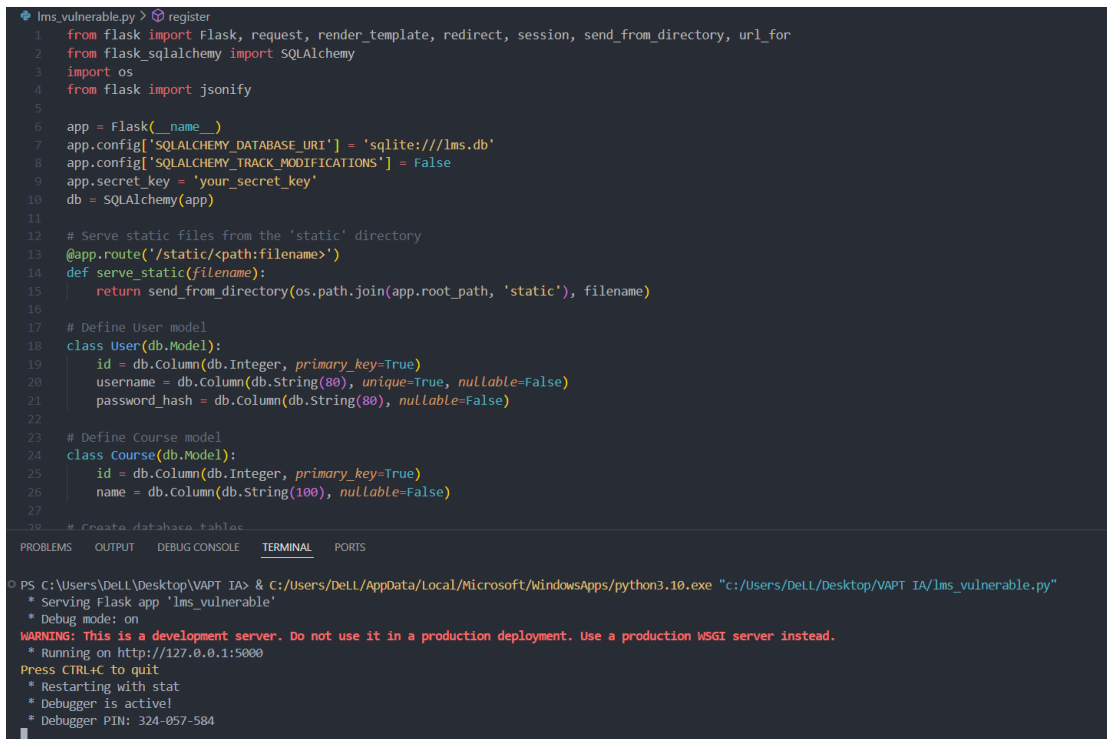
Name: Vishnav Tuli

Problem Statement: “rectify a Cryptographic Failures vulnerability in an Online Learning Management System, specifying the associated CWE: Weak Encoding for Password (CWE-261) and (CWE-862) Missing Authorization”

Implementation:

- Let us first look at the first vulnerability: Weak Encoding for Password (CWE-261)

1. We first start out flask application in the terminal



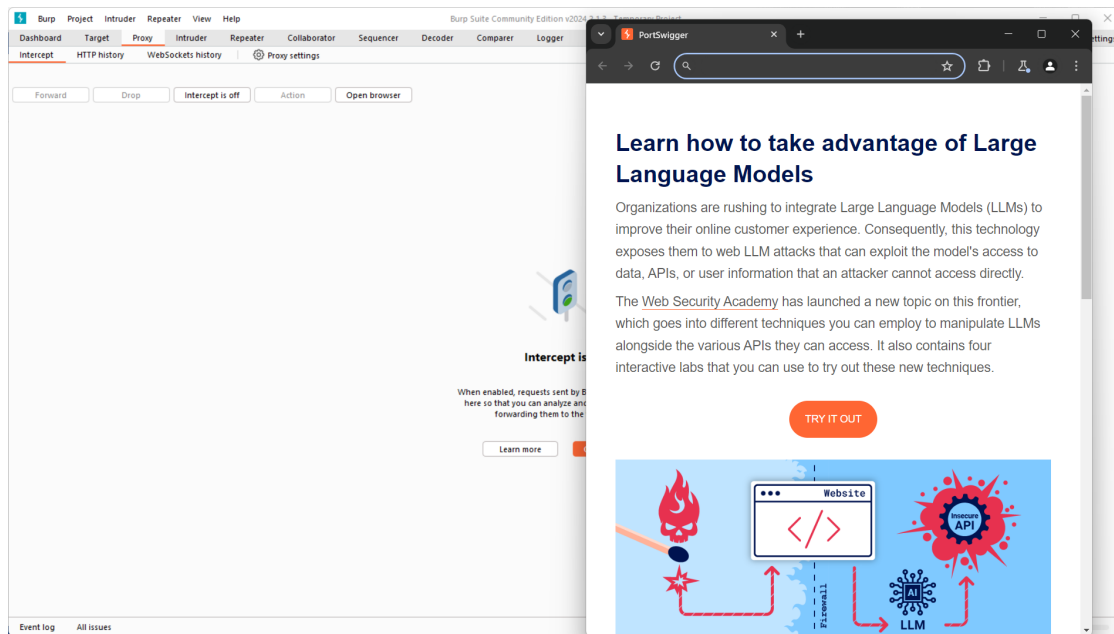
```
lms_vulnerable.py > register
1 from flask import Flask, request, render_template, redirect, session, send_from_directory, url_for
2 from flask_sqlalchemy import SQLAlchemy
3 import os
4 from flask import jsonify
5
6 app = Flask(__name__)
7 app.config['SQLALCHEMY_DATABASE_URI'] = 'sqlite:///lms.db'
8 app.config['SQLALCHEMY_TRACK_MODIFICATIONS'] = False
9 app.secret_key = 'your_secret_key'
10 db = SQLAlchemy(app)
11
12 # Serve static files from the 'static' directory
13 @app.route('/static/<path:filename>')
14 def serve_static(filename):
15     return send_from_directory(os.path.join(app.root_path, 'static'), filename)
16
17 # Define User model
18 class User(db.Model):
19     id = db.Column(db.Integer, primary_key=True)
20     username = db.Column(db.String(80), unique=True, nullable=False)
21     password_hash = db.Column(db.String(80), nullable=False)
22
23 # Define Course model
24 class Course(db.Model):
25     id = db.Column(db.Integer, primary_key=True)
26     name = db.Column(db.String(100), nullable=False)
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28 # Create database tables
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PROBLEMS OUTPUT DEBUG CONSOLE **TERMINAL** PORTS

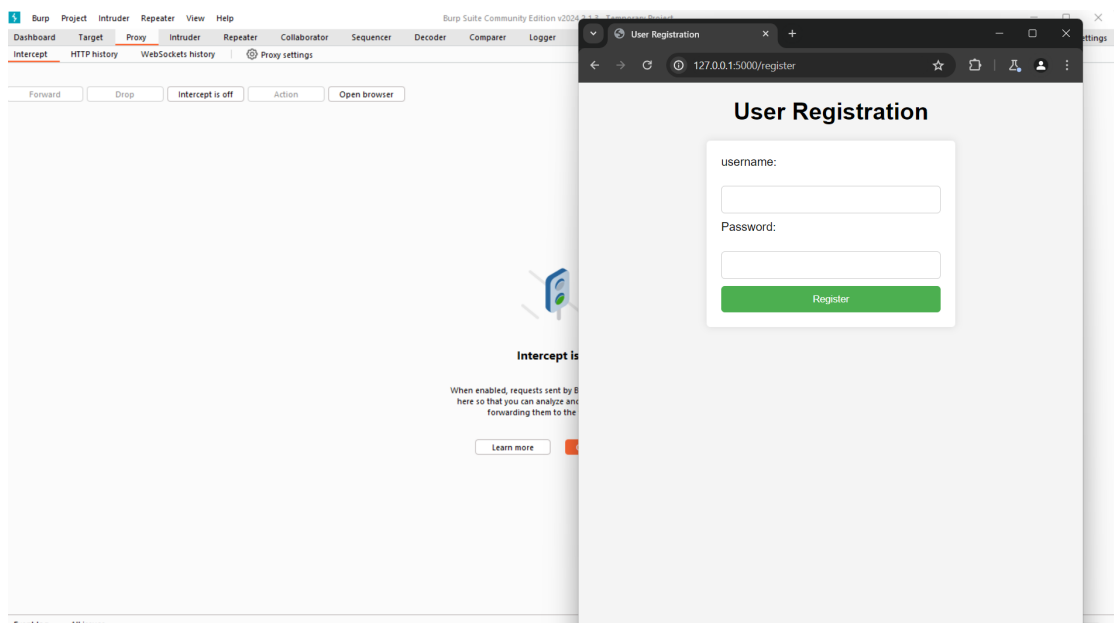
```
PS C:\Users\DeLL\Desktop\VAPT IA> & C:\Users\DeLL\AppData\Local\Microsoft\WindowsApps\python3.10.exe "c:/Users/DeLL/Desktop/VAPT IA/lms_vulnerable.py"
* Serving Flask app 'lms_vulnerable'
* Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on http://127.0.0.1:5000
Press CTRL+C to quit
* Restarting with stat
* Debugger is active!
* Debugger PIN: 324-057-584
```

As we can see our flask application is running on <http://127.0.0.1:5000>

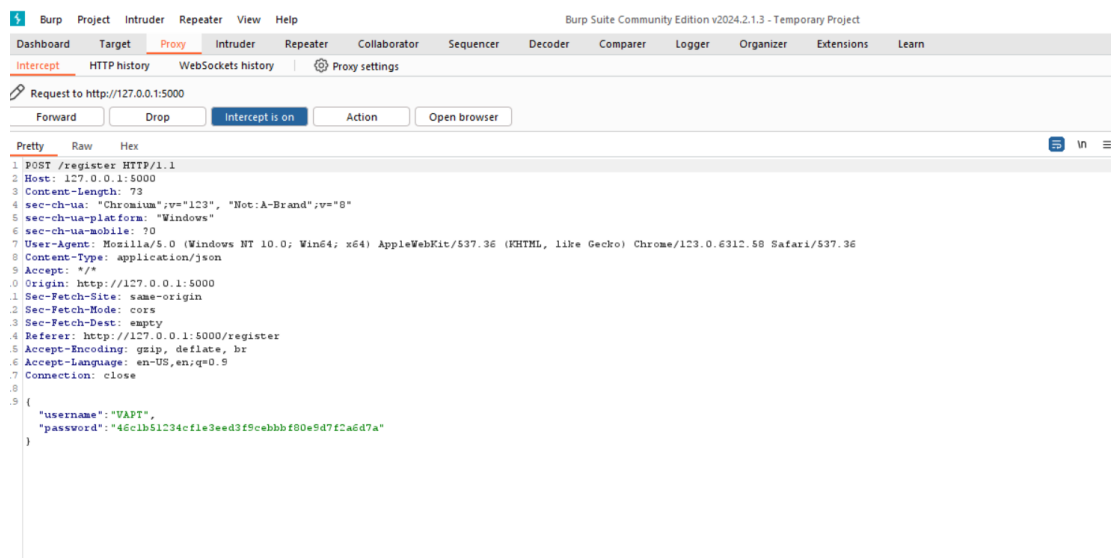
-
2. In the next step we open Burpsuite so that we can use its browser to run our website and intercept the requests and gain the credentials of the user.



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3. In the third step we open our website which is a learning management system and we go to the first page which is the register page where users can register themselves



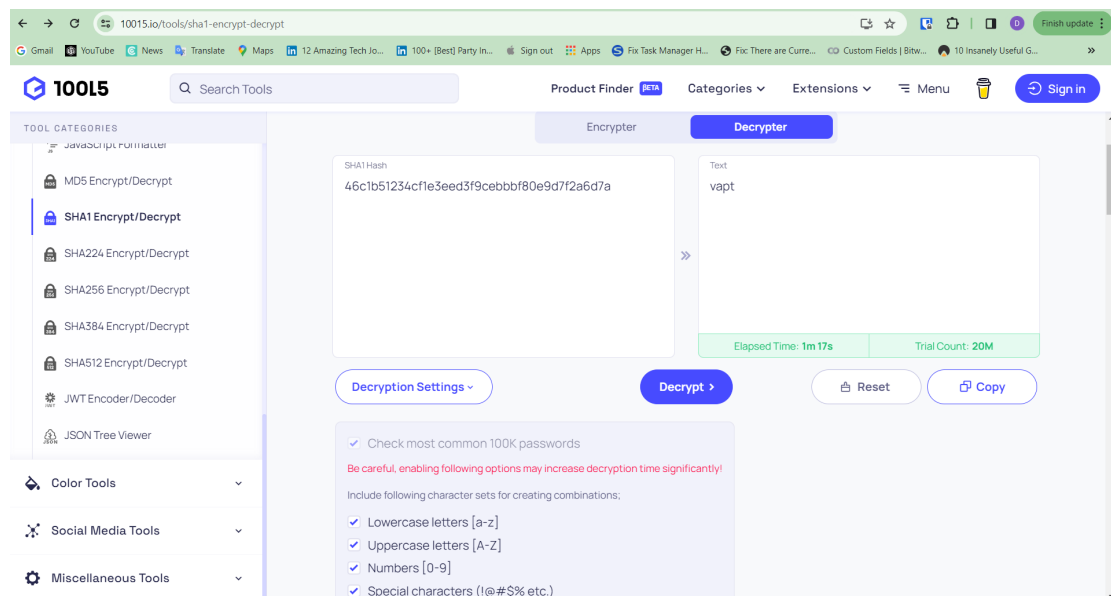
4. In this step we turn the intercept in the burpsuite on and then register a user.



As we can see as soon as we register a user when intercept is switched on we get the username and password the user entered. But the password we intercepted is hashed.

The password is hashed using SHA1 hashing too show the weak encoding vulnerability.

5. In this step we copy the SHA1 hashed password and upload it on 1005.io which is an online encryption/decryption site and see the time it takes to decrypt in real life

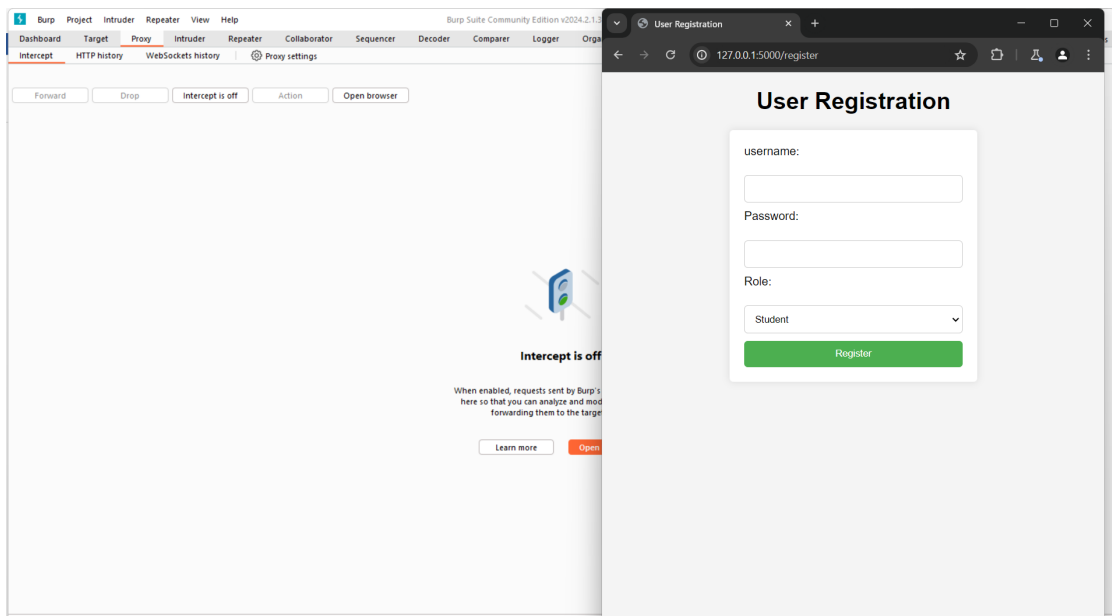


In this image you can see the decrypted password and the time it took to decrypt it which is 1min 17. Which is very less time to crack a hashed password.

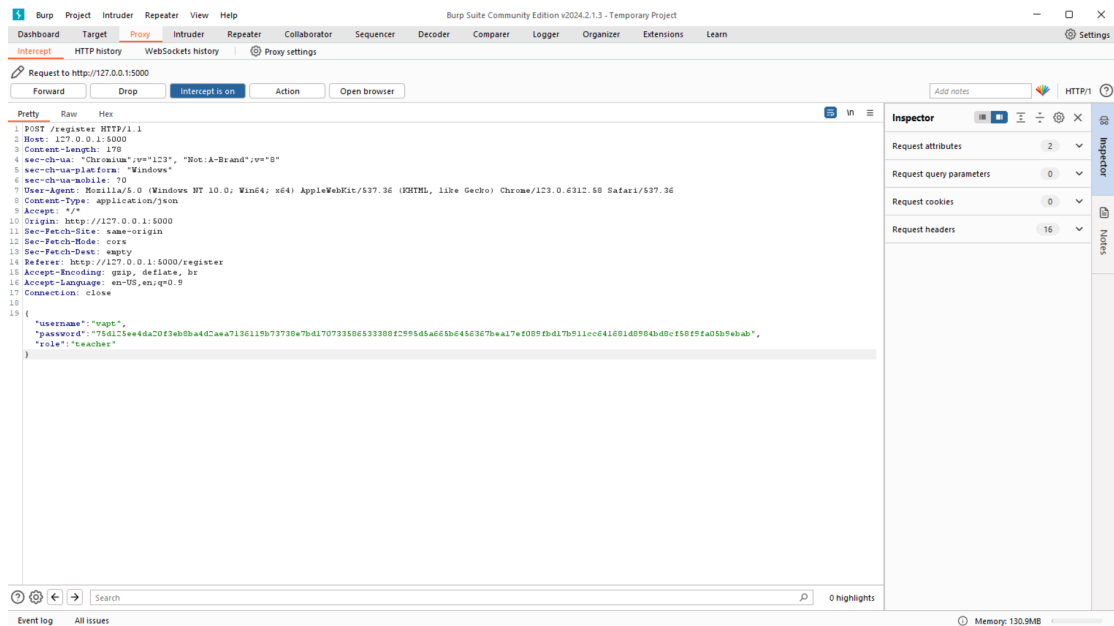
- Now we look at the rectification for this vulnerability: Weak Encoding for Password (CWE-261)

1. We follow the same 4 steps as we did above and capture the password. The images for those are given below

The screenshot shows a VS Code editor with a file explorer on the left containing a project named 'VAPT IA FINAL'. The main editor displays the file 'lms_vulnerable.py', which is a Flask application using SQLAlchemy for database management. The code includes imports for Flask, SQLAlchemy, and OS, and defines a Flask app with a SQLite database. It also defines a 'User' model with fields for id, username, password_hash, and role. The terminal at the bottom shows the command to run the application: 'C:\Users\DELL\Desktop\VAPT IA Final> C:\Users\DELL\AppData\Local\Microsoft\WindowsApps\python3.10.exe "c:\Users\DELL\Desktop\VAPT IA Final\lms_vulnerable.py"', and the output indicating the app is running on http://127.0.0.1:5000.



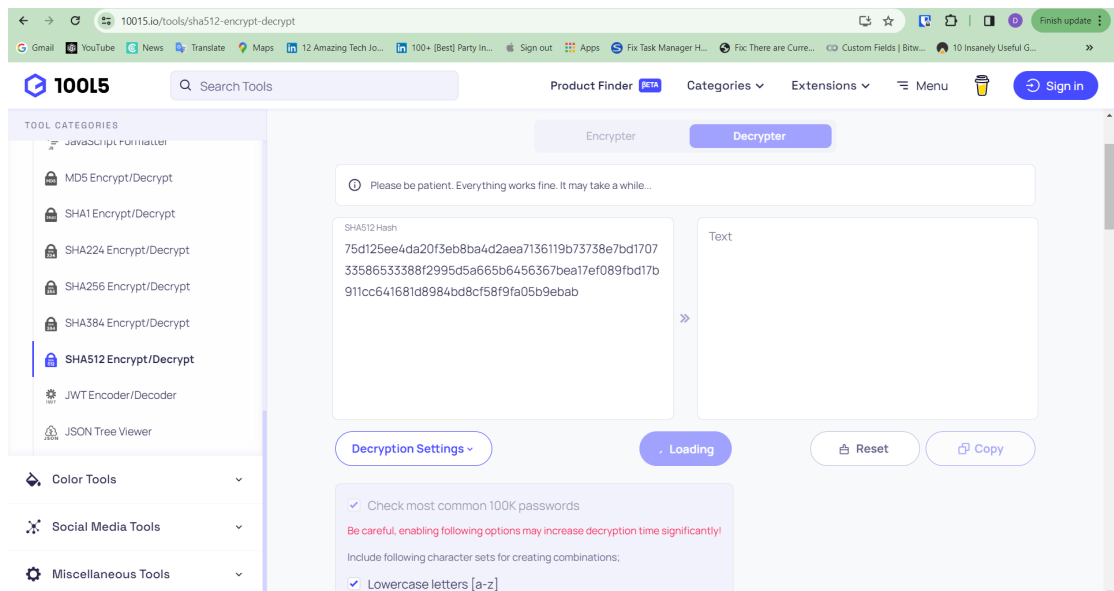
We register the user again using the same login username and password and intercept it.

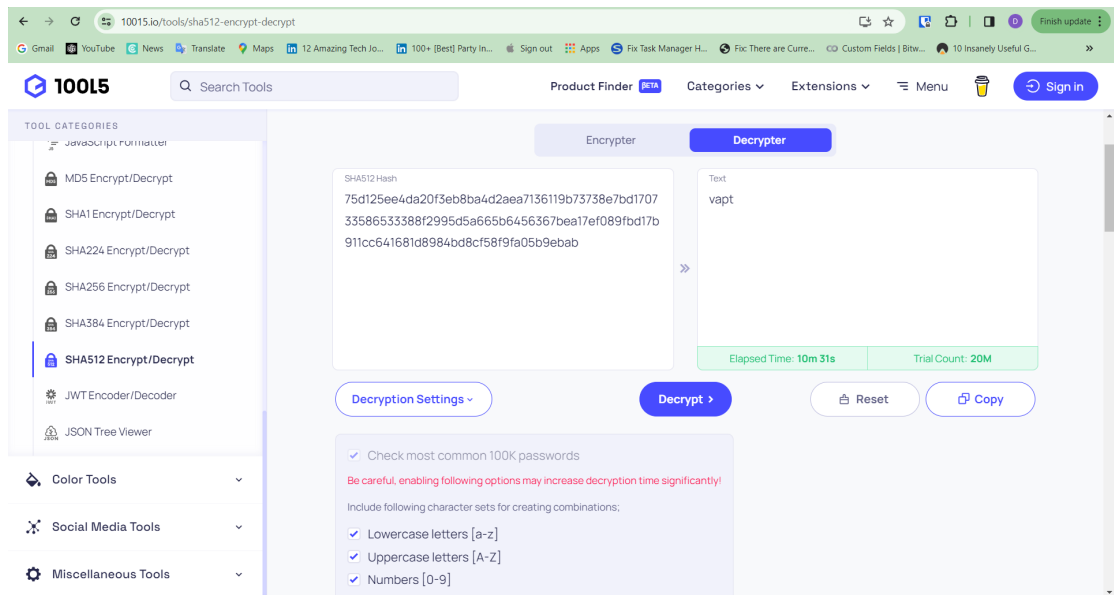


As we can see as soon as we register a user when intercept is switched on we get the username and password the user entered. But the password we intercepted is hashed.

The password is hashed using SHA512 hashing as a way to rectify the vulnerability.

- Here now we copy this SHA512 hashed password and upload it on 1005.io which is an online encryption/decryption site and see the time it takes to decrypt in real life.



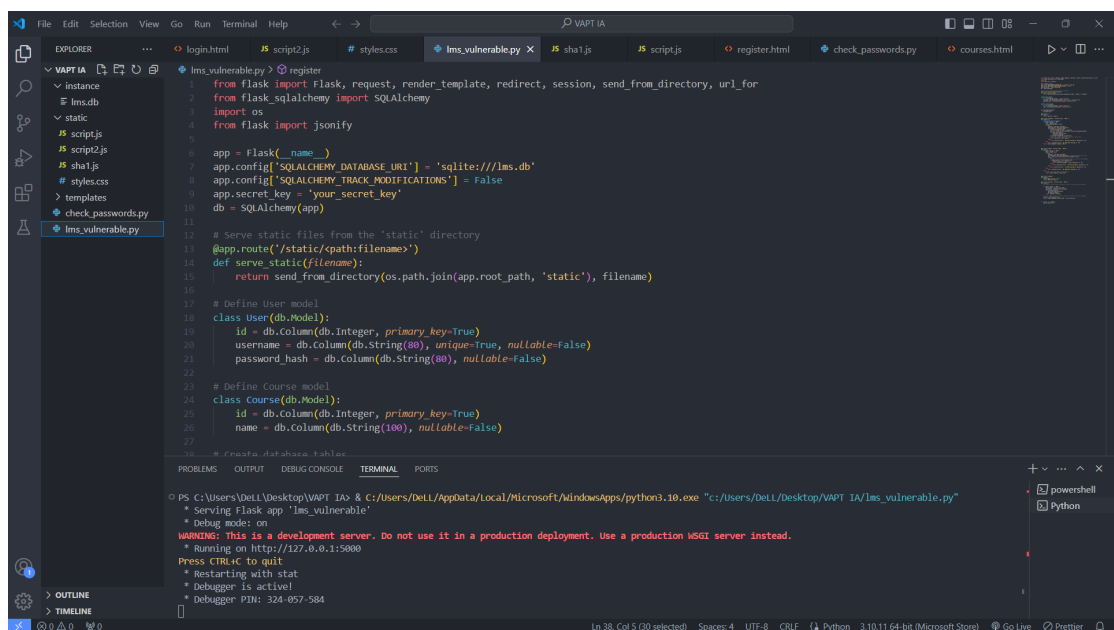


In this image you can see the decrypted password and the time it took to decrypt it which is 10min 31seconds.

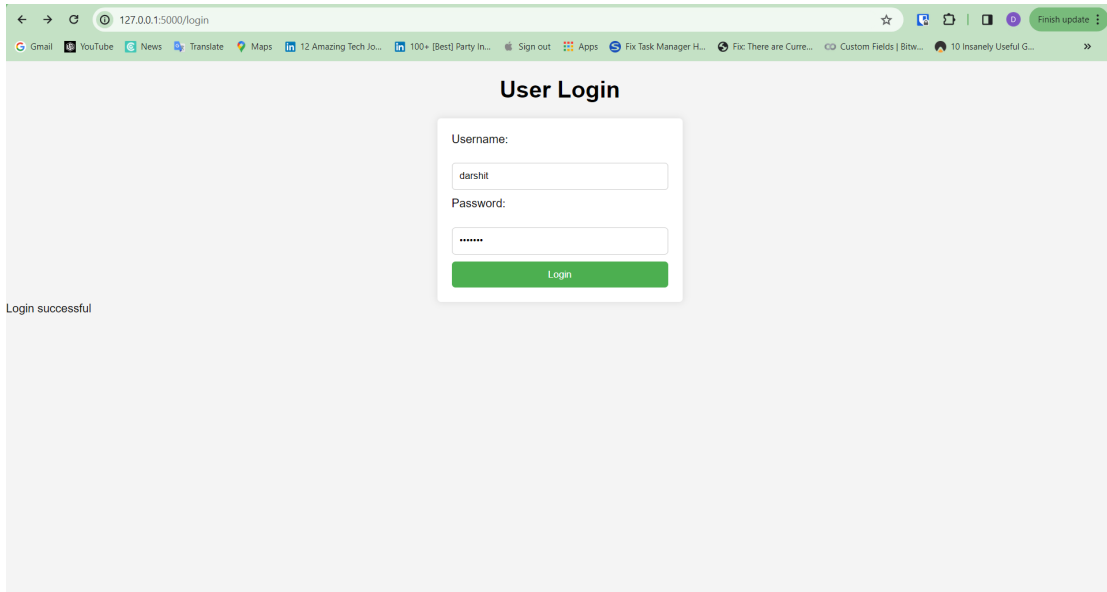
- So now by comparing the time taken to decrypt the two hashes we can state that the SHA512 is strong and SHA1 is weak hashing. So the weak encoding vulnerability was appropriately shown by using SHA1 hash and rectified appropriately by using the stronger SHA512 hash.

• Now let us look at the second vulnerability: (CWE-862) Missing Authorization

1. Let us first start our flask application in the terminal again

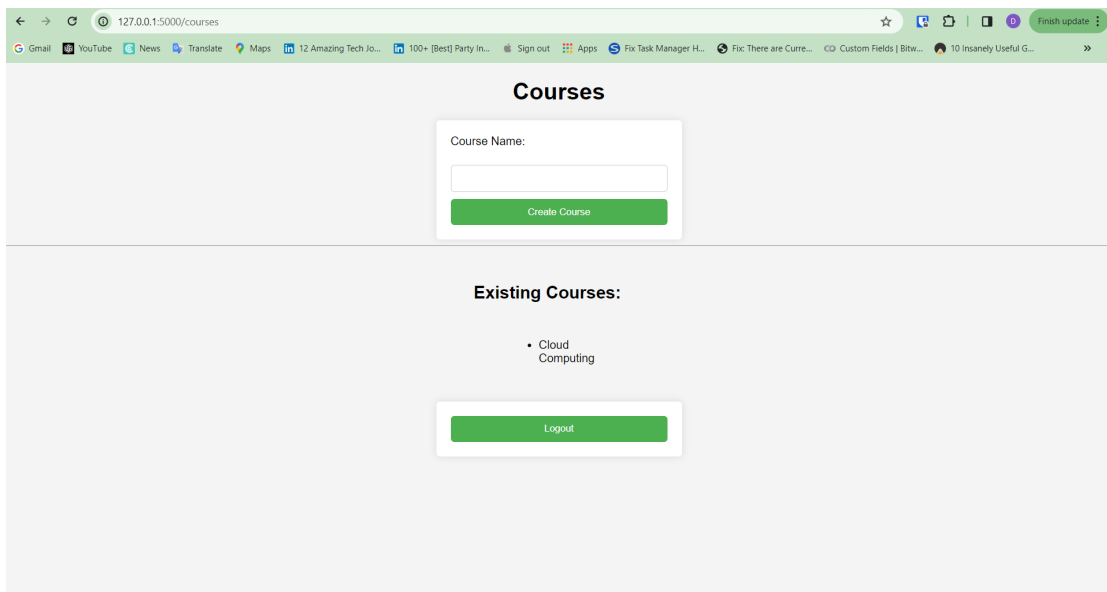


2. Now we go to the login page and login using the username and password.



The screenshot shows a web browser at the URL 127.0.0.1:5000/login. The page has a light gray background and a white login form in the center. The form is titled "User Login" and contains two input fields: "Username:" with the value "darshit" and "Password:" with masked characters "*****". Below the fields is a green "Login" button. To the left of the form, the text "Login successful" is displayed. The browser's address bar and tabs are visible at the top.

As soon as we login in successfully we are redirected to the courses page

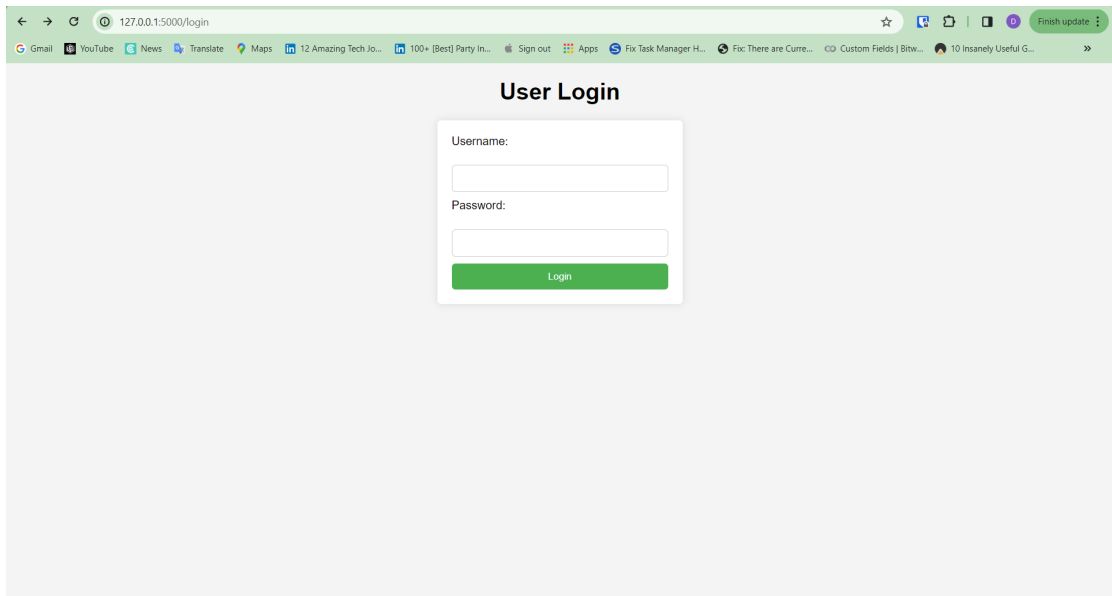


The screenshot shows a web browser at the URL 127.0.0.1:5000/courses. The page has a light gray background. At the top, the word "Courses" is centered. Below it is a white form with a "Course Name:" label and an empty input field, followed by a green "Create Course" button. Further down, the text "Existing Courses:" is centered, followed by a bulleted list containing "Cloud Computing". At the bottom, there is a green "Logout" button. The browser's address bar and tabs are visible at the top.

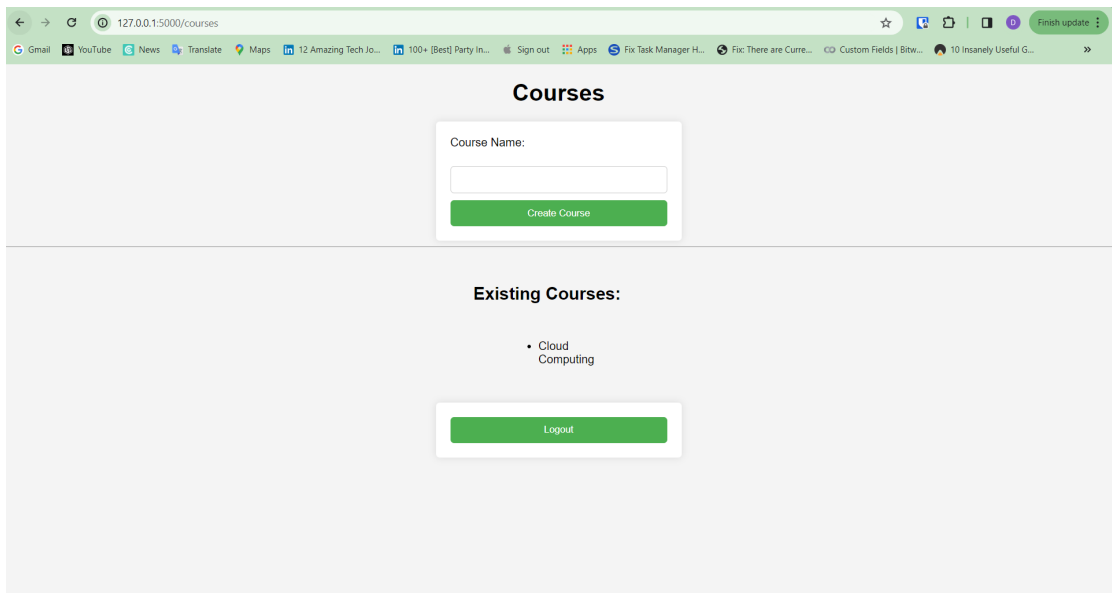
As you can see anyone who logs in successfully on login page is redirected to the courses page. On the courses page they can see the list of existing courses and also an option to add courses. Here the vulnerability is that anyone who logs in can add the courses and there is no authentication or authorization.

3. Also when we logout we are redirected to login page and technically should not be allowed back on the courses page but we can bypass the login process and directly proceed to the courses page without login in by typing courses in the url. This proves to be a big vulnerability of authorization as anyone who is not part of the organization can also make changes in the courses page.

Here is a screenshot of me not login in but directly accessing the courses page:



The screenshot shows a web browser window with the address bar displaying '127.0.0.1:5000/login'. The page title is 'User Login'. It features a login form with two input fields: 'Username:' and 'Password:'. Below these fields is a green 'Login' button. The browser's address bar shows several tabs, including 'Gmail', 'YouTube', 'News', 'Translate', 'Maps', '12 Amazing Tech Jo...', '100+ (Best) Party In...', 'Sign out', 'Apps', 'Fix Task Manager H...', 'Fix: There are Curre...', 'Custom Fields | Bitw...', and '10 Insanely Useful G...'. A 'Finish update' button is visible in the top right corner of the browser window.

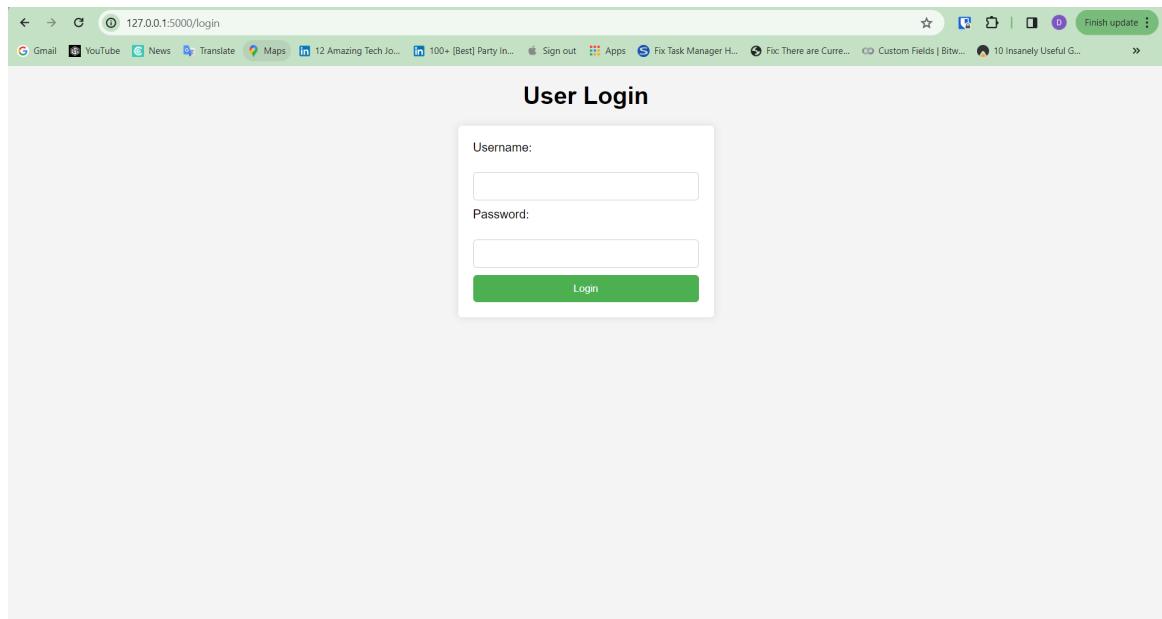


The screenshot shows a web browser window with the address bar displaying '127.0.0.1:5000/courses'. The page title is 'Courses'. It features a form with a 'Course Name:' label and an input field. Below the input field is a green 'Create Course' button. Below this form, there is a section titled 'Existing Courses:' which contains a bulleted list with the item '• Cloud Computing'. At the bottom of the page, there is a green 'Logout' button. The browser's address bar shows the same tabs as the previous screenshot, and a 'Finish update' button is visible in the top right corner.

So these are all the missing authorization vulnerability in our learning management system.

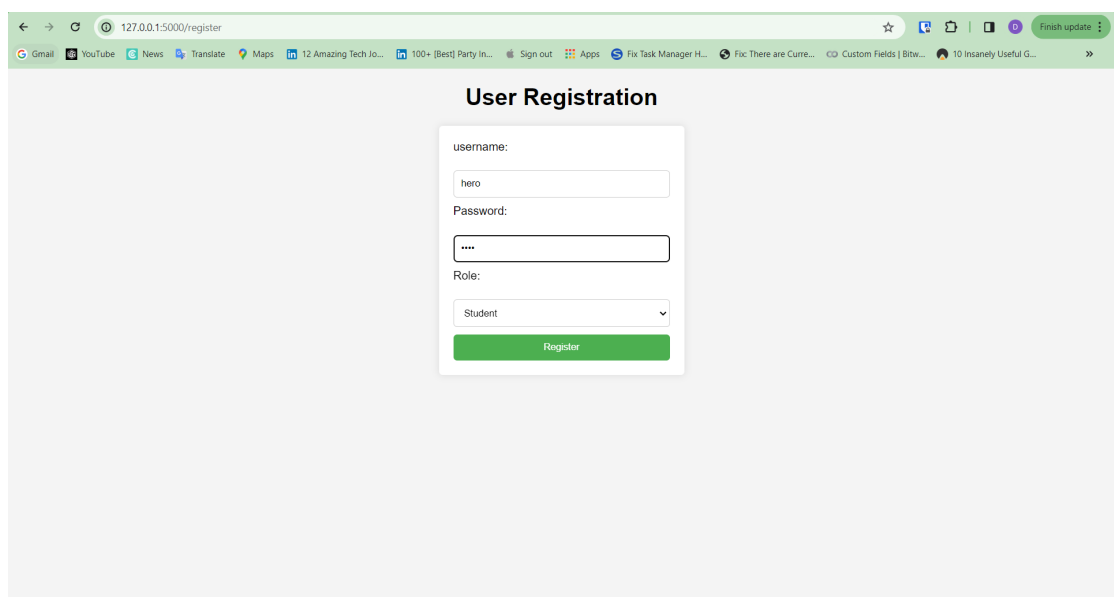
- **Now we look at the rectification for this vulnerability: (CWE-862) Missing Authorization**
1. So the starting steps remain the same we start the flask application.


```
File Edit Selection View Go Run Terminal Help
VAPT IA Final
lms_vulnerable.py x courses.html register.html styles.css script.js
VAPT IA FINAL
instance
lms.db
static
script.js
sha512.js
styles.css
templates
courses.html
login.html
register.html
check_passwords.py
lms_vulnerable.py
lms_vulnerable.py
1 from flask import Flask, request, render_template, request, session, send_from_directory, url_for
2 from flask_sqlalchemy import SQLAlchemy
3 import os
4 from flask import jsonify
5
6 app = Flask(__name__)
7 app.config['SQLALCHEMY_DATABASE_URI'] = 'sqlite:///lms.db'
8 app.config['SQLALCHEMY_TRACK_MODIFICATIONS'] = False
9 app.secret_key = 'your_secret_key'
10 db = SQLAlchemy(app)
11
12 # Serve static files from the 'static' directory
13 @app.route("/static/<path:filename>")
14 def serve_static(filename):
15     return send_from_directory(os.path.join(app.root_path, 'static'), filename)
16
17 # Define User model
18 class User(db.Model):
19     id = db.Column(db.Integer, primary_key=True)
20     username = db.Column(db.String(80), unique=True, nullable=False)
21     password_hash = db.Column(db.String(80), nullable=False)
22     role = db.Column(db.String(10), nullable=False, default='student') # Default role is 'student'
23
24 # Define Course model
25 class Course(db.Model):
26     id = db.Column(db.Integer, primary_key=True)
27     name = db.Column(db.String(100), nullable=False)
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So as we can see when we try to directly access the courses page without logging in, we are redirected to the login page automatically. So here we solve this vulnerability and no one from outside can access our learning management system.

3. Now we go to the register page



As we can see here now we have added a new field of role where users can select while registering if they are teachers or students and based on that after logging in they will get different accesses.

Here we register a student named hero and then in next step we login using these credentials.

4. Login

127.0.0.1:5000/login

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User Login

Username:

hero

Password:

Login

Now when we login using these credentials we are taken to the courses page

5.

127.0.0.1:5000/courses

Google Gmail YouTube News Translate Maps 12 Amazing Tech Jo... 100+ (Best) Party In... Sign out Apps Fix Task Manager H... Fix: There are Curre... Custom Fields | Bitw... 10 Insanely Useful G... Finish update

Courses

Existing Courses:

Logout

In this as we can see now there is no option of adding courses as our code checks if the user is a student or a teacher and for a student it can only view the list of courses and not add courses. Here the existing courses is empty as there are no courses added yet.

5. Now in this step we register a new user with role teacher and login using credentials of a teacher and we see how the courses page is different

127.0.0.1:5000/register

User Registration

username:

darvish

Password:

.....

Role:

Teacher

Register

127.0.0.1:5000/login

User Login

Username:

darvish

Password:

.....

Login

Login successful

127.0.0.1:5000/courses

Courses

Course Name:

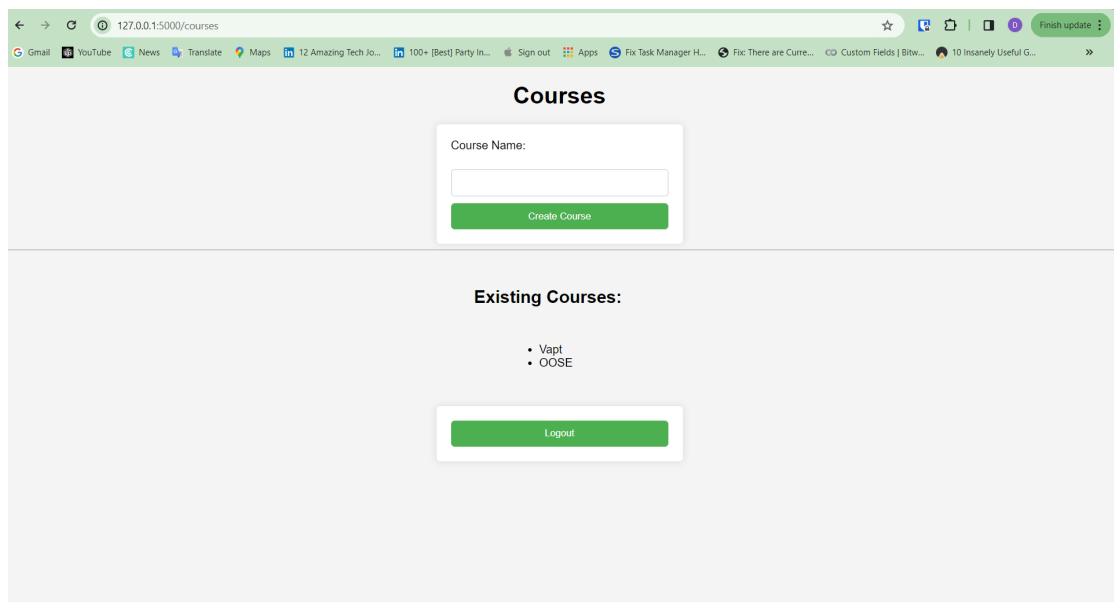
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Create Course

Existing Courses:

- Vapt

Logout



As you can see here the user got the option to add a new course as he is a teacher.

- **So we can state that the Implementation of authentication mechanisms ensures that only authenticated users can access sensitive areas of the LMS and all the vulnerabilities have been rectified.**