UNT CSE

Tomorrow's Technology through Today's Education

Security Lab

Student Name:

Lab 2: Information Gathering and WebGoat Attacks Lab

This lab uses the **Kali 2021** virtual machine (VM) as OVA file **KALI-20.ova** on Canvas. The credentials are as follows:

Username: osboxes

Password: osboxes.org

Information Gathering

Before attacking (i.e., pen testing) a website, we need to gather some important value to map the attack surface. If we don't understand how the site is working, what is available on the site, what type of input it takes etc., then we will not be able to launch a good attack.

Gathering information and mapping the site is very important, so you will be given a basic understanding of a few tools that can be used but you will need to dig deeper to attack a system.

Lab Tasks

`nslookup` (Name Server Lookup) is the name of a program that lets an Internet server administrator, or any computer user enter a host name. You may access `nslookup` using the Terminal Emulator.

If you encounter any issues while using the update command use the following three commands first and proceed with update command(Step 1)

```
# download
wget http://http.kali.org/kali/pool/main/k/kali-archive-keyring/kali-archive-keyring_2022.1_all.deb

# install
sudo dpkg -i kali-archive-keyring_2022.1_all.deb

# remove downloaded file again
rm kali-archive-keyring_2022.1_all.deb
```

Step 1: Only if `nslookup` is not installed:

- `sudo apt-get update`
- `sudo apt-get install dnsutils`

`nslookup` followed by the domain name will display the "A Record" (IP Address) of the domain. Use this command to find the address record for `google.com`:

```
> nslookup google.com
```

Q1: Attach a screenshot of your results from this `nslookup` command.

We can also view all the available DNS records using the `-type=any` option.

```
> nslookup -type=any google.com
```

Q2: Attach a screenshot of your results from this `nslookup` command. Since there can be a lot of information presented here, only include the actual data between the server/address (found in the earlier query) and the authoritative answers (where there should be several authoritative answers that start with `google.com`).

Q3: Does the information help you as an attacker? If yes, how? Otherwise, if no, why?

`nmap` (Network Mapper) is a security scanner used to discover hosts and services on a computer network, thus creating a "map" of the network. To accomplish its goal, `nmap` sends specially crafted packets to the target host and then analyzes the responses.

The software provides several features for probing computer networks, including host discovery and service and operating system detection. These features are extensible by scripts that provide more advanced service detection, vulnerability detection, and other features. `nmap` is also capable of adapting to network conditions including latency and congestion during a scan.

Only if `nmap` is not installed:

- `sudo apt-get install nmap`

Now, let's find our gateway's open ports as well as OS name and version using `nmap`. Note that this command requires root privileges.

```
> sudo nmap -O -v 129.120.210.235
```

Q4: Attach a screenshot of your results from this `nmap` command.

Q5: Does the information help you as an attacker? If yes, how? Otherwise, if no, why?

References:

1) http://www.debianhelp.co.uk/nslookup.htm

2) http://nmap.org/nmap_doc.html

Webgoat

1. Type the `docker` command to start the web server as shown below:

   `> docker run -p 8080:8080 -t webgoat/webgoat-7.1`

```
┌──(osboxes㉿osboxes)-[~]
└─$ docker run -p 8080:8080 -t webgoat/webgoat-7.1
Apr 04, 2022 9:21:58 PM org.apache.coyote.http11.Http11Protocol init
INFO: Initializing ProtocolHandler ["http-bio-8080"]
Apr 04, 2022 9:21:58 PM org.apache.catalina.core.StandardService startInternal
INFO: Starting service Tomcat
Apr 04, 2022 9:21:58 PM org.apache.catalina.core.StandardEngine startInternal
INFO: Starting Servlet Engine: Apache Tomcat/7.0.59
```

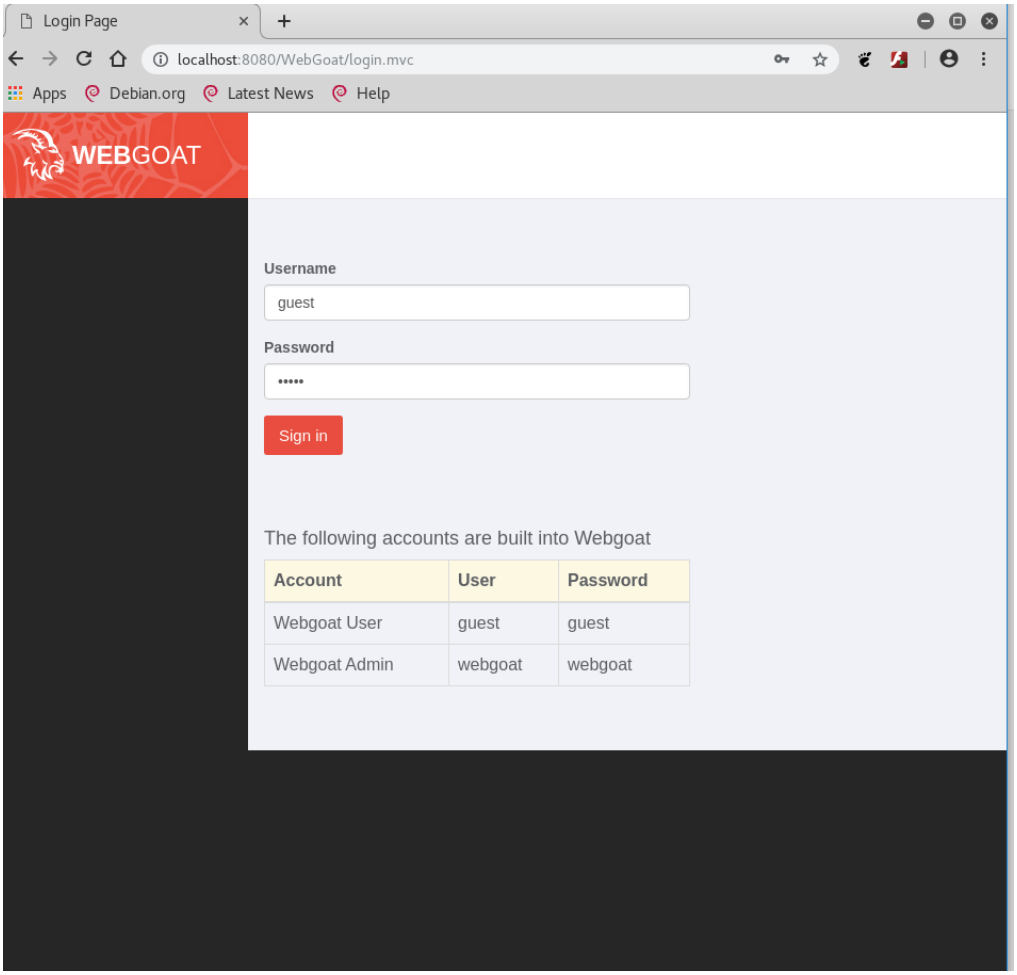
2. You will then get a web server started (no additional command here):

```
2022-04-04 21:22:06,275 INFO  - Initializing main webgoat servlet
2022-04-04 21:22:06,276 INFO  - Browse to http://localhost:8080/WebGoat and happy hacking!
Apr 04, 2022 9:22:06 PM org.apache.coyote.http11.Http11Protocol start
INFO: Starting ProtocolHandler ["http-bio-8080"]
```

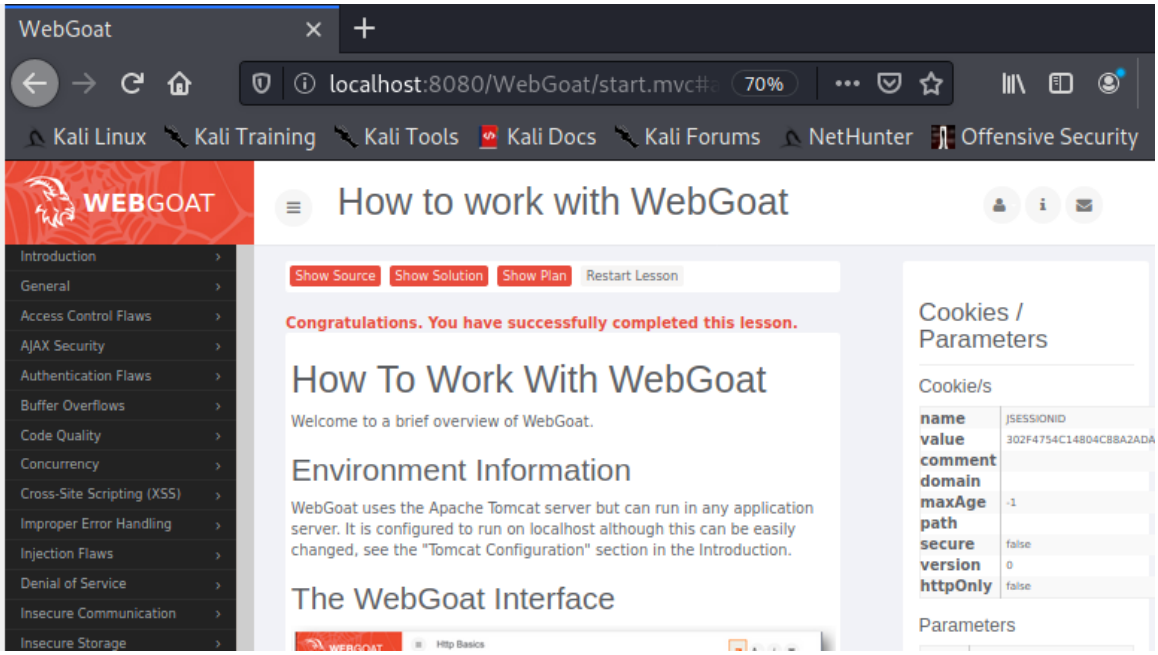
Normally, you should see a message as above if WebGoat's Apache Tomcat server started successfully. Occasionally, the notifications as above are not shown, so please proceed with the next command, regardless of whether you see the notifications or not.

Type: "`localhost:8080/WebGoat/login.mvc`" in the browser address bar to start WebGoat.

Default passwords are shown on the below screenshot:



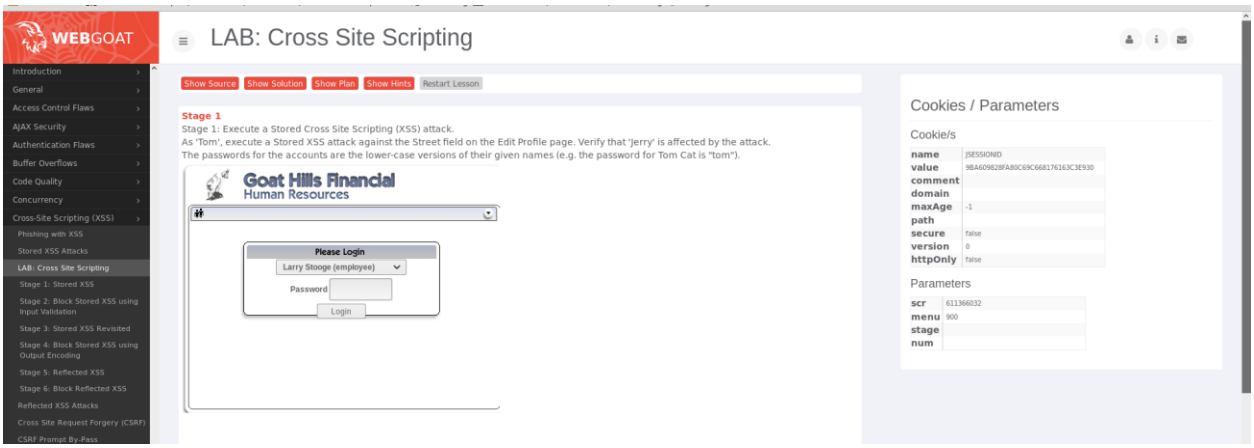
Use the "`guest`" login to start WebGoat.



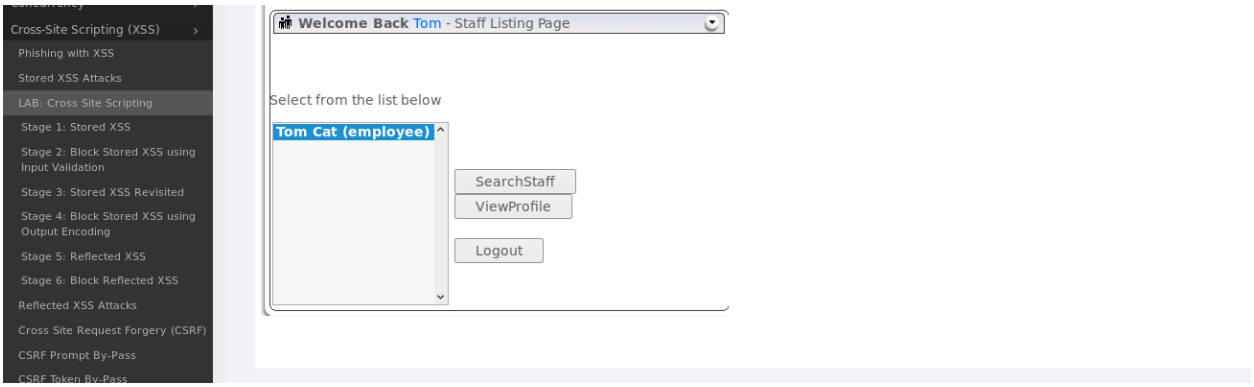
CROSS SITE SCRIPTING

Select the following option in the WebGoat left hand menu:

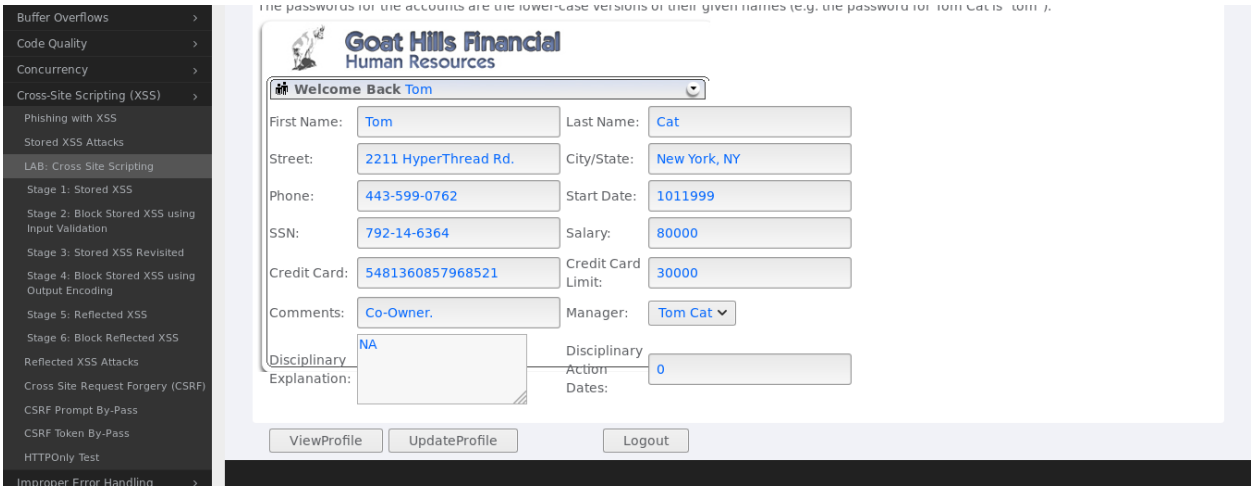
Cross Site Scripting → LAB: Cross Site Scripting



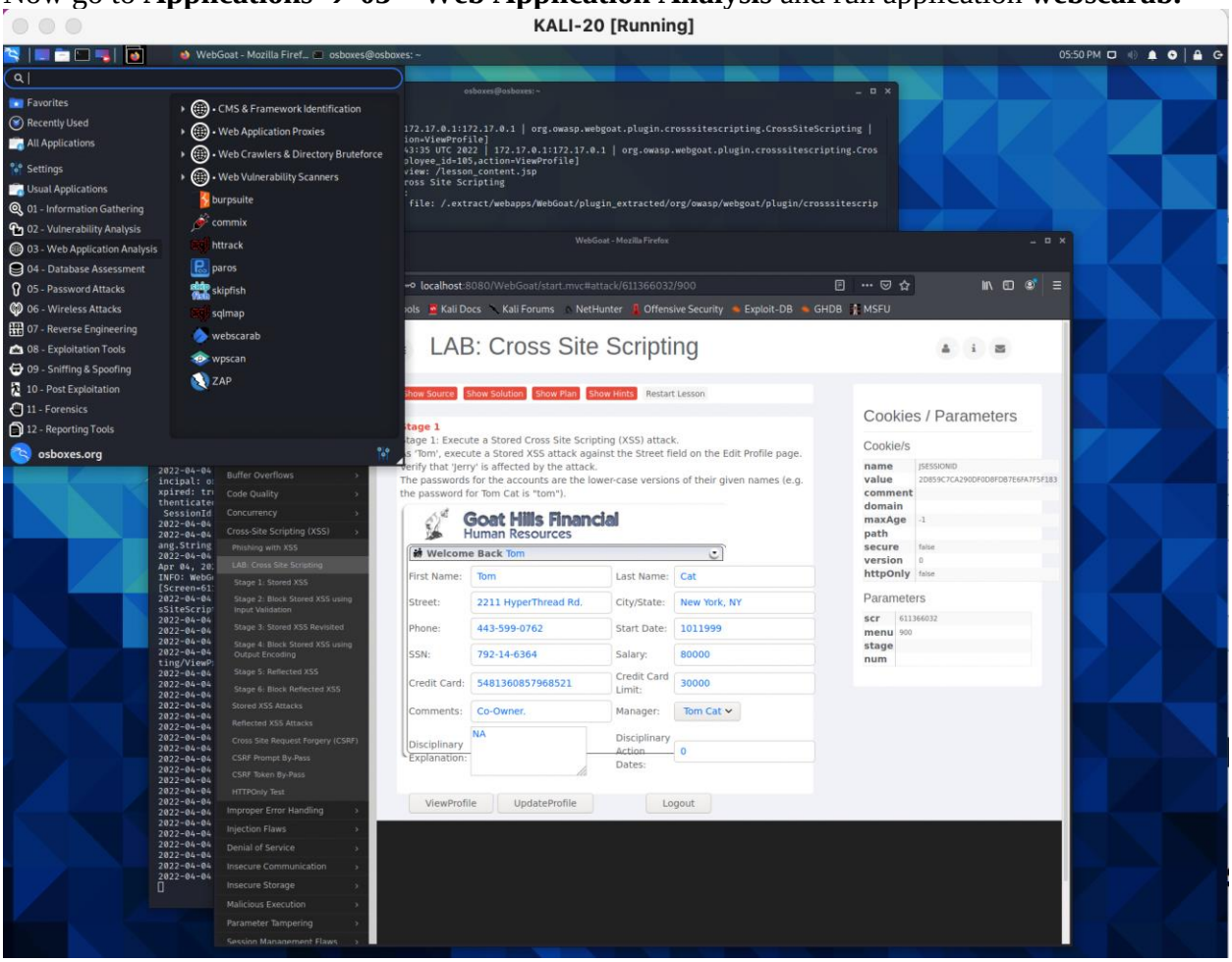
Login as user `Tom Cat (employee)` where password is "`tom`" in the above page. You should then see the following page or similar.



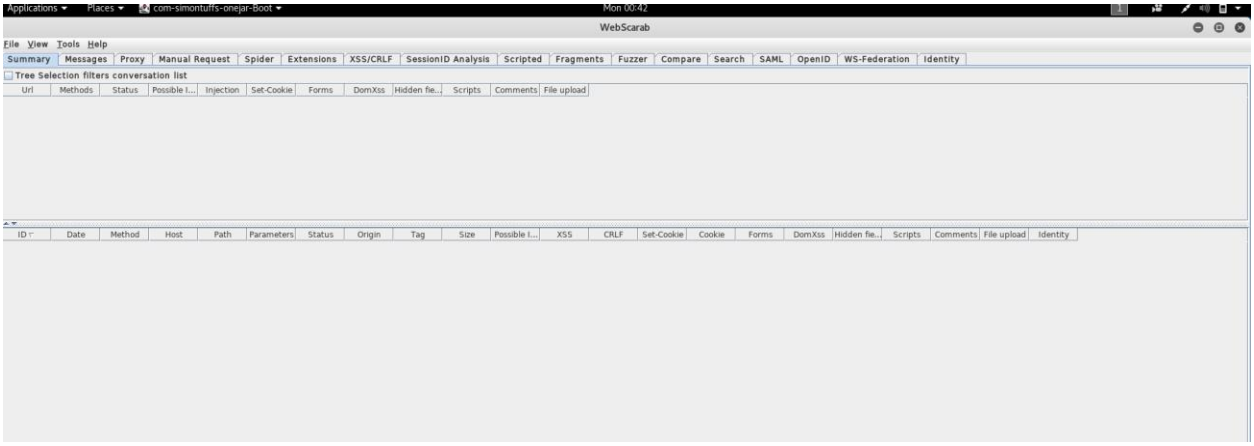
Select `Tom Cat (employee)` and then click on **View Profile.** Now click on **Edit Profile** to see the following screen.



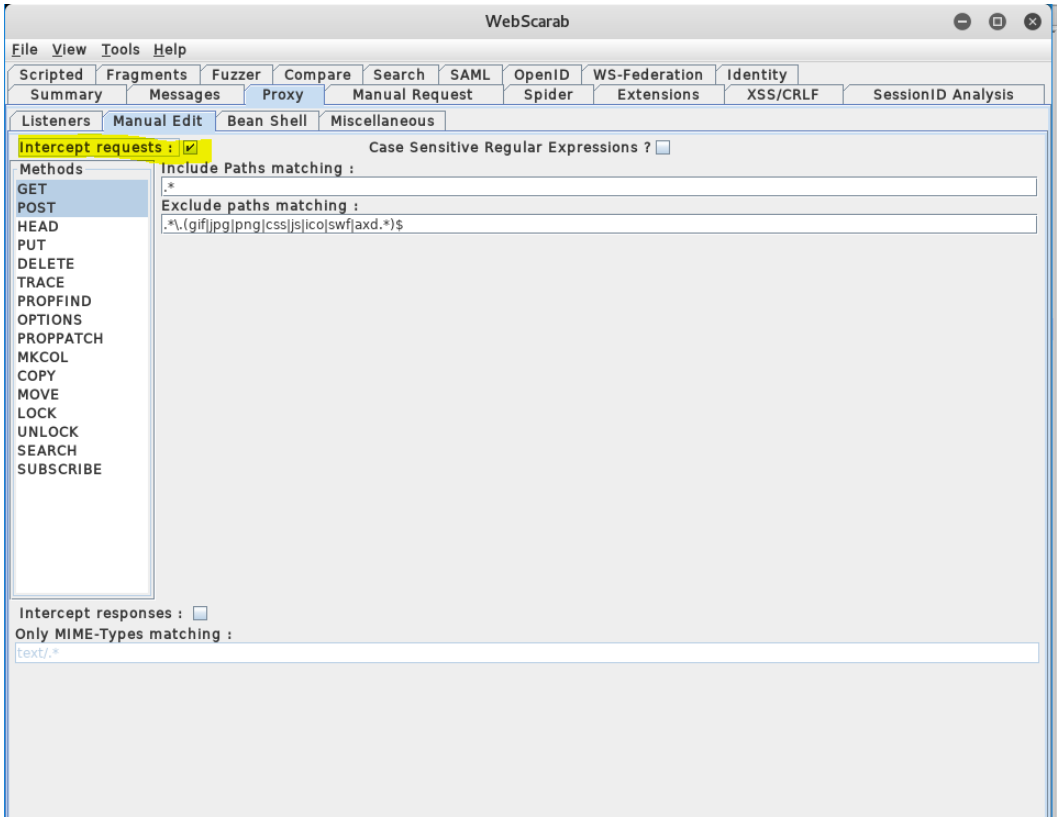
Now go to **Applications → 03 – Web Application Analysis** and run application **webscarab.**



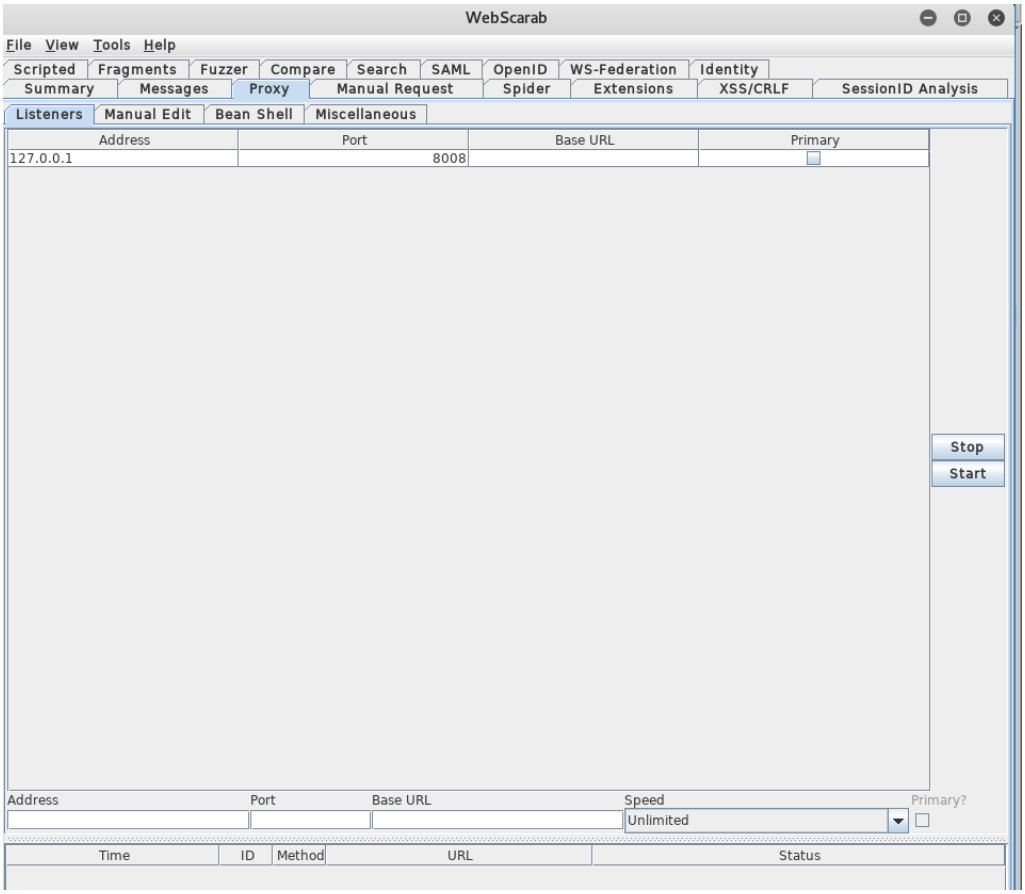
This application is used to manipulate the data being sent using the HTTP "POST" method. After opening **webscarab**, you should see the following screen:



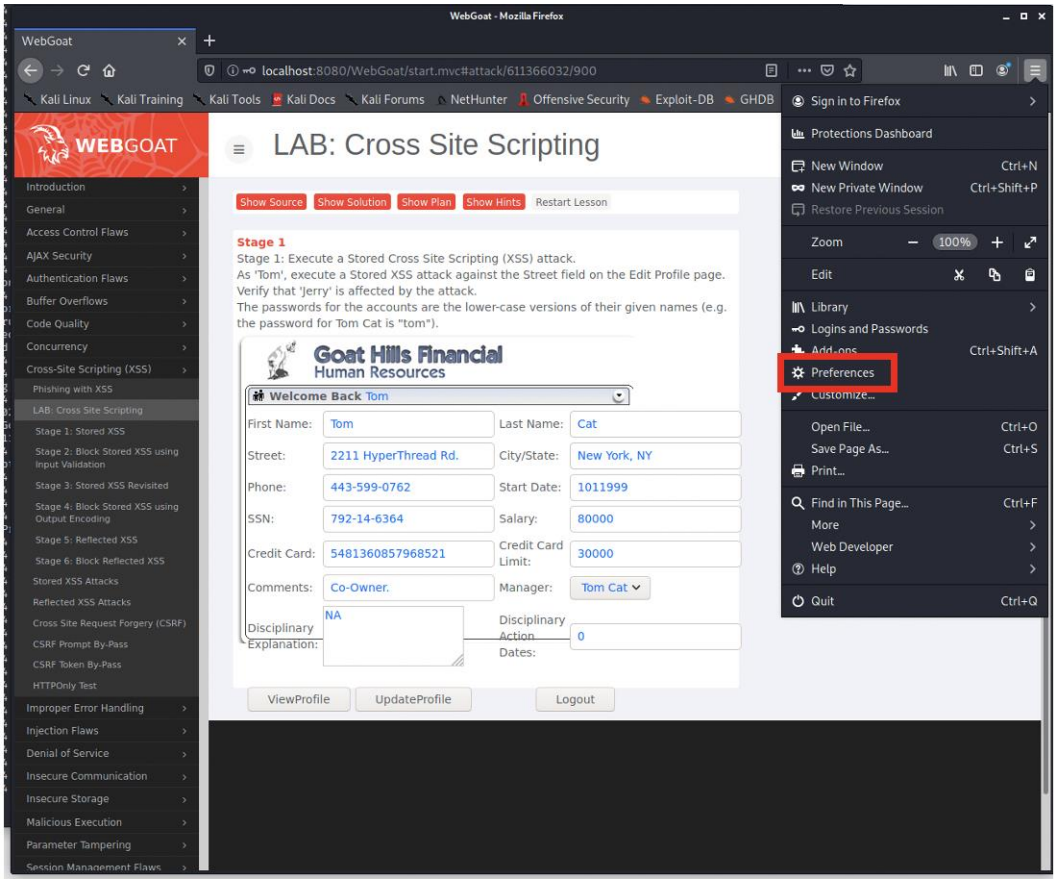
Go to **Proxy → Manual Edit** and select **Intercept requests**.



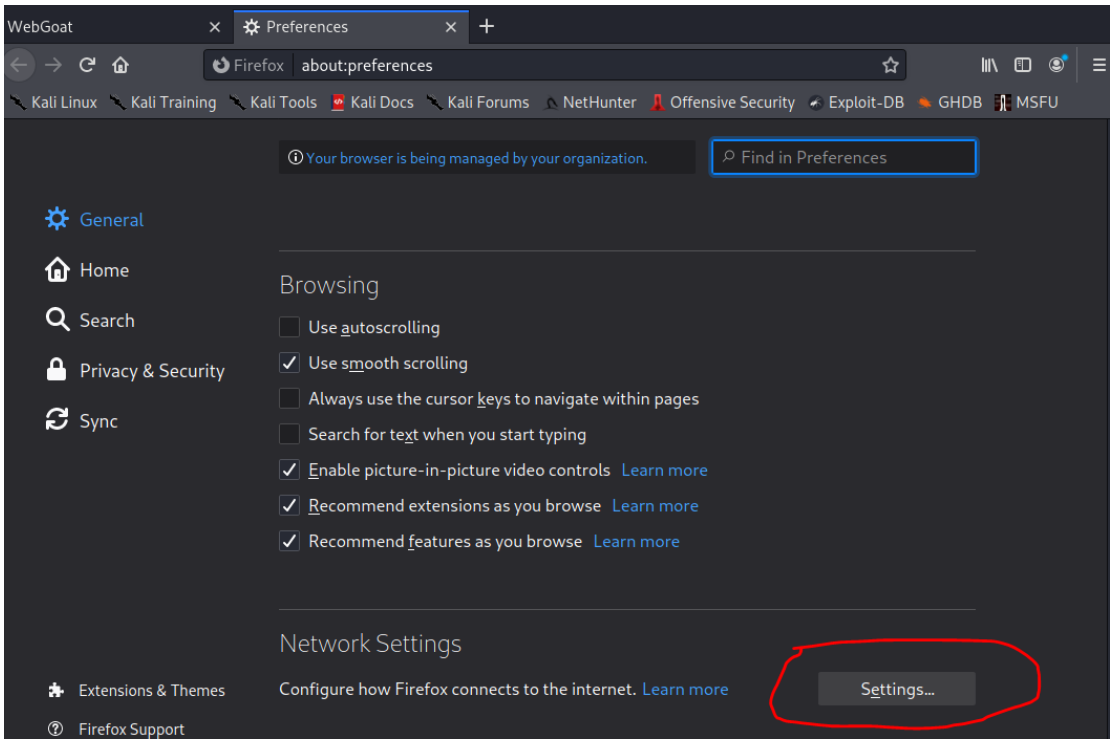
Go to **Proxy → Listeners** and observe the port and address (in the case shown, it is 127.0.01 and 8008).



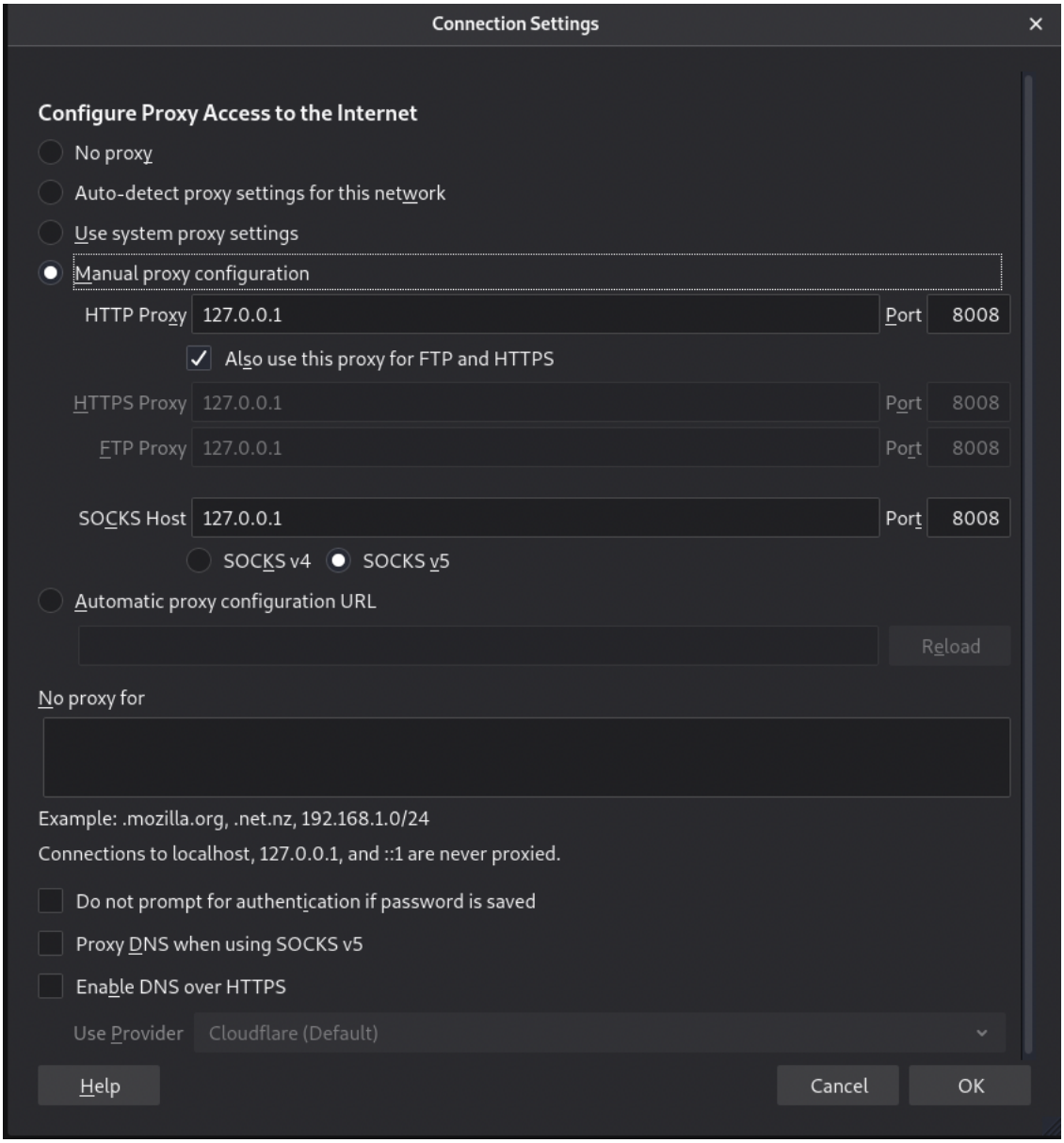
Now go to your browser (for WebGoat) and open **Preferences** in the menu.



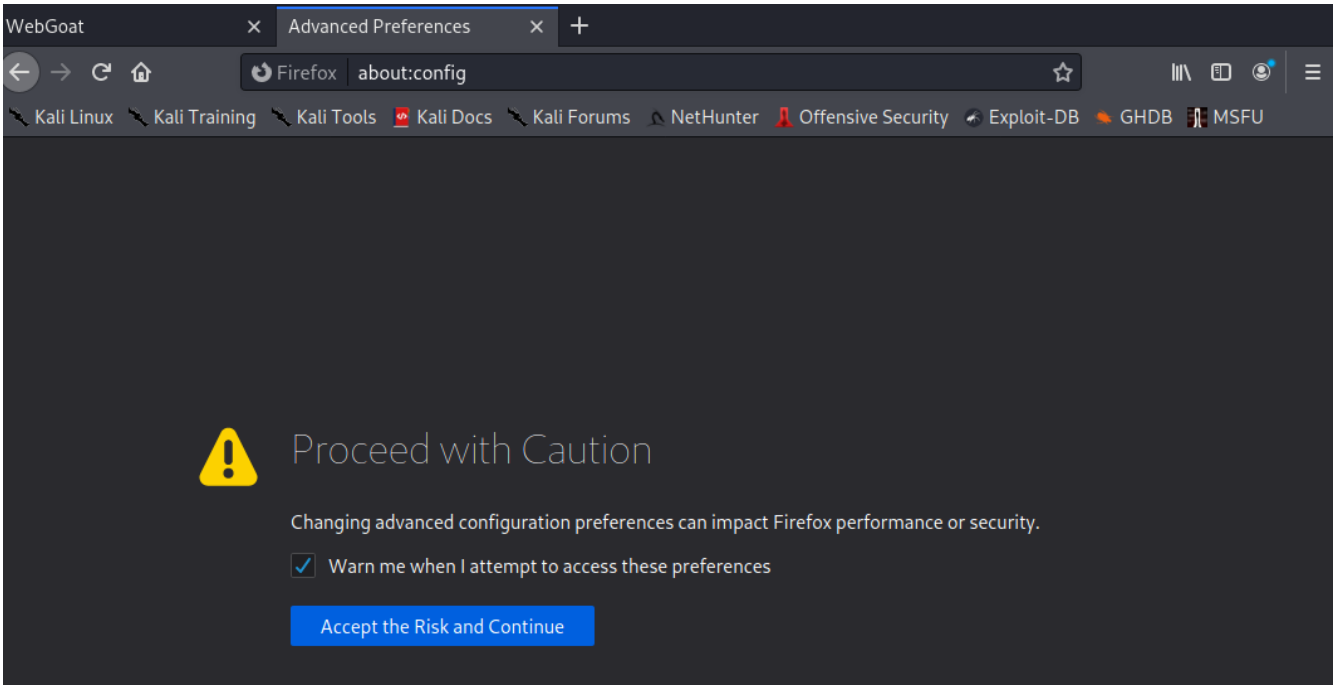
Under **General**, scroll down to find **Network Settings** and then click on **Settings**.



Enter the settings as below and, if applicable, remove any text in **No proxy for** box. Enter the address (127.0.0.1) and port number (8008) from **webscarab** and click **OK**.

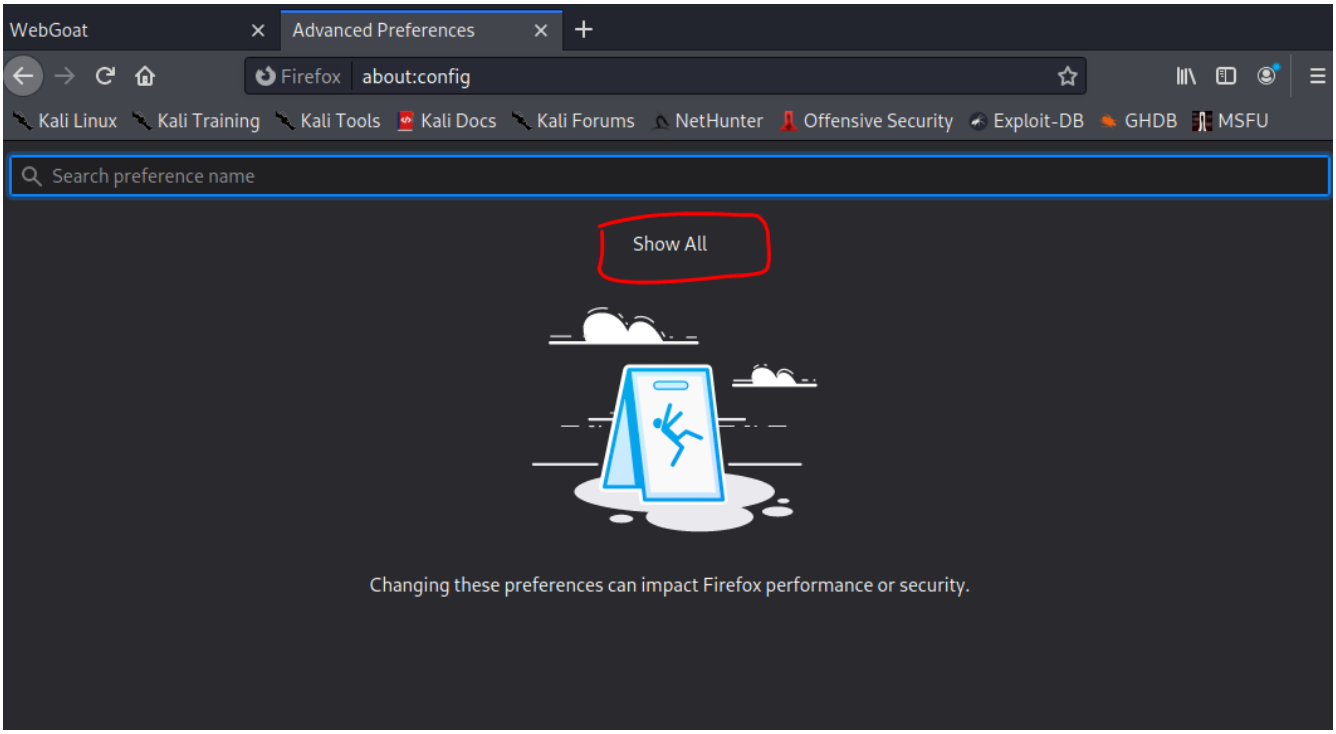


In the browser URL location, type "**about:config**" and hit enter as shown below.

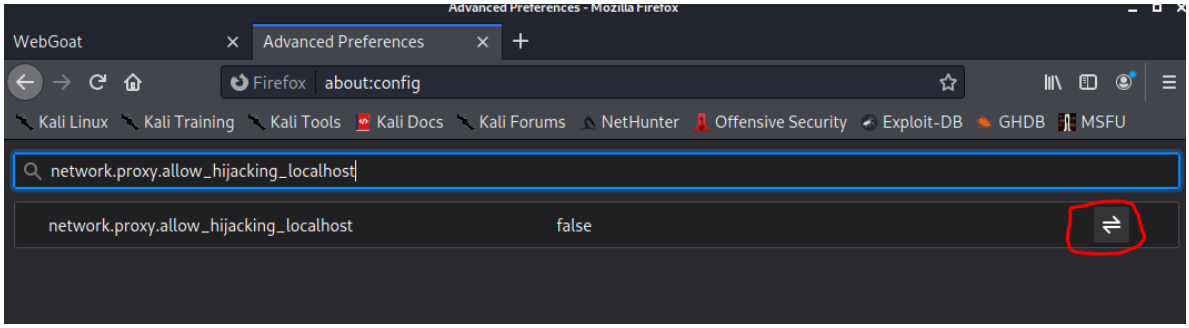


Click on "**Accept Risk and Continue**".

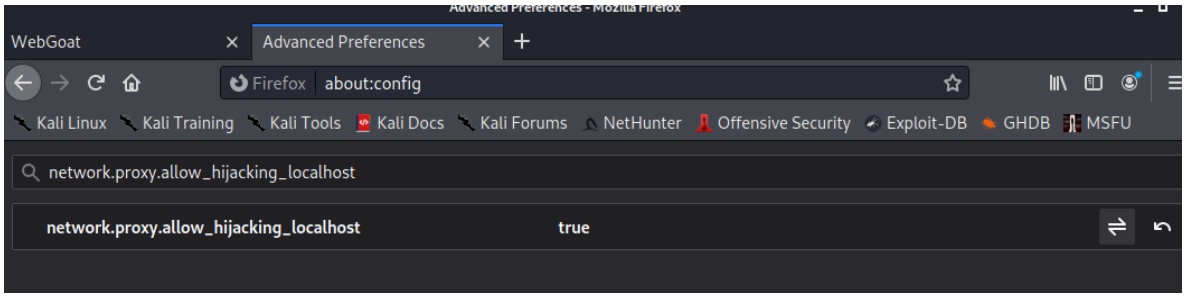
In the next window, click on "**Show All**".



In the search bar, type "**network.proxy.allow_hijacking_localhost**", as shown below. You will see the field set to "false". Click on the button (highlighted in red below) to switch it to "true".

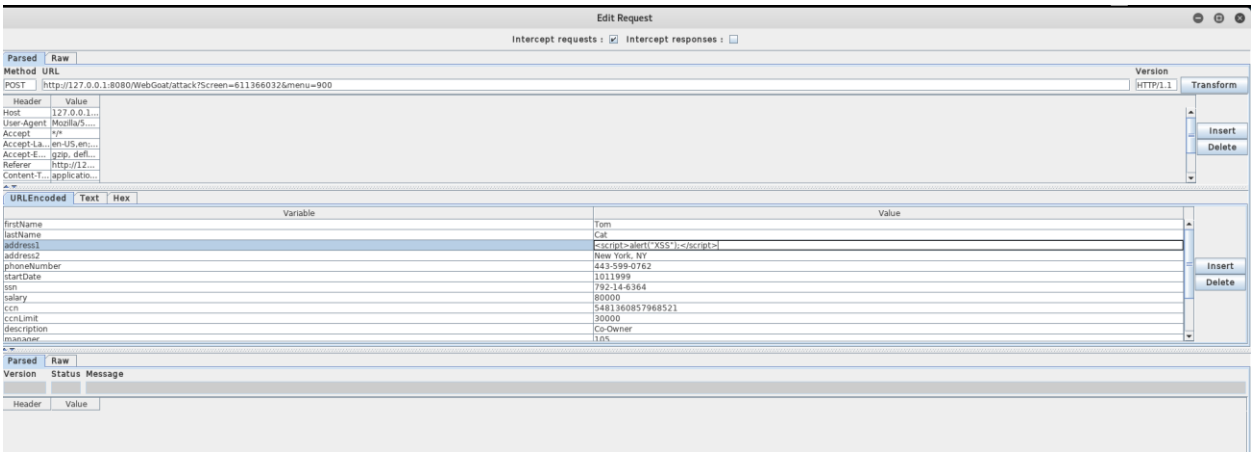


The field will now be set to "true".

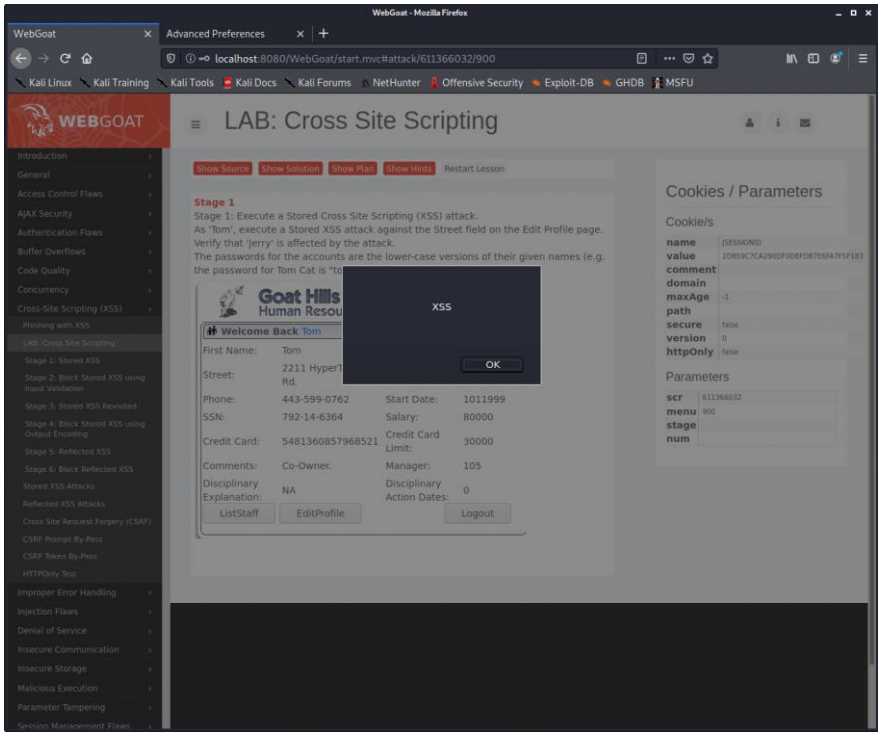


Now, click on **Update Profile** of `Tom Cat (employee)`.

A window pops up showing all the fields in "Update Profile" form. Append the following JavaScript to the `address1` field: **`<script>alert("XSS");</script>`**



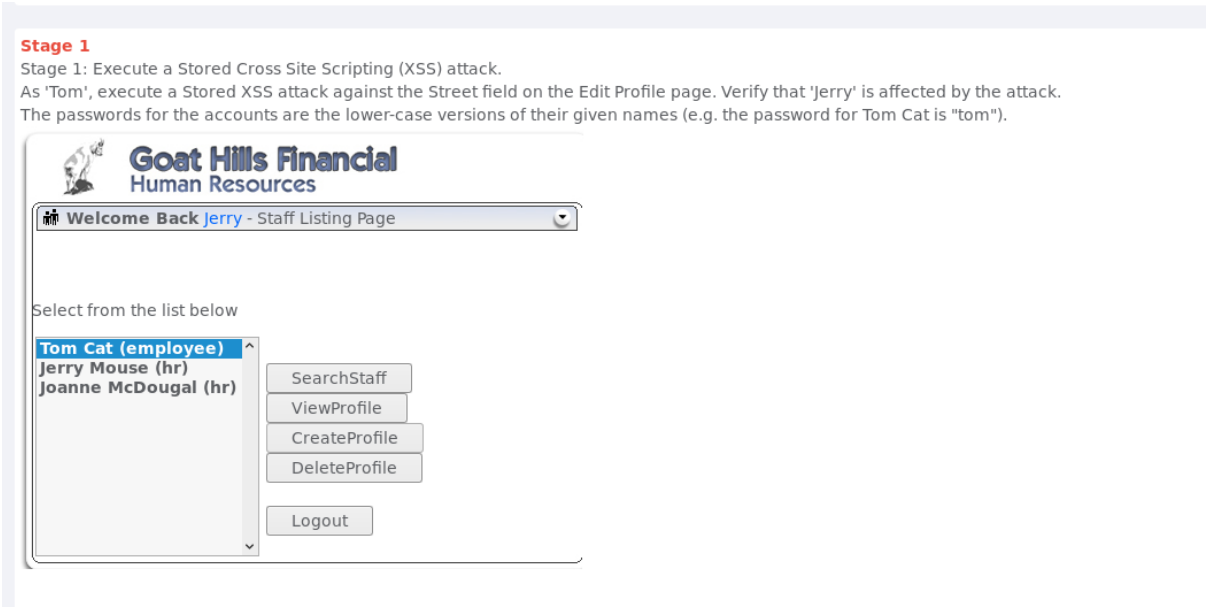
Click **Accept Changes**.



Click **OK** on the XSS alert. Now, go to **webscarab** and uncheck the **Intercept requests** box under **Proxy → Manual Edit**.
Then, log out as `Tom Cat (employee)`.

Now, let's login as another user and see if the JavaScript we have added works when we view Tom's profile.

Login as `Jerry Mouse (hr)` where password is "`jerry`". Select `Tom Cat (employee)` and **View Profile**.



We should see an alert dialog, saying "XSS". This confirms that our script runs when *another user* is logged in. Using this attack, an attacker can steal user information from the cookies of a victim.

Click **OK** on the XSS alert and logout as `Jerry Mouse (hr)`.

Turn off intercept until needed to process the web requests without delay.

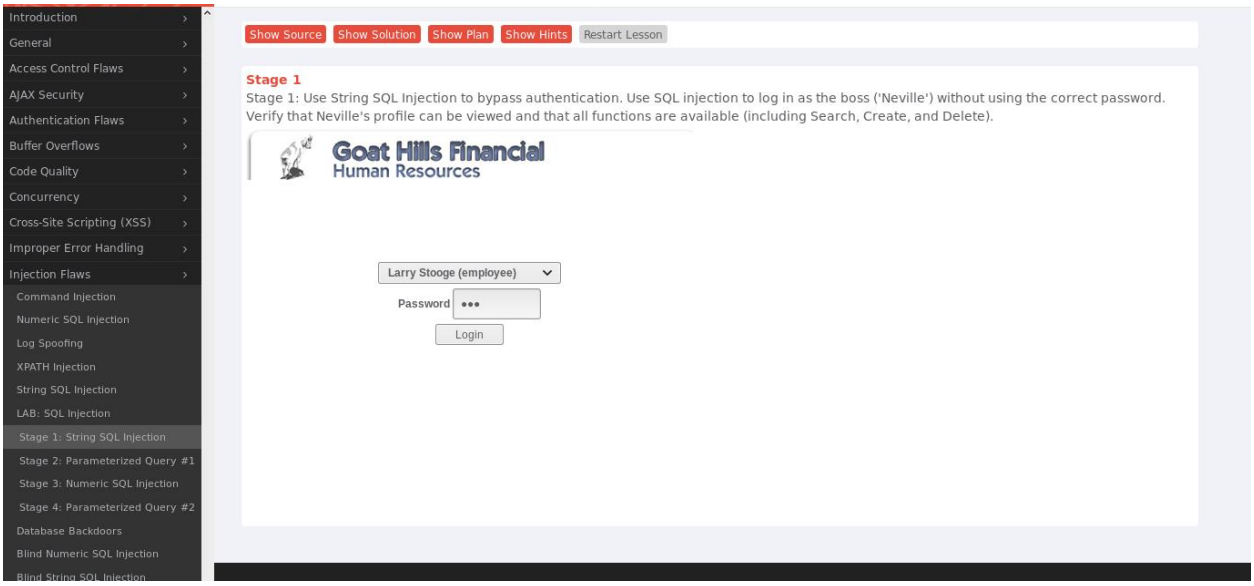
Q6: Attach a screenshot of your results showing the lab was successful (with the XSS alert logged in as `Jerry Mouse (hr)`.

SQL INJECTION

SQL Injection is a technique to inject attack code into the SQL queries that run on the server. One simple attack is to inject an *attack string* to achieve unauthorized access to a user's account.

Select the following option in the WebGoat left hand menu:

Injection Flaws → LAB: SQL Injection → Stage 1: String SQL Injection

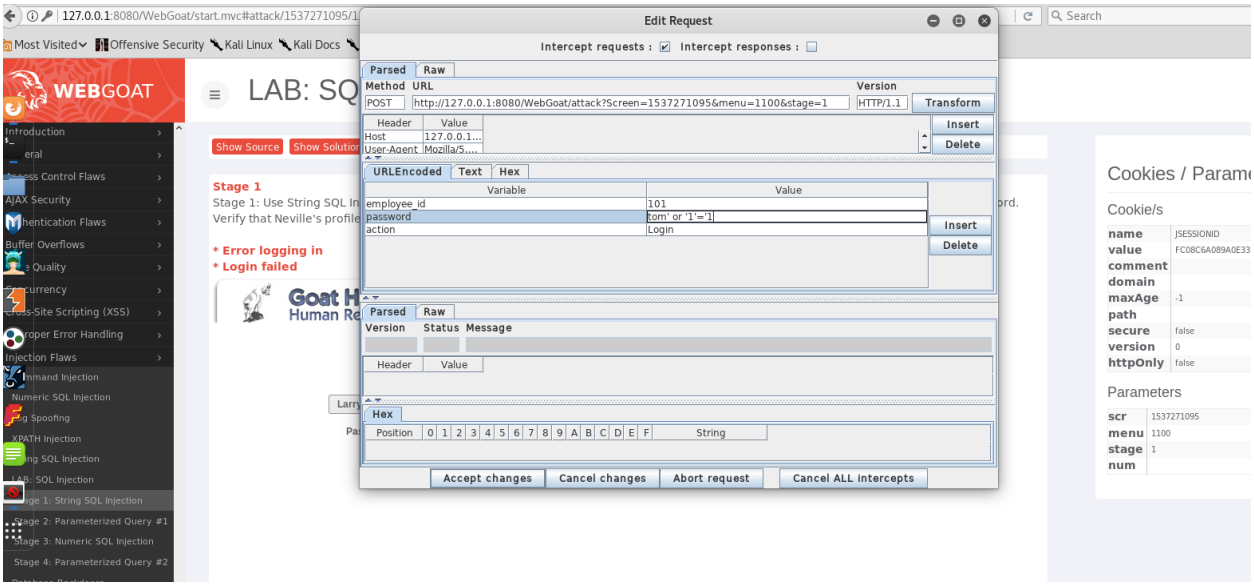


Start the intercept in webscarab:

Go to **Proxy → Manual Edit** and select **Intercept requests**.

In WebGoat, select the admin (last user on the list). We will see how an attacker can login to a vulnerable web application without providing the password. Click **Login** on the web application and this request is trapped the **webscarab** as follows:

Now tamper the password as follows:
Set password as **`<any string>' OR '1'='1`**. As an example, we set our password as: **`PWNED' OR '1'='1`**.



Click Accept changes and **Stop intercepting**

You should be now logged in as the administrator. To verify your admin rights, try viewing any profile.

Click **Logout** to logout as admin.

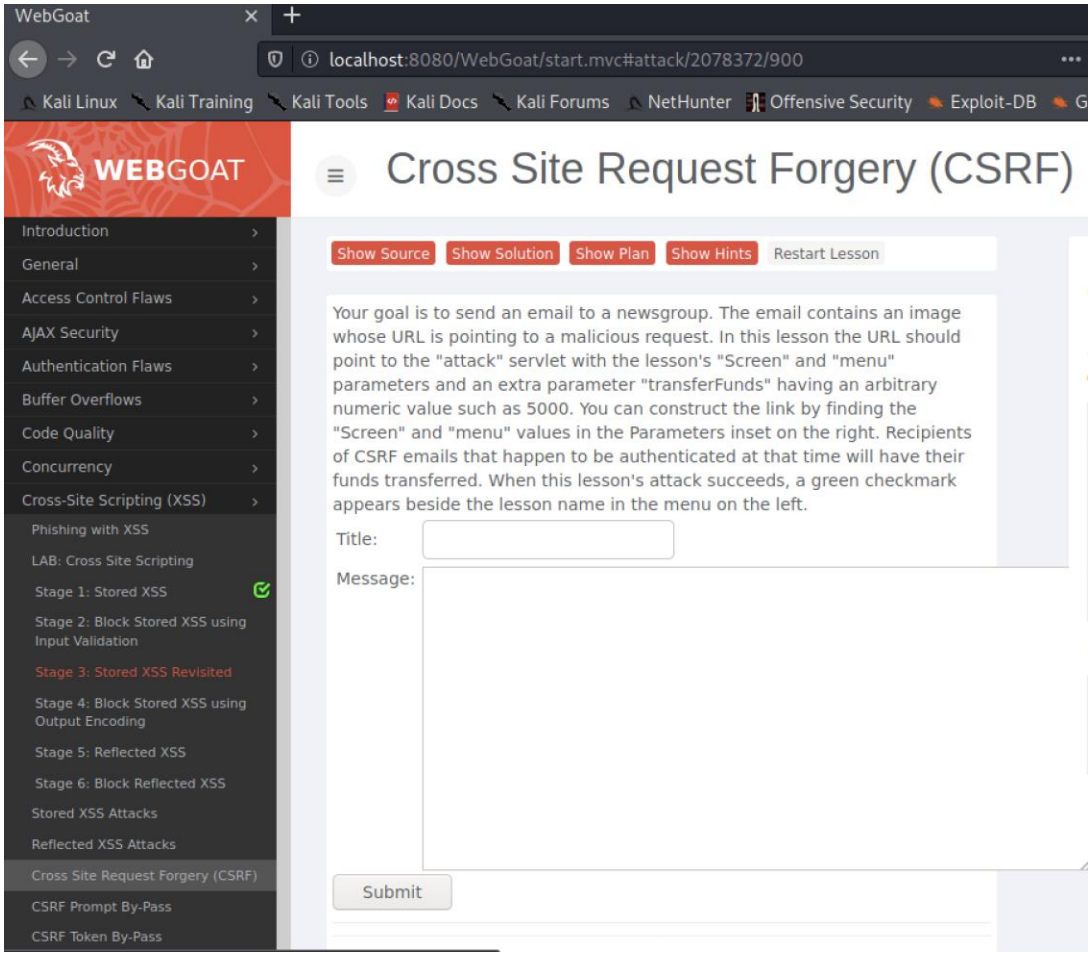
Q7: Attach a screenshot of successful completion of task.

CROSS SITE REQUEST FORGERY

CSRF is an attack which forces an end user to execute unwanted actions on a web application in which he/she is currently authenticated. With a little help of social engineering (like sending a link via email/chat), an attacker may force the users of a web application to execute actions of the attacker's choosing. A successful CSRF exploit can compromise end user data and operation in case of normal user. If the targeted end user is the administrator account, this can compromise the entire web application.

Select the following option in the WebGoat left hand menu:

Cross Site Scripting (XSS) → Cross Site Request Forgery (CSRF)



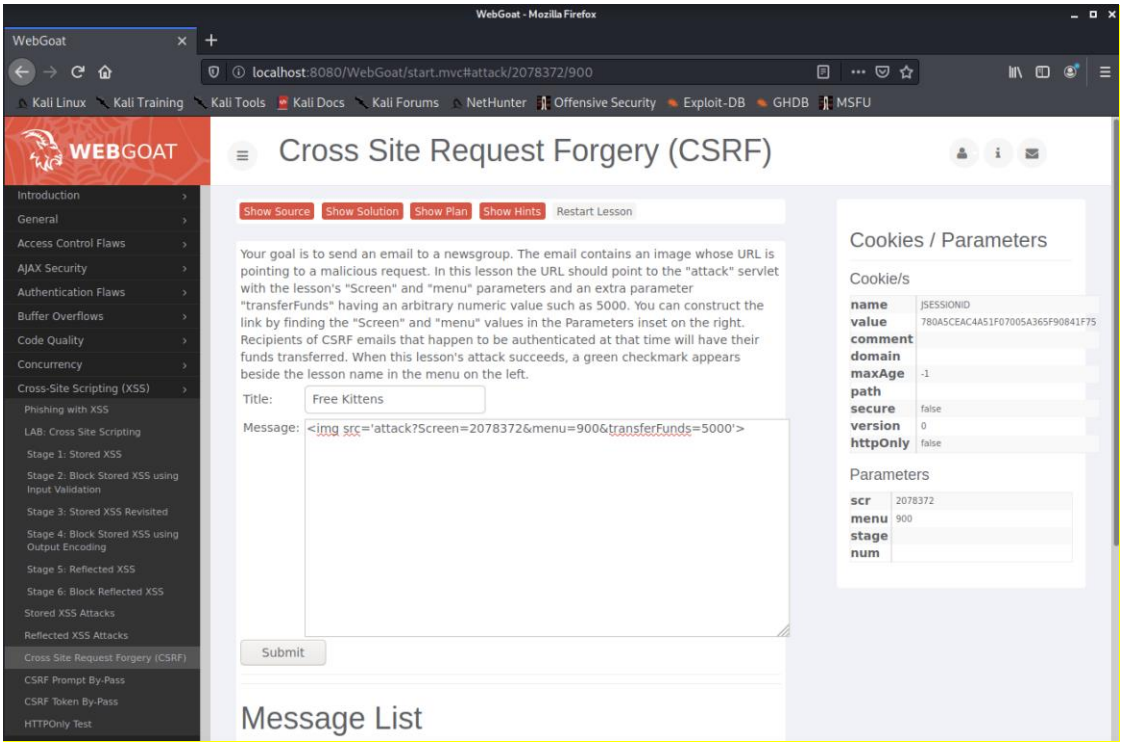
In the "**Title:**" field**,** enter a <u>unique</u> title to grab the victims' attention such as "**Free Kittens**".

<u>Be sure the Title is unique by including your EUID so we know the submitted solution is yours.</u>

In the "**Message:** " field, you will need to load an HTML image where the image is actually empty and a "transferFunds" parameter is loaded with an arbitrary value as follows:

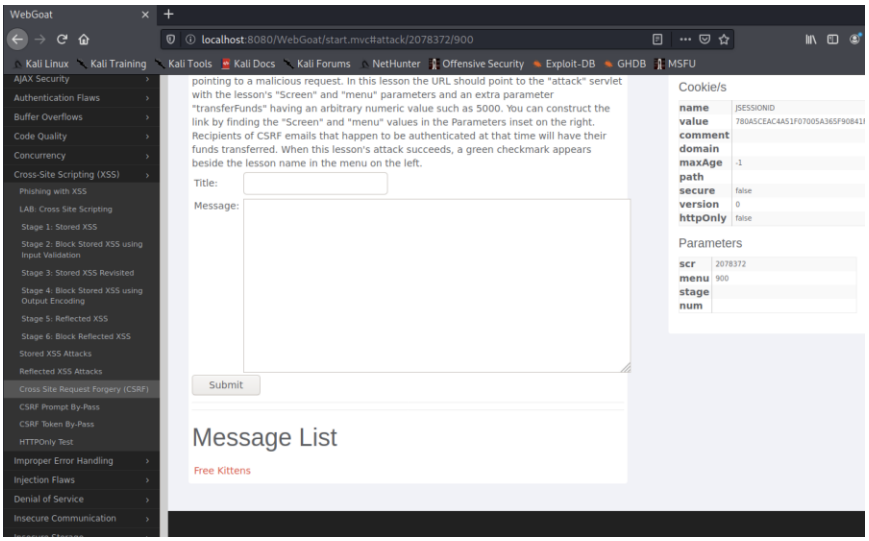
```
<img src='attack?Screen=2078372&menu=900&transferFunds=5000'>
```

Then click the "Submit" button.

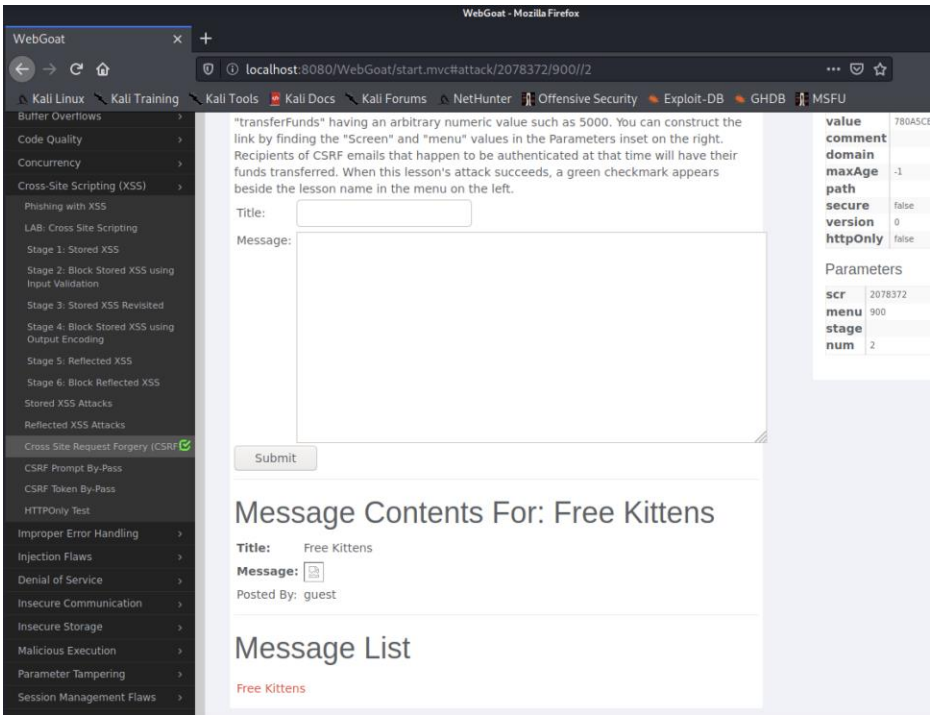


(Note: the Screen and menu parameters come from the page source)

You should now scroll down to see your new entry in the Message List below:



Clicking on your message should cause your message to load on the victim webpage pulling in your exploit code and revealing a green check box next to the WebGoat Cross Site Request Forgery (CSRF) menu option revealing successful completion of this task. (You may need to refresh the page to get the check box.)



Q8: Attach a screenshot showing the lab is successful.

BUFFER OVERFLOW

A buffer overflow occurs when a program or process tries to store more data in a buffer (temporary data storage area) than it was intended to hold. Since buffers are created to contain a finite amount of data, the extra information - which has to go somewhere - can overflow into adjacent buffers, corrupting or overwriting the valid data held in them. Although it may occur accidentally through programming error, buffer overflow is an increasingly common type of security attack on data integrity. In buffer overflow attacks, the extra data may contain codes designed to trigger specific actions, in effect sending new instructions to the attacked computer that could, for example, damage the user's files, change data, or disclose confidential information. There are many variations of the buffer overflow but for this lab we will focuses on web applications.

Buffer Overflow and Web Applications

Attackers use buffer overflows to corrupt the execution stack of a web application. By sending carefully crafted input to a web application, an attacker can cause the web application to execute arbitrary code – effectively taking over the machine.

Buffer overflow flaws can be present in both the web server or application server products that serve the static and dynamic aspects of the site, or the web application itself. Buffer overflows found in widely used server products are likely to become widely known and can pose a significant

risk to users of these products. When web applications use libraries, such as a graphics library to generate images, they open themselves to potential buffer overflow attacks.

Buffer overflows can also be found in custom web application code, and may even be more likely given the lack of scrutiny that web applications typically go through. Buffer overflow flaws in custom web applications are less likely to be detected because there will normally be far fewer hackers trying to find and exploit such flaws in a specific application. If discovered in a custom application, the ability to exploit the flaw (other than to crash the application) is significantly reduced by the fact that the source code and detailed error messages for the application are normally not available to the hacker.

Consequences

- Category: Availability: Buffer overflows generally lead to crashes. Other attacks leading to lack of availability are possible, including putting the program into an infinite loop.
- Access control (instruction processing): Buffer overflows often can be used to execute arbitrary code, which is usually outside the scope of a program's implicit security policy.
- Other: When the consequence is arbitrary code execution, this can often be used to subvert any other security service.

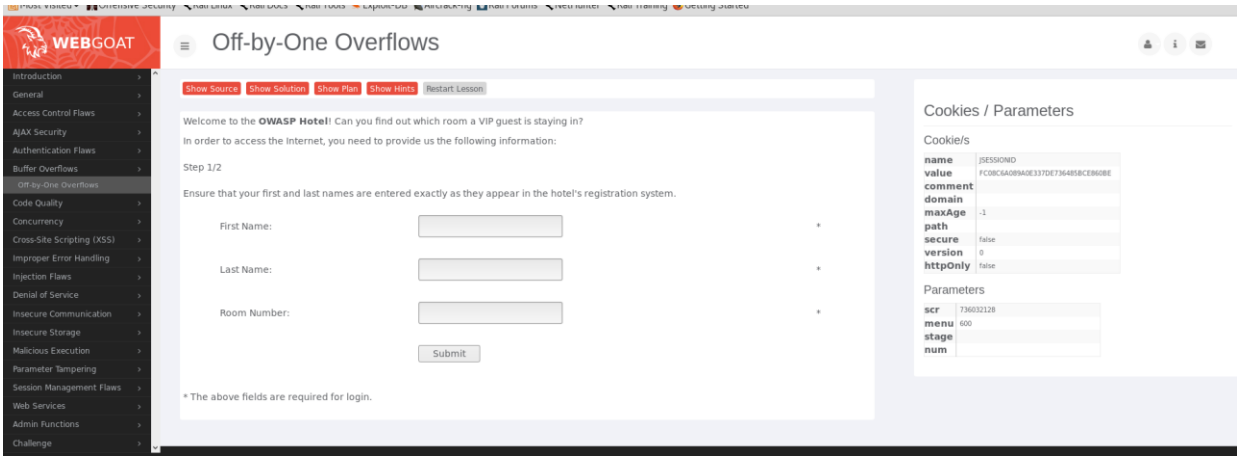
Exposure period

- Requirements specification: The choice could be made to use a language that is not susceptible to these issues.
- Design: Mitigating technologies such as safe-string libraries and container abstractions could be introduced.
- Implementation: Many logic errors can lead to this condition. It can be exacerbated by lack of or misuse of mitigating technologies.

Select the following option in the WebGoat left hand menu:

Buffer Overflows → Off-by-One Overflows

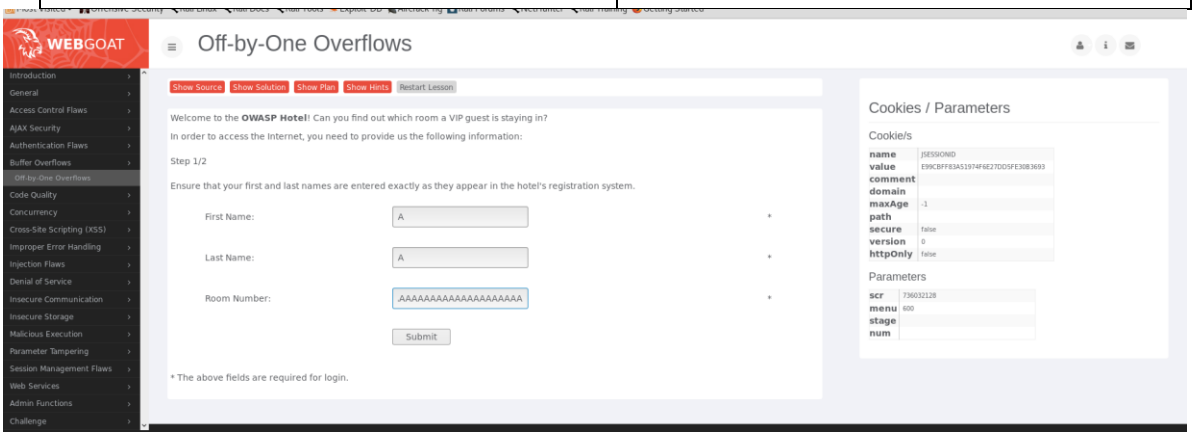
A web page will be displayed; the web page is simulating a room booking.



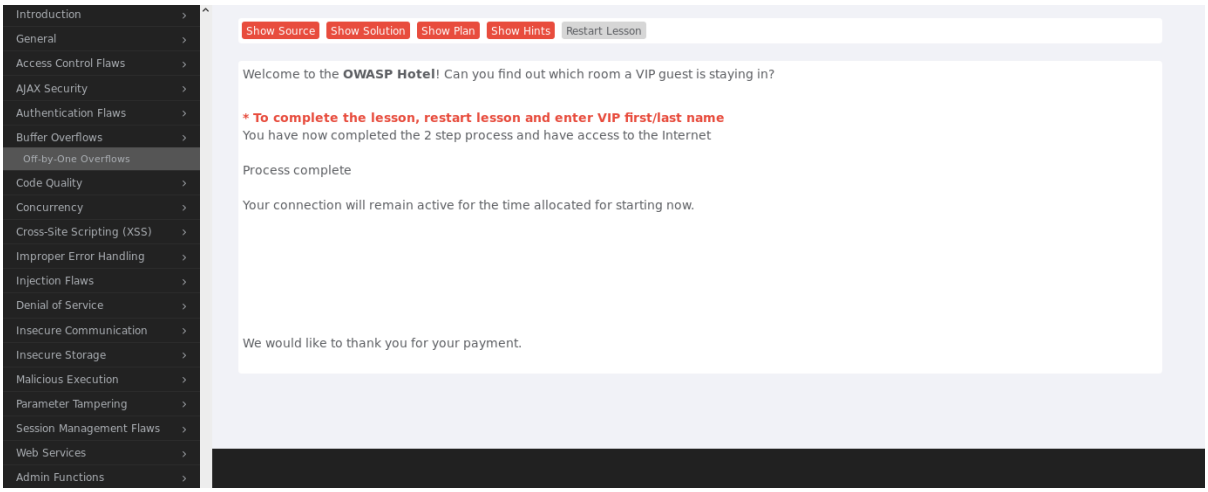
What you need to do

1. You will enter arbitrary details.

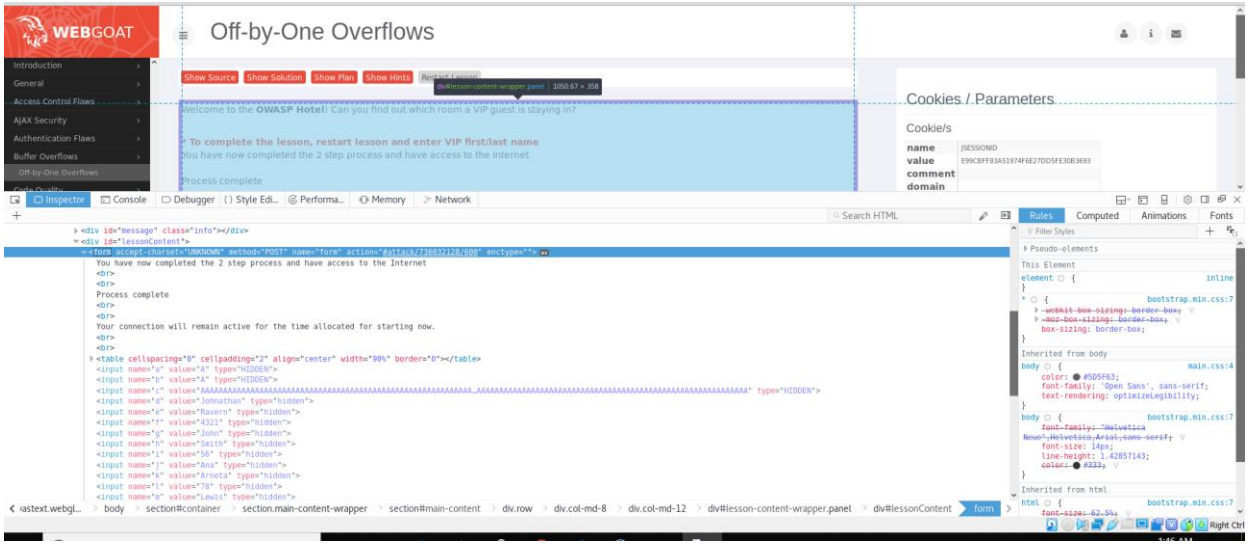
First Name	A
Last Name	A
Room Number	Over 6000 A's or any characters as shown below



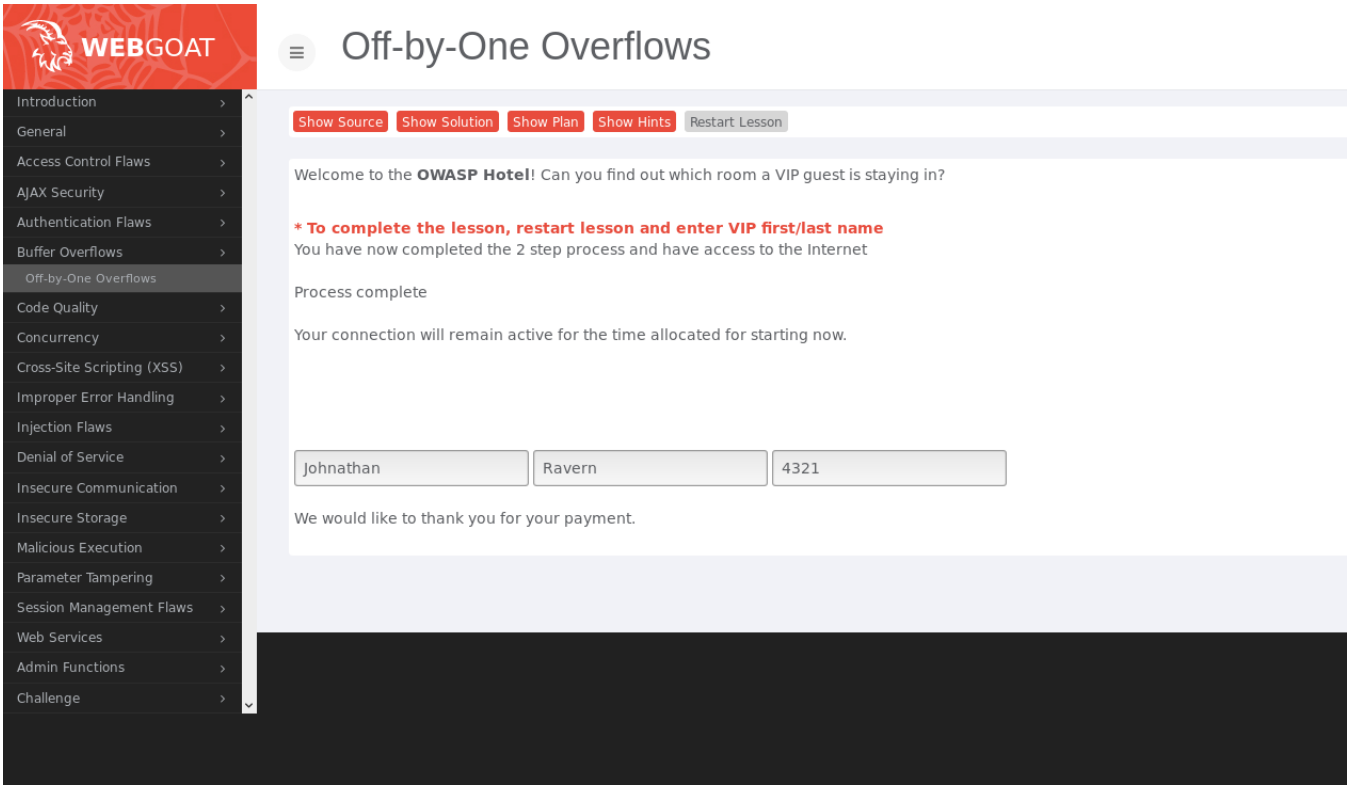
2. Click "**Submit**" and then "**Accept Terms**".



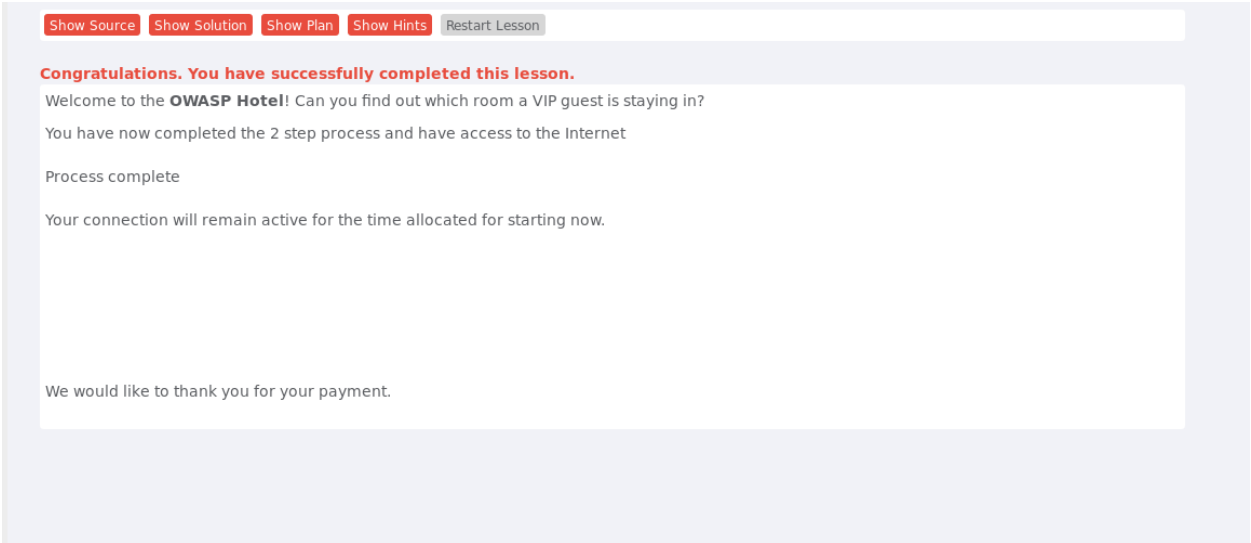
3. Right click on the page and select "**Inspect Element (Q)**" you will be able to see hidden form fields. Remove the `type="HIDDEN"` parameters for all of the guests.



4. After deleting the parameter `type="HIDDEN"` you will be able to see details of your input data on the web page. Remember the other guest's information (i.e., First Name, Last Name, Room Number).



5. Click on "**Restart Lesson**" and give these room details for one of the users to complete the task. (You can use any of the other member room details.)



Q9: What is John Smith's room number? Attach a screenshot of the web page showing the details.