Web Application Security Analysis with Open-Source Tools

Objective : Conduct a detailed security analysis of a web application using open-source tools to identify and address security flaws. This task will give us hands-on experience with web application security testing.

Skills : Basic Web Security, Vulnerability Analysis, Risk Mitigation

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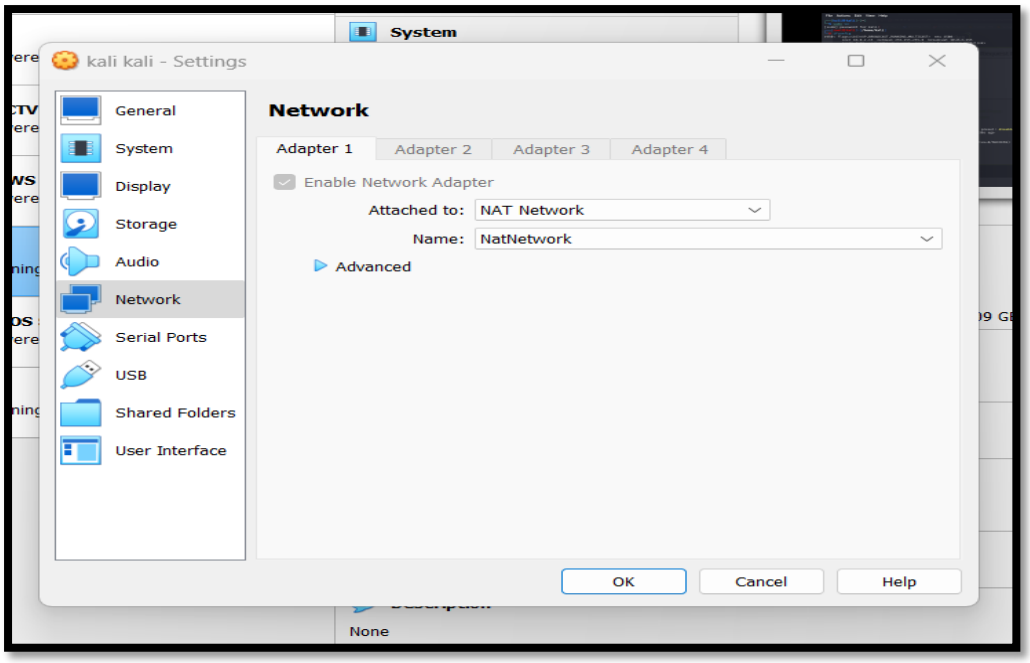
Tools and Methods Used :

- **DVWA (Damn Vulnerable Web Application):** A web application specifically designed to test and understand security vulnerabilities. It provides several challenges involving common web application vulnerabilities.
- **Metasploitable2 VM :** Used for exploitation and testing of vulnerabilities.
- **OWASP ZAP (Zed Attack Proxy):** A tool for scanning web applications for security issues. It helps in identifying vulnerabilities like SQL Injection, XSS, and CSRF.
- **Kali Linux:** A penetration testing operating system that includes tools like OWASP ZAP and Metasploit for security testing.

➢ Steps taken to complete the task

1. Setup DVWA (Damn Vulnerable Web Application)

1. **Open Kali Linux:**
    - Boot up your Kali Linux machine.
    - Set Network To NAT network.

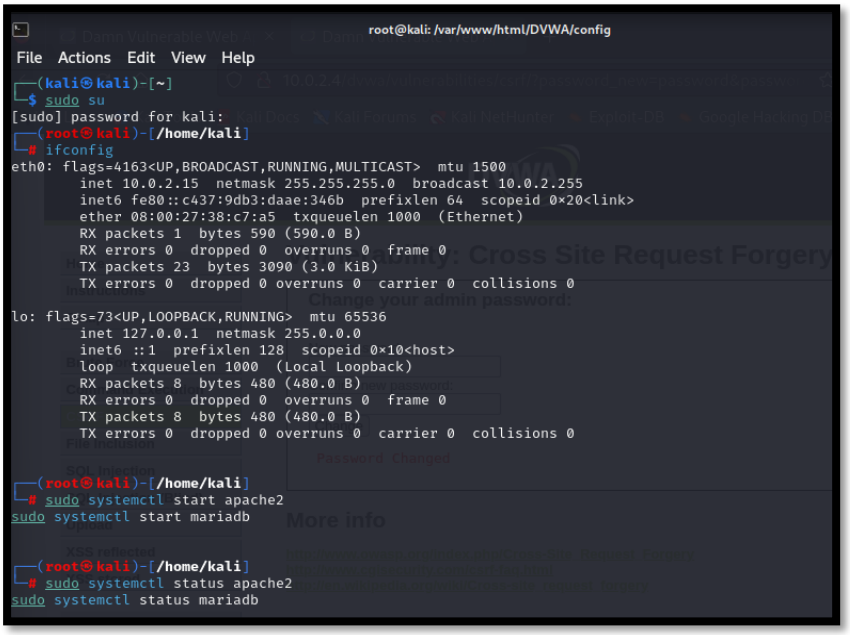


2. **Start Apache Server:**
   - Start the Apache service to host the DVWA:

     sudo service apache2 start

   - Ensure that Apache is running by checking its status:

     sudo systemctl start apache2
     sudo systemctl start mariadb



Step 1: Download Metasploitable2

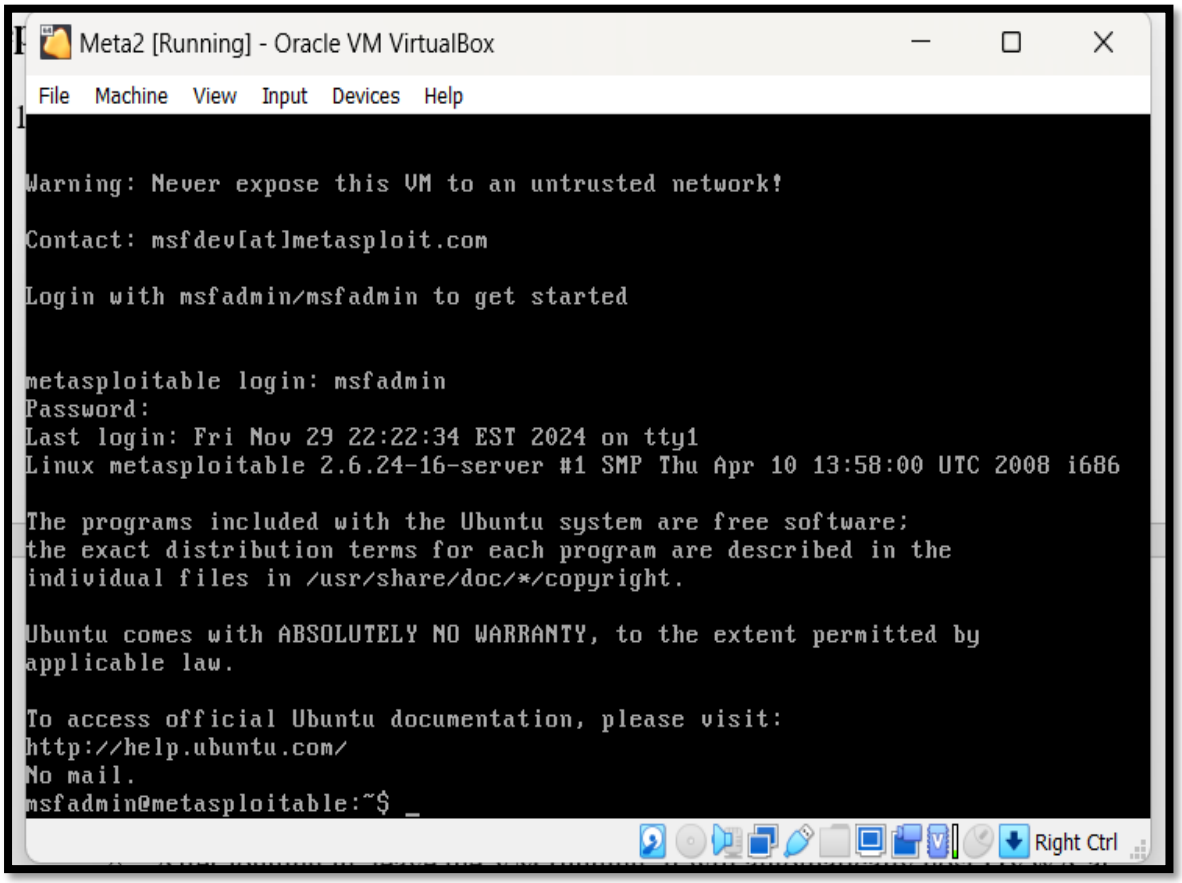
1. **Download the Metasploitable2 VM** from Rapid7's official site.
2. Import the VM into VirtualBox or VMware:
   - Open your virtualization software.
   - Click **File** > **Import Appliance** (or similar) and select the downloaded Metasploitable2 .ova file.
   - Follow the instructions to import the VM.

Step 2: Start Metasploitable2 and Kali Linux VMs

1. **Start Metasploitable2:**
   - Launch Metasploitable2 in your virtualization software.
   - Log in using the following credentials:

     Username: msfadmin
     Password: msfadmin

   - After logging in, leave the VM running. It will automatically host DVWA at its IP address.



2. **Start Kali Linux:**
   - Launch your Kali Linux VM.
   - Ensure both Kali Linux and Metasploitable2 are on the **same network** (e.g., using **NAT Network** in VirtualBox/VMware settings).

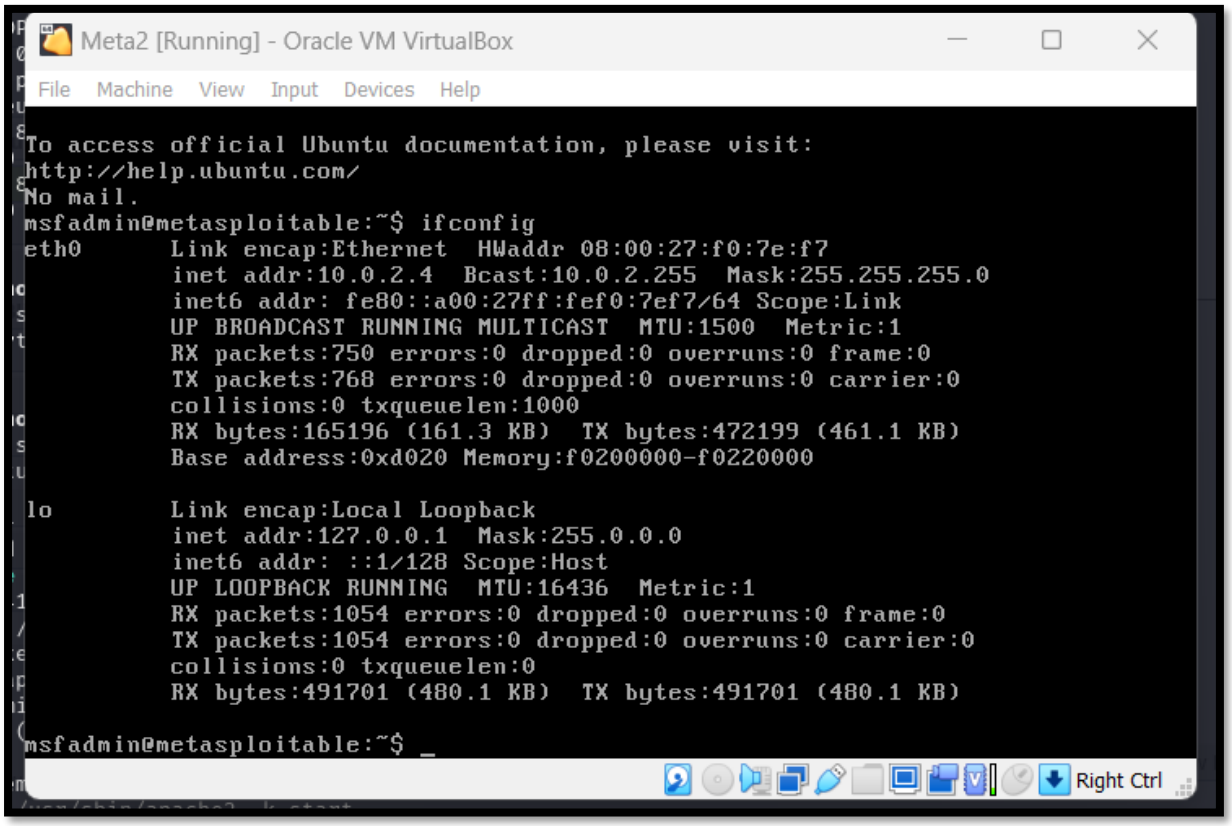
Step 3: Find Metasploitable2's IP Address

1. In Metasploitable2, check the IP address by running:

   ifconfig

   Look for the IP address under eth0 (e.g 10.0.2.4).

2. Make a note of this IP address, as it will be used to access DVWA from Kali Linux.



Step 4: Access DVWA from Kali Linux

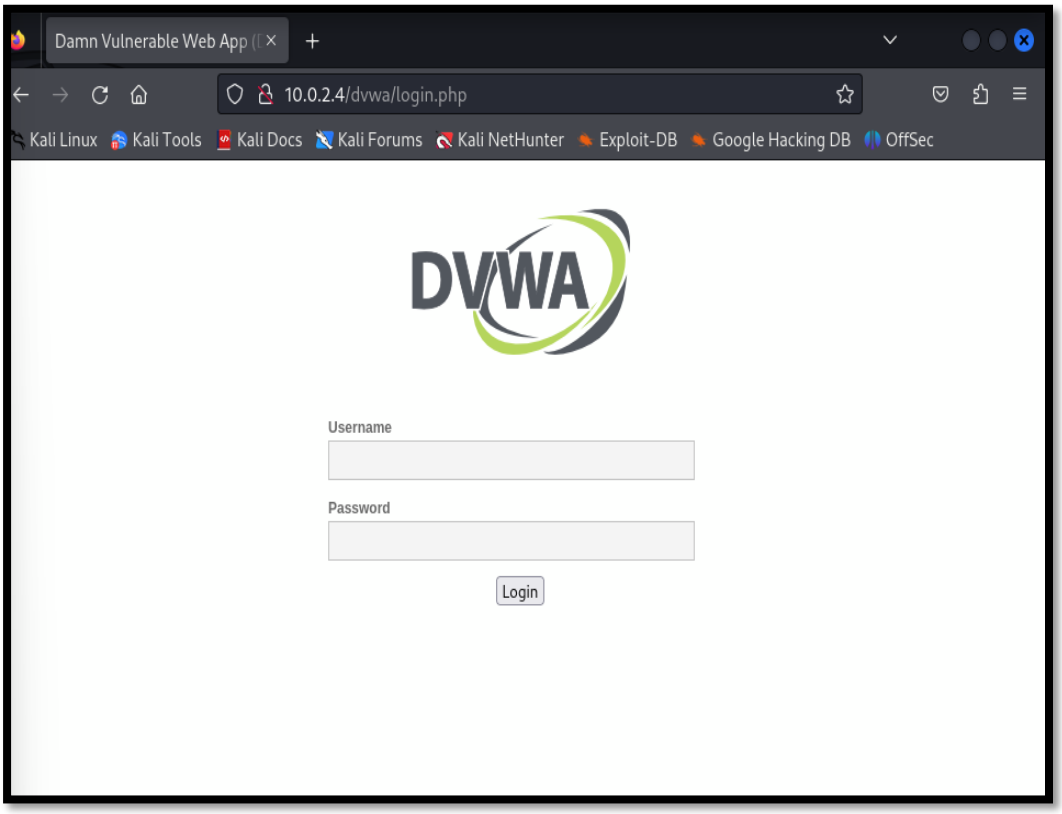
1. Open **Firefox** or any browser in Kali Linux.

2. Navigate to the DVWA web interface by entering the following in the address bar:

   http://<Metasploitable2-IP>/dvwa

   Example:

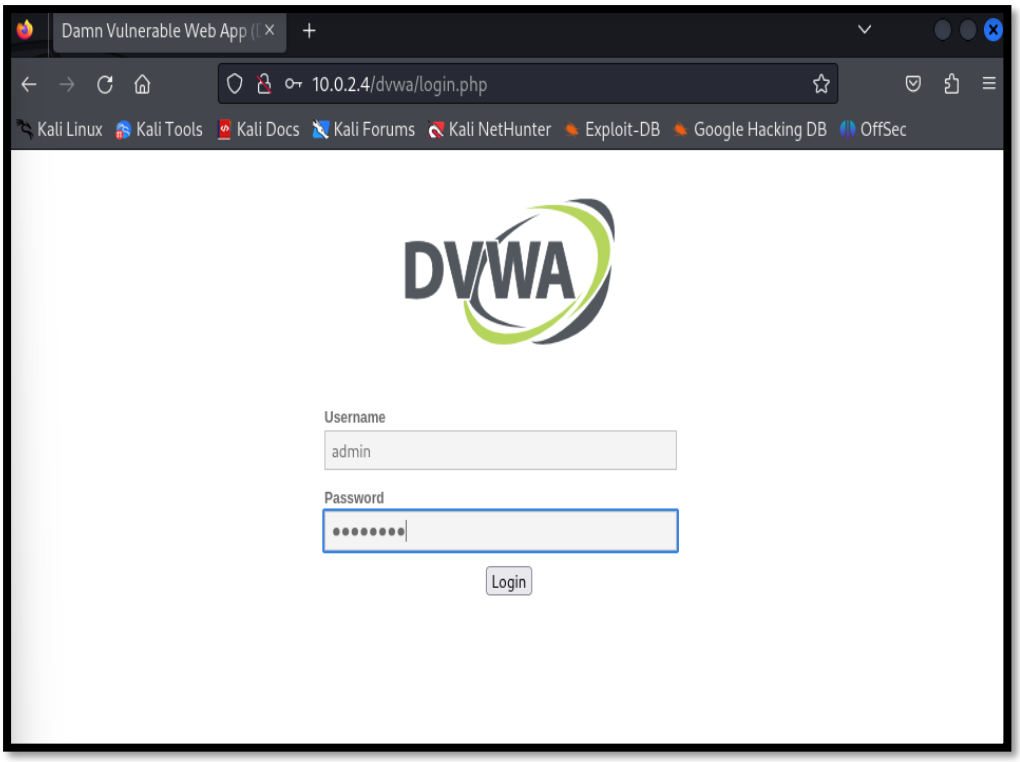
   http://10.0.2.4/dvwa



Step 5: Log In to DVWA

1. Use the default credentials to log in:

   Username: admin
   Password: password



2. Once logged in, you will see the **DVWA dashboard**.

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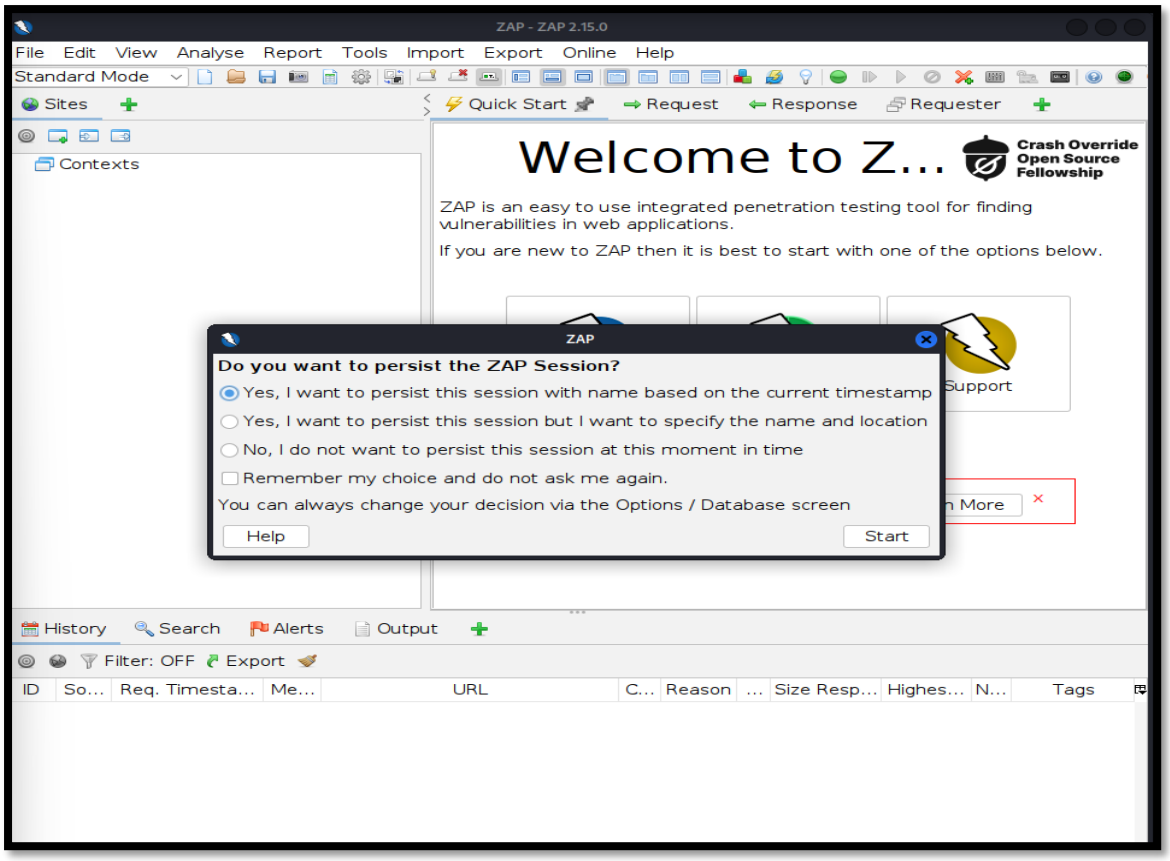
2. Perform Vulnerability Analysis Using OWASP ZAP

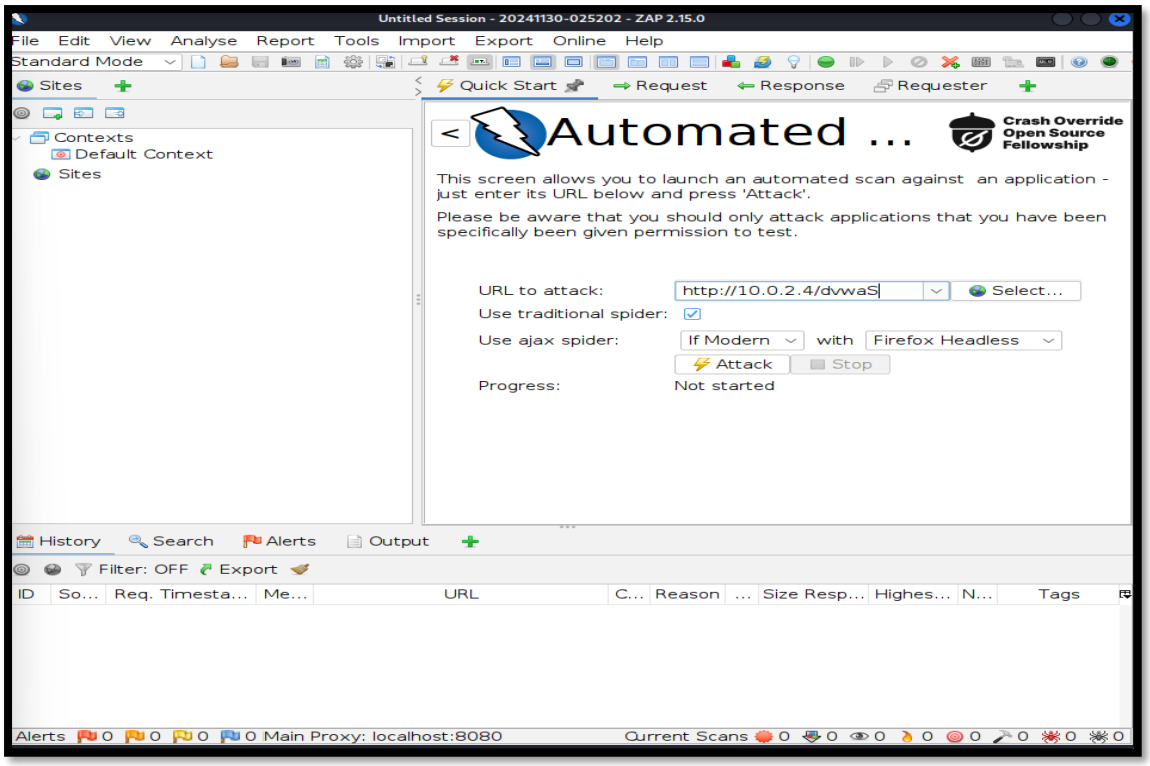
1. **Launch OWASP ZAP:**
   - Open another terminal window in Kali Linux.
   - Start OWASP ZAP by typing:

     zaproxy

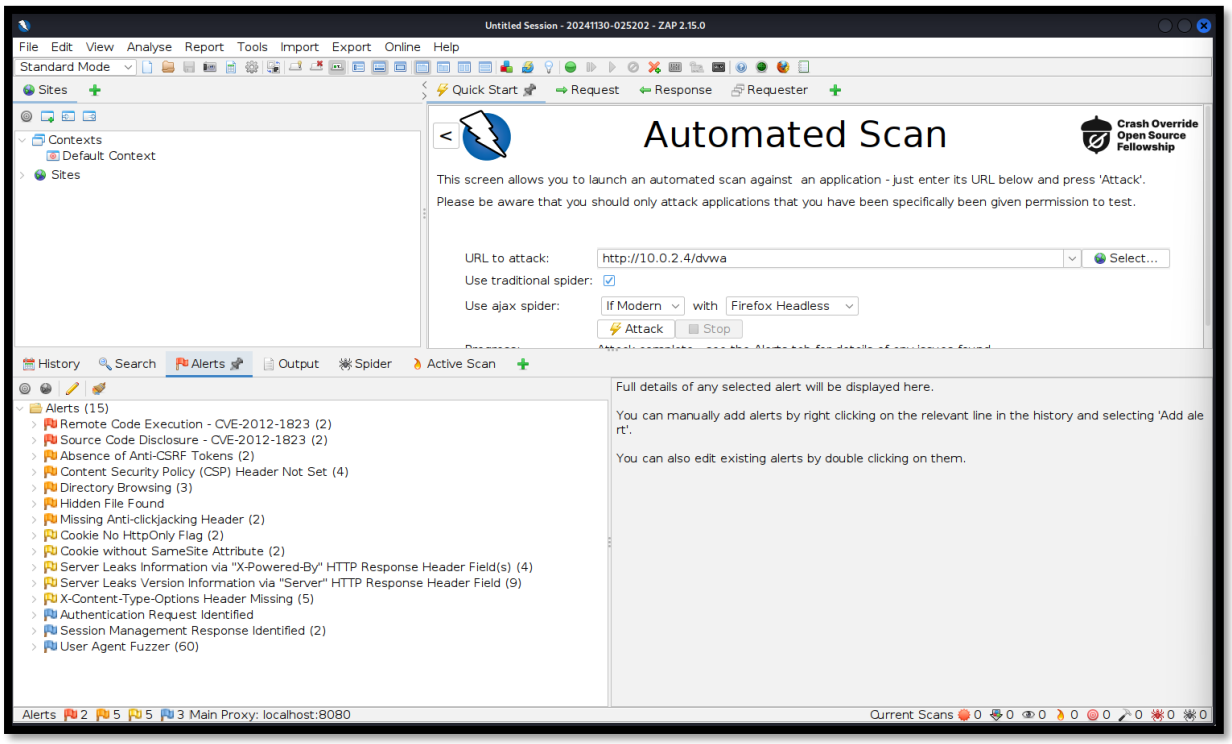
   - The OWASP ZAP GUI should open.



2. **Configure ZAP for Scanning:**
   - In ZAP, click on **"Quick Start"** and select **"Automated Scan"**.
   - Enter http://localhost/dvwa as the target URL and click **"Start Scan"**.



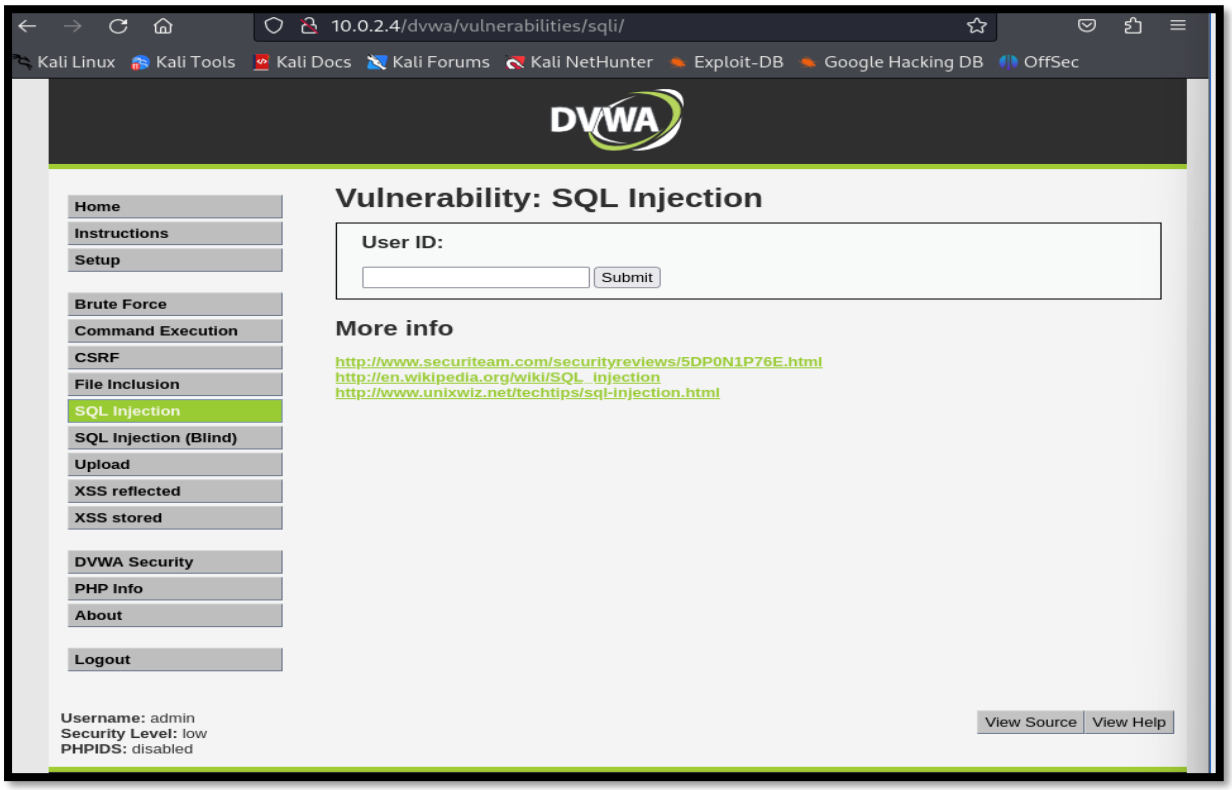
3. **Scan Results:**
   - After the scan is complete, go to the **Alerts** tab to see the vulnerabilities ZAP has identified.
   - ZAP will flag potential issues such as **SQL Injection**, **XSS**, and **CSRF** based on its analysis.



3. Exploit Vulnerabilities Manually

A. SQL Injection (SQLi)

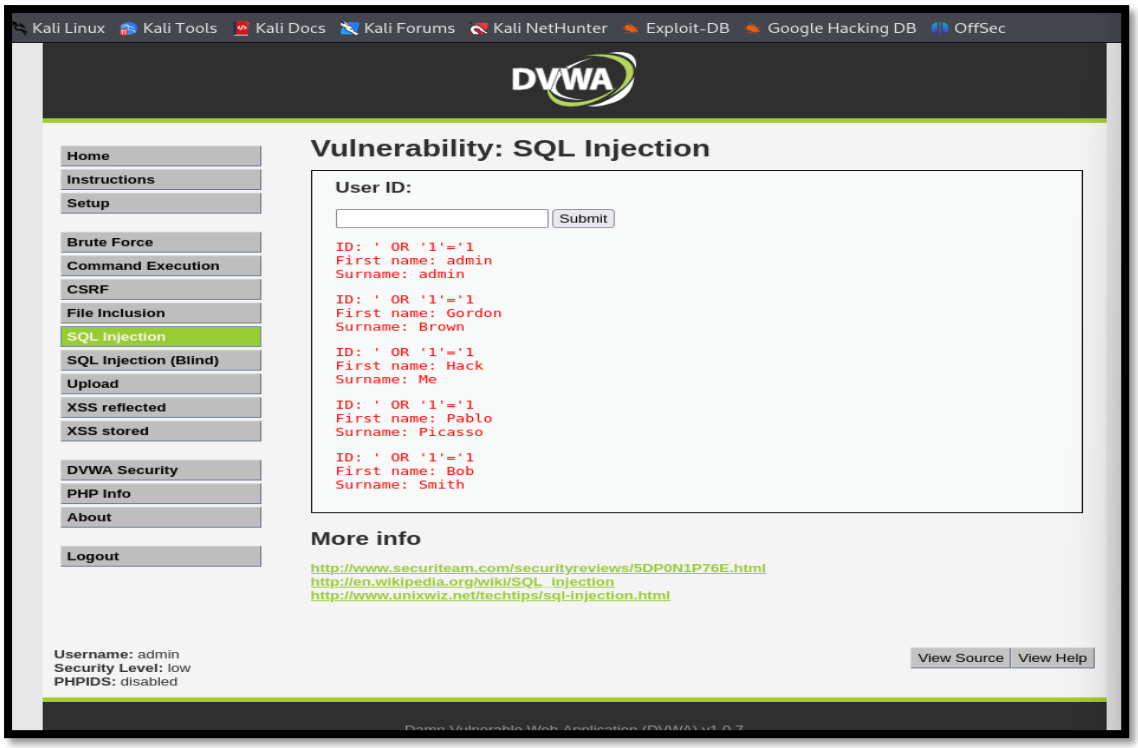
1. **Access the Login Form:**
   - In the DVWA interface, under the "Security" tab, set the security level to **Low** (this makes vulnerabilities easier to exploit).
   - Go to the **"SQL Injection"** section of DVWA.



2. **Test for SQL Injection:**
   - In the login form (or any form that takes user input), try entering the following payload:

     'OR’1’=’1

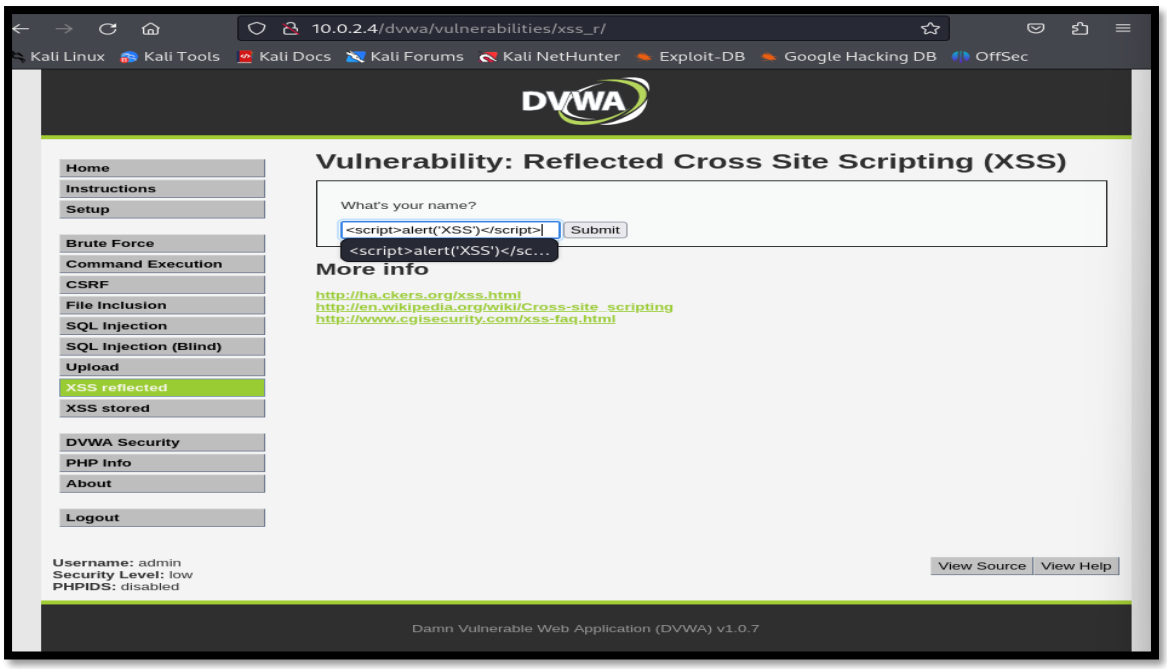
   - Click **Submit**. If the login is bypassed and you are logged in as an admin, the application is vulnerable to SQL Injection.



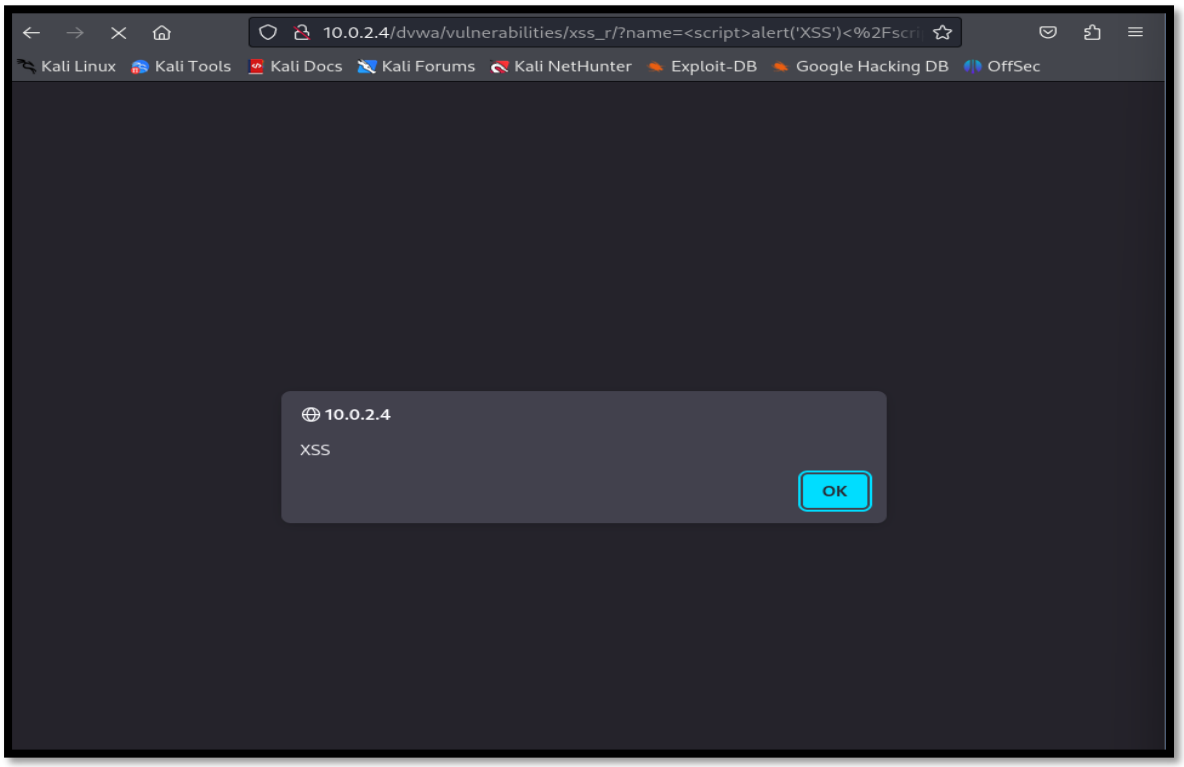
B. Cross-Site Scripting (XSS)

1. **Navigate to the XSS Section:**
   - Under DVWA, select the **"XSS (Reflected)"** vulnerability.
2. **Test for XSS:**
   - In the input field, enter the following JavaScript payload:

<script>alert('XSS')</script>



- Submit the form. If a pop-up alert with "XSS" appears, the application is vulnerable to XSS.



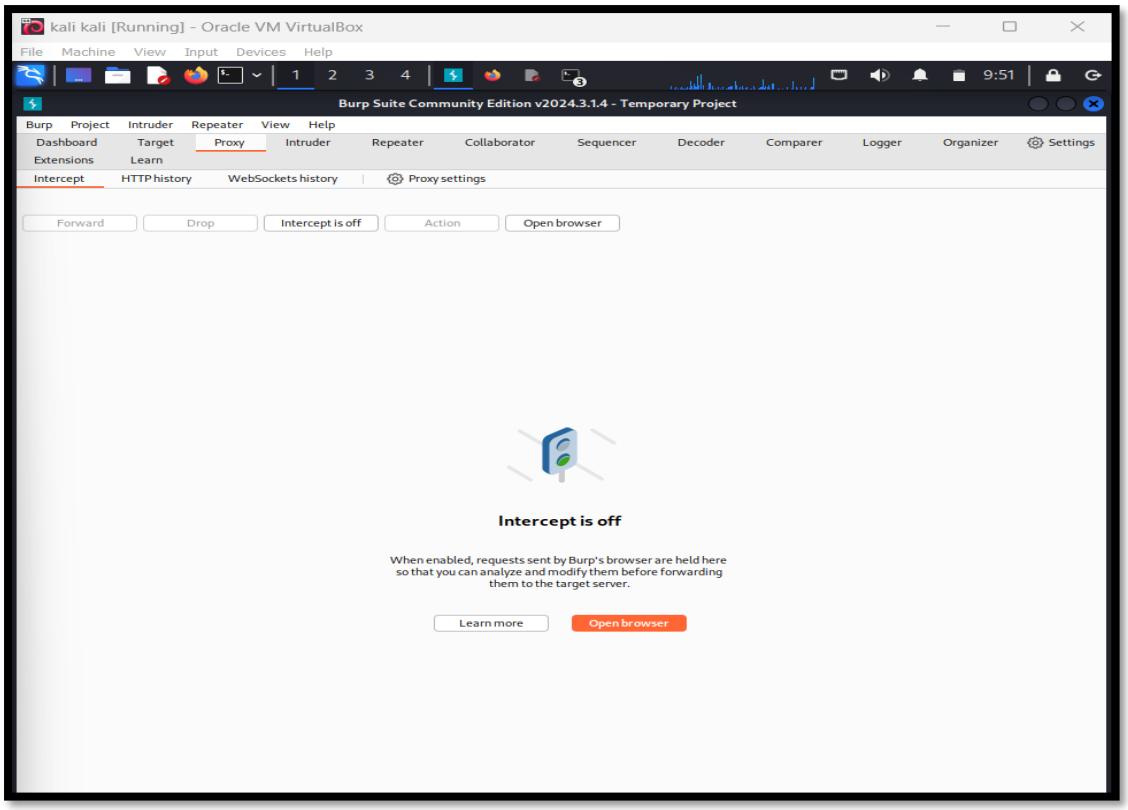
C. Cross-Site Request Forgery (CSRF) Exploitation Using Burp Suite and DVWA (Step-by-Step Guide)

In this, we will learn how to manually exploit **CSRF** using **Burp Suite** and **DVWA** with **Kali Linux** and **Metasploitable2**. CSRF occurs when an attacker tricks a user into performing actions without their consent while authenticated.

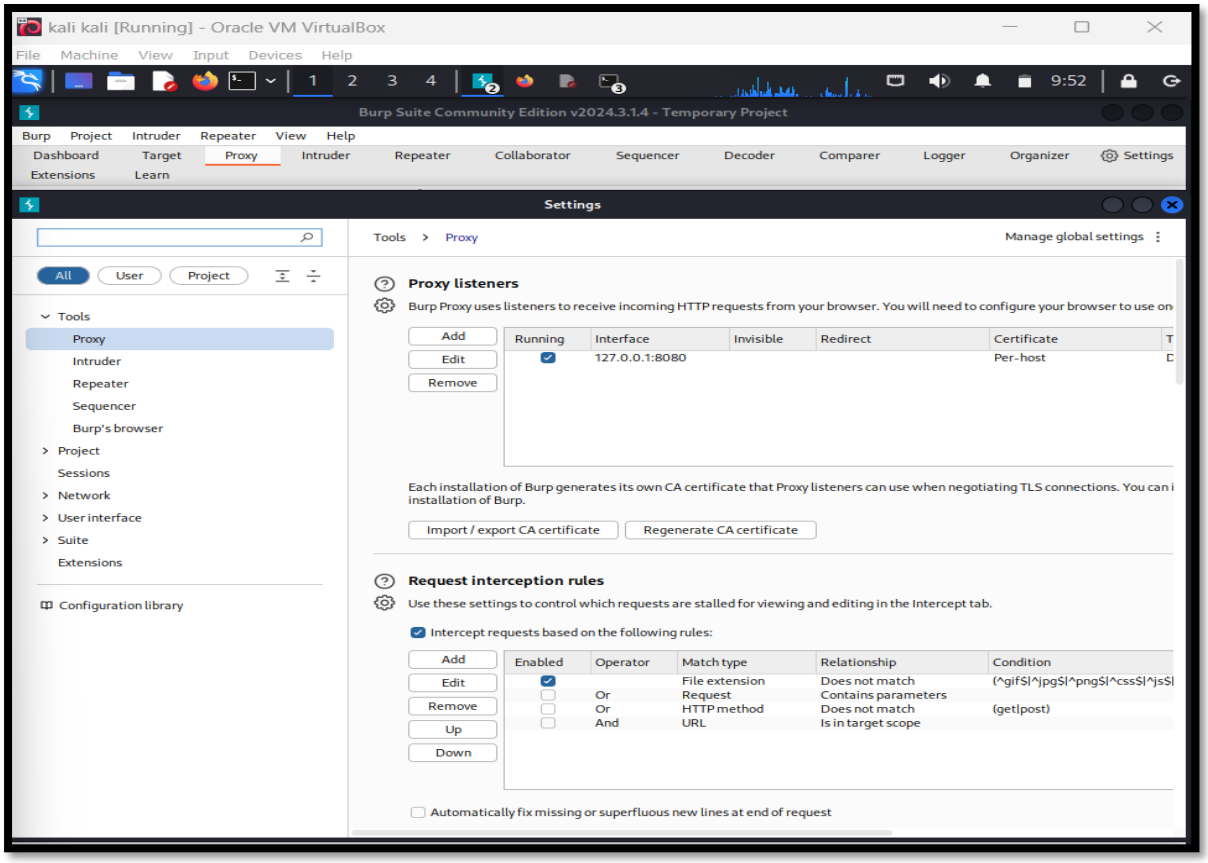
Step 1: Start Burp Suite and Configure Browser

1. **Open Burp Suite:**
   - On Kali Linux, launch **Burp Suite**:

     Burpsuite



2. **Configure Burp to Intercept Traffic:**
   - In Burp Suite, go to **Proxy > Intercept** and ensure **Intercept is on**.



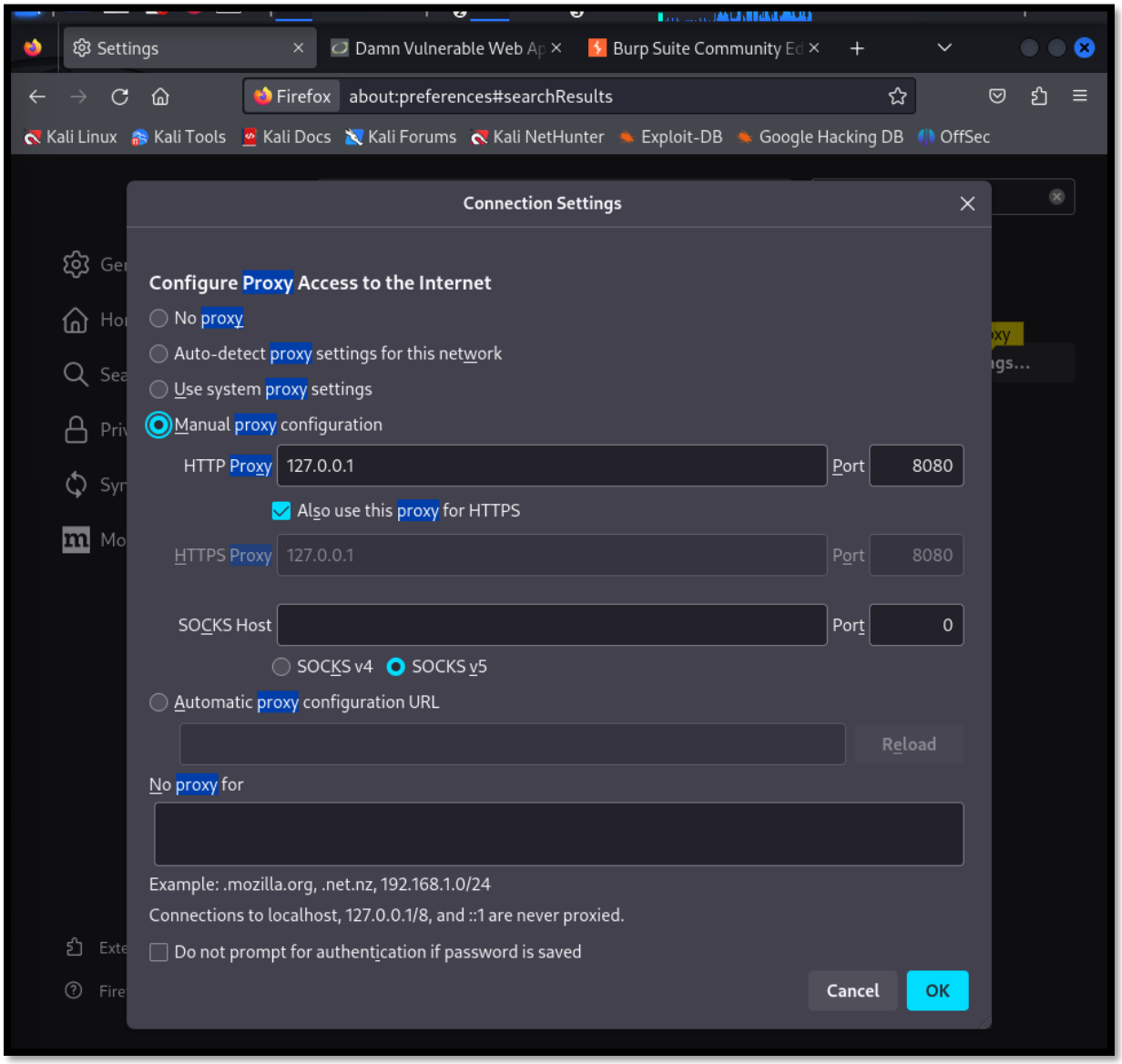
3. **Set Up Browser Proxy:**

In Firefox (Kali):

Go to **Preferences** > **Network Settings** > **Manual Proxy Configuration**.

Set HTTP Proxy to 127.0.0.1 and Port to 8080.

Check **Use this proxy for all protocols**.



Step 2: Access DVWA CSRF Page

1. Open **Firefox** and navigate to DVWA (running on Metasploitable2):

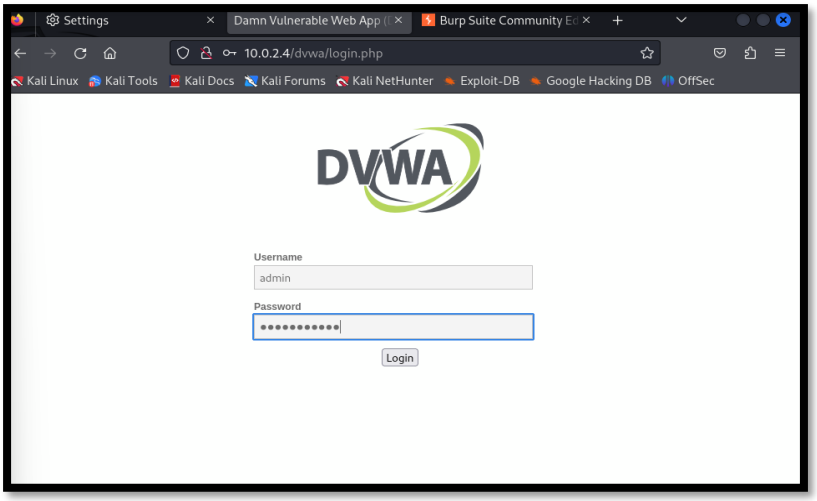
http://<Metasploitable2-IP>/dvwa

Example:

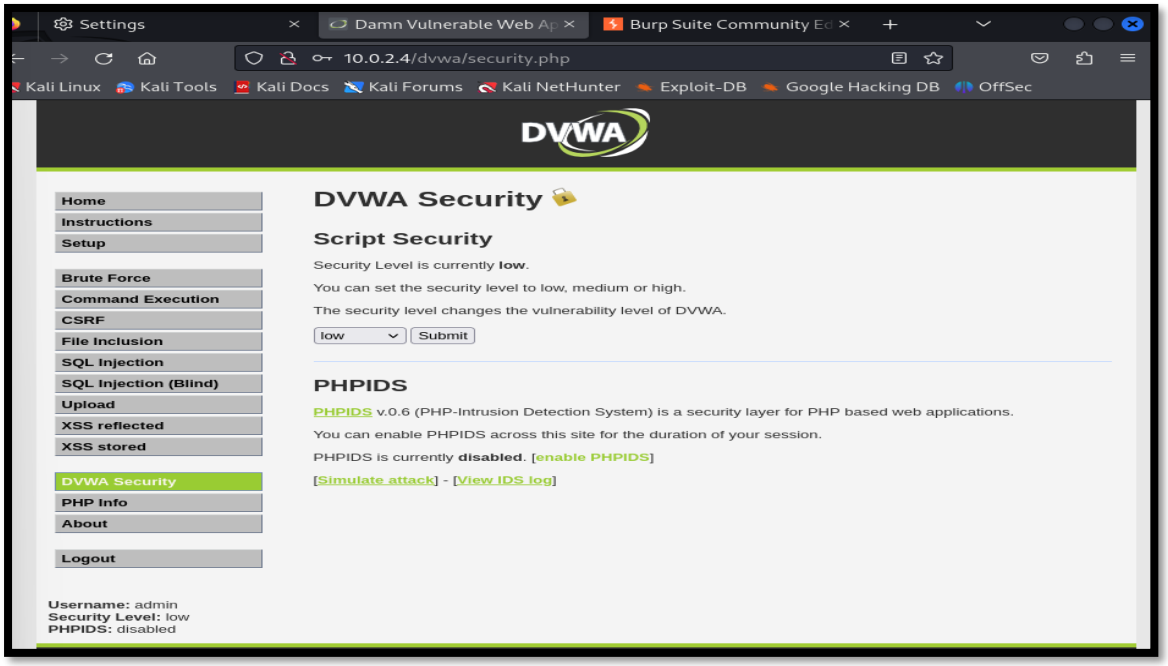
http://10.0.2.4/dvwa

2. **Log in** with default credentials:

   Username: admin
   Password: password



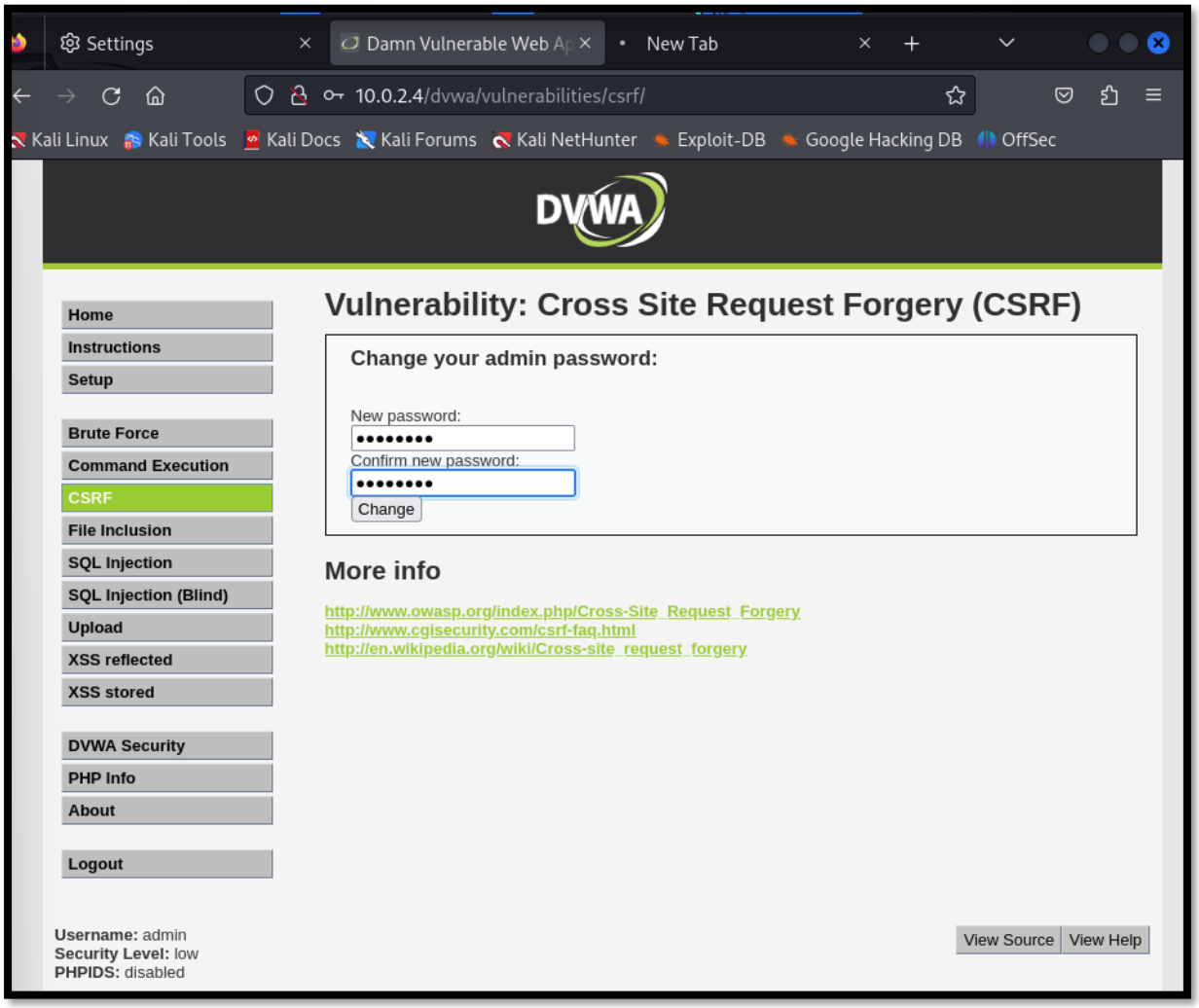
3. Go to **DVWA Security** and set the **Security Level to Low**.



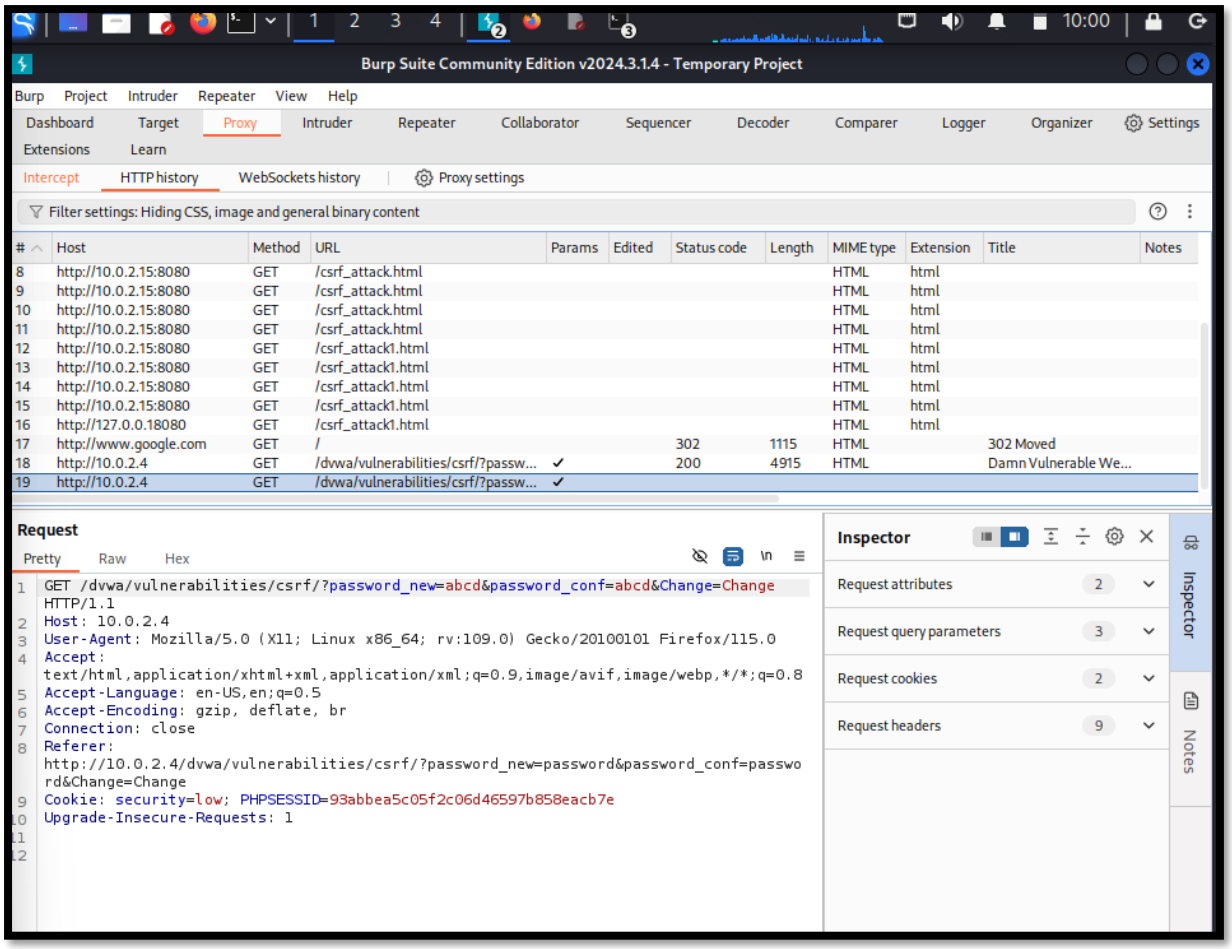
4. Navigate to **DVWA Vulnerabilities** and select **CSRF**.

Step 3: Capture the CSRF Request in Burp Suite

1. **Intercept the Request:**
   - On the **CSRF** page, you'll find a form that allows you to change the user's password.
   - Enter any values for the new password fields (e.g., abcd).
   - Click **Change** to submit the form.



2. **Switch to Burp Suite:**
   - Go to **Proxy > HTTP History** and look for the **GET request** that was sent to the CSRF endpoint.
   - Click the GET request and analyze the parameters sent.



Step 4: Craft a Malicious CSRF HTML Page

1. Stop intercepting in Burp Suite.
2. Create a malicious HTML file on Kali that replicates the form submission:

   html
   Copy code
   <!DOCTYPE html>
   <html lang="en">
   <body>
   <h1>CSRF Attack</h1>
   <form action="http://10.0.2.4/dvwa/vulnerabilities/csrf/" method="POST">
   <input type="hidden" name="password_current" value="password">
   <input type="hidden" name="password_new" value="hacked">
   <input type="hidden" name="password_conf" value="hacked">
   <input type="hidden" name="Change" value="Change">
   <input type="submit" value="Submit Request">

```
  </form>
  <script>document.forms[0].submit();</script>
</body>
</html>
```

3. Save it as csrf_attack.html on Kali.

Step 5: Host the Malicious Page

1. Start a simple web server on Kali to serve the malicious page:

   python3 -m http.server 8080

2. Access the malicious page from the victim's browser:

   http://<Kali_IP>:8080/csrf_attack.html

Step 6: Verify the Attack

1. Once the victim accesses the page, the form auto-submits.

2. Check the password change by logging back into DVWA with admin and the new password hacked.
3. If successful, the CSRF attack worked.

❖ Mitigation Techniques:

1. **CSRF Tokens:** Use anti-CSRF tokens to validate requests.
2. **SameSite Cookies:** Set cookies to SameSite to prevent cross-site requests.
3. **User Authentication:** Re-authenticate sensitive actions like password changes.

❖ Results and Findings:

1. **Vulnerabilities Identified:**
   - **SQL Injection:** Unauthorized login using payloads.
   - **XSS:** Execution of malicious scripts.
   - **CSRF:** Password changes without authorization.
2. **Exploitation Impact:**
   - **SQLi:** Access to sensitive data and unauthorized actions.
   - **XSS:** Session hijacking or application defacement.
   - **CSRF:** Unauthorized user actions.

❖ Recommendations for Mitigation:

1. **SQL Injection:**
   - Use parameterized queries or prepared statements.
   - Sanitize and validate user inputs.
2. **Cross-Site Scripting:**
   - Sanitize inputs and outputs.
   - Implement a Content Security Policy (CSP).
3. **Cross-Site Request Forgery:**
   - Use anti-CSRF tokens.
   - Set cookies to SameSite.

❖ Challenges Faced:

1. Setting up and configuring DVWA with proper dependencies.
2. Understanding the intricacies of manually exploiting vulnerabilities.

❖ Outcomes:

- Successfully identified and exploited SQLi, XSS, and CSRF vulnerabilities in DVWA.
- Gained practical experience in vulnerability analysis and exploitation.
- Strengthened skills in web application penetration testing and mitigation strategies.