Orbital Security

INTRODUCTION TO (OFFENSIVE) WEB SECURITY

Whoamwe

Clyde
Samuel
Boston

Introduction

Beginner-level intro to web security

Hands-On

Offensive

Get our hands dirty with code

Discussion

Ground Rules

What we learn here should not be used on systems you do not have permission to attack

Singapore Law prescribes harsh penalties for those who break it

Do not deny others of the same training materials (e.g. by changing their passwords)

Rules of Engagement

Only attack the following URLs:

- http://206.189.38.220/DVWA/login.php

Let’s Get Started

Agenda

1. Software Preparation & Environment Set Up
2. Brief Recap on Web Concepts
3. Common Web Vulnerabilities
4. Basic Prevention

Software Preparation & Environment Set Up

Hopefully you should have the following:

- Google Chrome
- If not, you can download them now. It’s not that large.

Web Concepts Recap

HTTP Protocol

The HTTP protocol is a text-based protocol at its heart

Involves a client making requests for resources on the server

These resources take the form of web pages, images, scripts, etc

Sometimes these requests make changes on the server, sometimes they do not

HTTP Request

A simple handwritten HTTP request might look like this:

```
GET /orb HTTP/1.1
Host: http://206.189.38.220/DVWA/login.php
```

HTTP Request Breakdown

```
GET /orb HTTP/1.1
Host: http://206.189.38.220/DVWA/login.php
```

GET - HTTP Method

/orb - Resource

HTTP/1.1 - HTTP Version

HTTP Request

The response to the request might look like:

```
HTTP/1.1 200 OK
  Date: Mon, 30 May 2016 03:17:46 GMT
  Server: Apache/2.2.22 (Debian)
```

HTTP Request Breakdown

```
HTTP/1.1 200 OK
Date: Mon, 30 May 2016 03:17:46 GMT
Server: Apache/2.2.22 (Debian)
```

`HTTP/1.1` - HTTP Version

`200 OK` - Status Code

`Date: Mon, 30 May 2016 03:17:46 GMT` - Date Hdr

`Server: Apache/2.2.22 (Debian)` - Server Header

HTTP Methods

There are many methods supported by the HTTP protocol

Such methods include: GET, HEAD, POST, PUT, DELETE

Most requests in web applications make use of the GET or POST method

HTML

HTML is a language used to describe the layout and content of a web page

Essentially a hierarchy of <tags> representing a tree structure

Features attributes

E.g.

CSS

Handles the styling and presentation of the page

Different browsers have certain unique CSS

Can be linked into a HTML page with <link>

e.g. : body { color: blue; }

Images

Images are one type of resource represented by an HTML tag

Interesting properties and events supported by the tag

E.g.

Javascript

Javascript provides the dynamic and interactive behaviour of a webpage

Can be linked or executed by placing code within script tags

E.g. <script> alert(1); </script>

HTTP Headers

HTTP headers provide a means of communicating metadata between a server and client

Common headers include:

Date, Host, Cookie, Server

Cookies

HTTP is not a stateful protocol; it does not entertain the concept of persistence

Cookies help to implement that

Special HTTP header

E.g. Cookie: mycookie=thisisacookie

Analysis with Chrome

Chrome Inspector (View Source)

Chrome comes with a lot of useful tools for web security analysis

To bring up the Chrome Inspector, right click and select Inspect from the drop down menu

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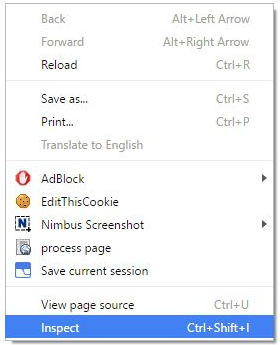
https://www.google.com.sg/?gws_rd=cr,ssl&ei=wnJMV_eGOsj8vASgo4-gCQ

Jeremy Gmail Images

Google Singapore

Google Search I'm Feeling Lucky

Google.com.sg offered in: 中文(简体) Bahasa Melayu தமிழ்



Advertising Business About Privacy Terms Settings Use Google.com

ENG 1:05 AM

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https://www.google.com.sg/?gws_rd=cr,ssl&ei=wnJMV_eGOsj8vASgo4-gCQ

Jeremy Gmail Images

Elements Console Sources Network Timeline Profiles Resources Security Audits EditThisCookie

```
<!DOCTYPE html>
<html itemscope itemtype="http://schema.org/WebPage" lang="en-SG">
▶<head>…</head>
▼<body class="hp vasq" onload="try{if(!google.j.b){document.f&&document.f.q.focus();document.gbqf&&document.gbqf.q.focus();}}catch(e){}if(document.images)new Image().src='/images/nav_logo242.png'" id="gsr">
  ▼<div class="ctr-p" id="viewport">
    <div data-jiis="cc" id="doc-info"></div>
    ▶<div data-jiis="cc" id="cst">…</div>
    <a href="/setprefs?suggon=2&prev=https://www.google.com.sg/?gws_rd%3Dcr,ssl%26ei%3DwnJMV_eGOsj8vASgo4-gCQ&sig=0_PrbzgAtquSpnj1YWp0-szvKQvs8%3D" style="left:-1000em;position:absolute">Screen-reader users, click here to turn off Google Instant.</a>
    <textarea name="csi" id="csi" style="display:none"></textarea>
    <script>if(google.j.b)document.body.style.visibility='hidden';</script>
    ▶<div class="jhp big" id="searchform">…</div>
    <div id="gac_scont"></div>
    ▶<div class="spch s2fp-h" style="display:none" id="spch">…</div>
    ▼<div class="content" data-jiis="cc" id="main">
      ▼<span class="ctr-p" id="body">
        ▼<center>
          ▶<div style="height:233px;margin-top:89px" id="lga">…</div>
          <div style="height:118px"></div>
          ▼<div data-jibp="h" data-jiis="uc" id="prm-pt" style="margin-top:12px">
            ▶<style>…</style>
            <script>window.gbar&&gbar.up&&gbar.up.tp&&gbar.up.tp();</script>
            ▶<div id="als">…</div> == $0
          </div>
        </center>
      </span>
    ▶<div class="ctr-p" id="footer">…</div>
    ▶<div data-jibp="h" data-jiis="uc" id="footc">…</div>
  </div>
  ▶<script>…</script>
  ▶<div class="gb_2a">…</div>
  ▶<style>…</style>
  <script>(function(){var ctx=[]
  ;google.jsc.x(ctx);})();</script>
  ▶<script>…</script>
  <div data-jiis="cc" id="lfootercc"></div>
 </div>
 <script src="/xjs/_/js/k=xjs.s.en.w-FeYl9BDhM.O/m=sy36,sy42,em2,em1,sy44,em0,sy259,…-HQNhCsILUgIFFAQ/rt=j/d=0/t=zcms/rs=ACT90oEKzSMd2CclDqLyIeJ9tU9j4oGa0Q" gapi_processed="true"></script>
▶<div class="jfk-bubble chw-oc" role="alertdialog" aria-describedby="bubble-5" style="display: none;">…</div>
▶<iframe src="https://clients5.google.com/pagead/drt/dn/" aria-hidden="true" style="display: none;">…</iframe>
</body>
</html>
```

html body#gsr.hp.vasq div#viewport.ctr-p div#main.content span#body.ctr-p center div#prm-pt div#als

Styles Computed Event Listeners

Filter :hov .cls +

```
element.style {
}
#als {                                          ?gws_rd=cr,ssl&…8vASgo4-gCO:52
  font-size: small;
  margin-bottom: 24px;
}
div {                                           user agent stylesheet
  display: block;
}
```

Inherited from center

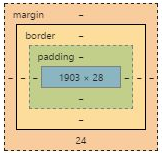
```
center {                                        user agent stylesheet
  display: block;
  text-align: -webkit-center;
}
```

Inherited from body#gsr.hp.vasq

```
body, html {                                    ?gws_rd=cr,ssl&…8vASgo4-gCO:10
  font-size: small;
}
body {                                          ?gws_rd=cr,ssl&…8vASgo4-gCO:10
  background: #fff;
  color: #222;
}
body, td, a, p, .h {                            ?gws_rd=cr,ssl&…8vASgo4-gCO:10
  font-family: arial,sans-serif;
}
```

Inherited from html

```
body, html {                                    ?gws_rd=cr,ssl&…8vASgo4-gCO:10
  font-size: small;
}
```



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Chrome Inspector (Sources)

We can view a list of sources available from the web page

These include javascript source files, images, and other resources

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https://www.google.com.sg/?gfe_rd=cr&ei=uJtMV6juLZvbugSG3r_ABA&gws_rd=ssl

Jeremy Gmail Images

Elements Console Sources Network Timeline Profiles Resources Security Audits EditThisCookie

Sources Content scr... Snippets | nav_logo242.png ×

- top
  - www.google.com.sg
    - images
      - branding/googlelogo/1x
        - nav_logo242.png
      - xjs/_/js/k=xjs.s.en.w-FeYl9BDhN
      - ?gfe_rd=cr&ei=uJtMV6juLZvbu
  - (no domain)
  - apis.google.com
  - clients5.google.com
  - lh3.googleusercontent.com
  - ssl.gstatic.com
  - www.google.com
  - www.gstatic.com
  - l1_1464638399019 (frame)
  - clients5.google.com/
- newtab-serviceworker.js

21.4 KB | 167 × 410 | image/png

Threads
Main
newtab-serviceworker.js
Watch
Call Stack
Not Paused
Scope
Not Paused
Service Workers
Breakpoints
No Breakpoints
DOM Breakpoints
XHR Breakpoints
Event Listener Breakpoints
Event Listeners

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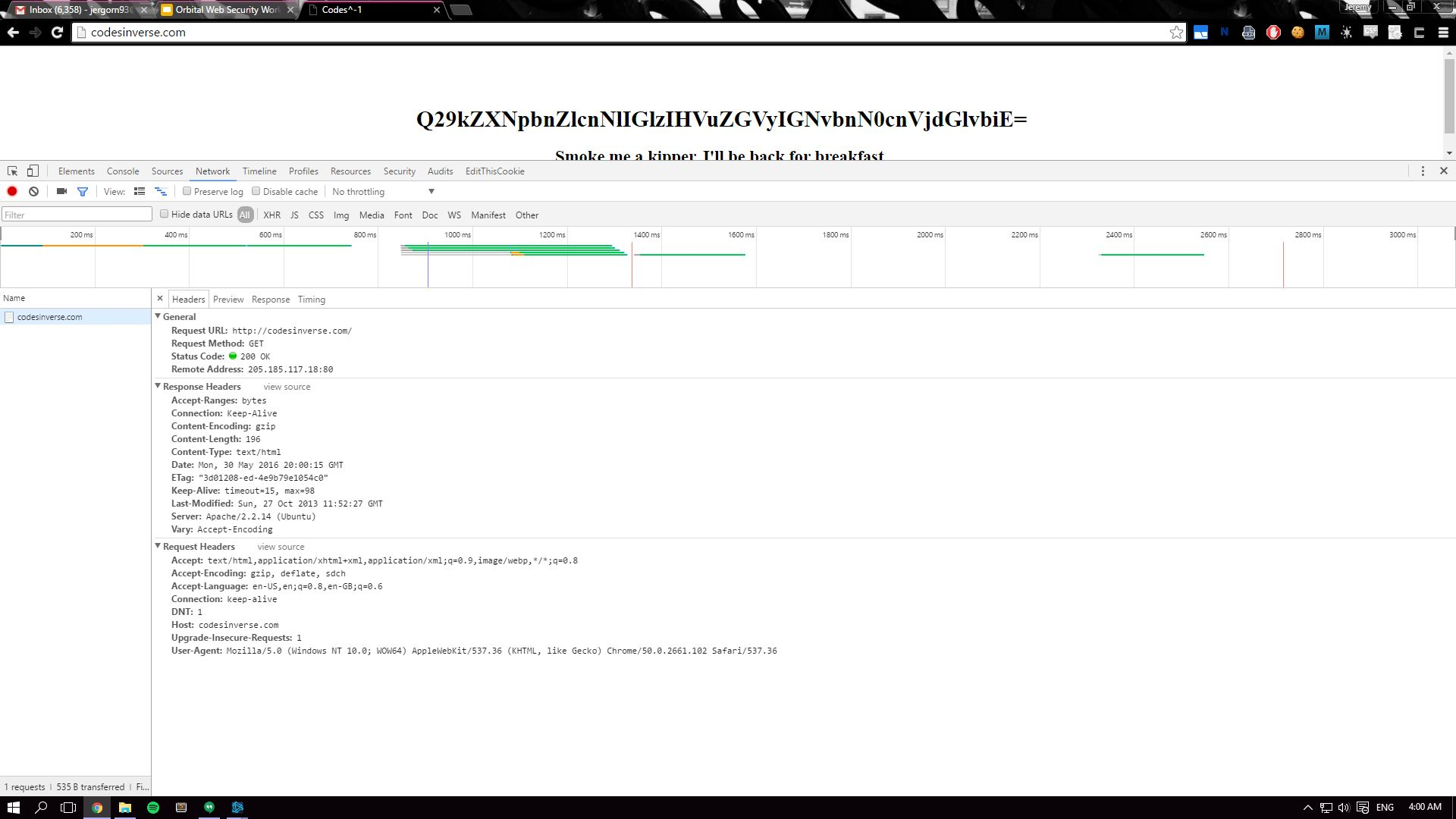
Chrome Inspector (Network Traffic)

Arguably the most important tab for analysis

Allows you to inspect the network activity

Extremely useful to get quick information at a glance and understand what the application is doing


Inbox (6,358) - jergorn93
Orbital Web Security Worl
Codes^-1
codesinverse.com
Jeremy
Q29kZXNpbnZlcnNlIGlzIHVuZGVyIGNvbnN0cnVjdGlvbiE=
Smoke me a kipper, I'll be back for breakfast
Elements Console Sources Network Timeline Profiles Resources Security Audits EditThisCookie
View: Preserve log Disable cache No throttling
Filter Hide data URLs All XHR JS CSS Img Media Font Doc WS Manifest Other
200 ms 400 ms 600 ms 800 ms 1000 ms 1200 ms 1400 ms 1600 ms 1800 ms 2000 ms 2200 ms 2400 ms 2600 ms 2800 ms 3000 ms
Name
codesinverse.com
Headers Preview Response Timing
General
Request URL: http://codesinverse.com/
Request Method: GET
Status Code: 200 OK
Remote Address: 205.185.117.18:80
Response Headers view source
Accept-Ranges: bytes
Connection: Keep-Alive
Content-Encoding: gzip
Content-Length: 196
Content-Type: text/html
Date: Mon, 30 May 2016 20:00:15 GMT
ETag: "3d01208-ed-4e9b79e1054c0"
Keep-Alive: timeout=15, max=98
Last-Modified: Sun, 27 Oct 2013 11:52:27 GMT
Server: Apache/2.2.14 (Ubuntu)
Vary: Accept-Encoding
Request Headers view source
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Accept-Encoding: gzip, deflate, sdch
Accept-Language: en-US,en;q=0.8,en-GB;q=0.6
Connection: keep-alive
DNT: 1
Host: codesinverse.com
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/50.0.2661.102 Safari/537.36
1 requests | 535 B transferred | Fi...
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Editing Cookies

Cookies store persistent data

Most of the time cookies store a session id which identifies the data associated with current session of the browser

A tool (eg. EditThisCookie) to tamper this data can be useful when looking for vulnerabilities in the application

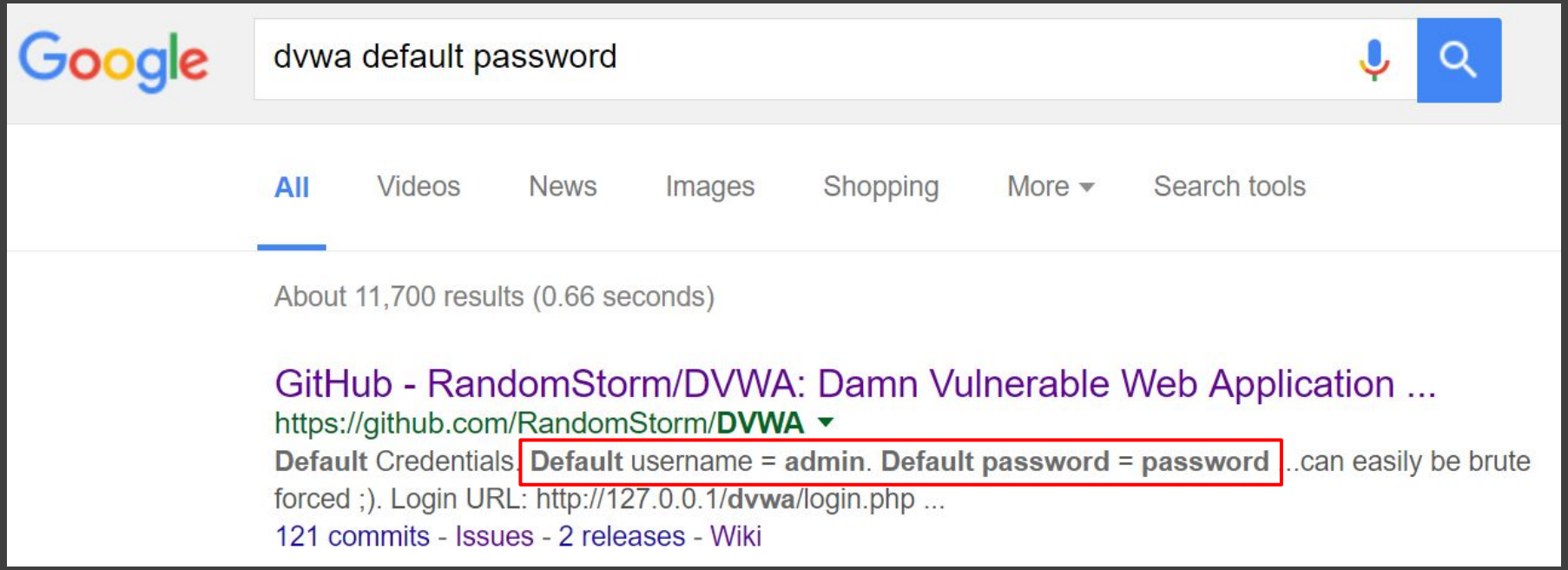
Common Web Vulnerabilities

Damn Vulnerable Web Application (DVWA)

Go to http://206.189.38.220/DVWA/login.php

Guess what is the admin's password?

Default Passwords



Default Passwords

Default passwords are not as uncommon as you think

Cracking them is as easy as doing a Google search

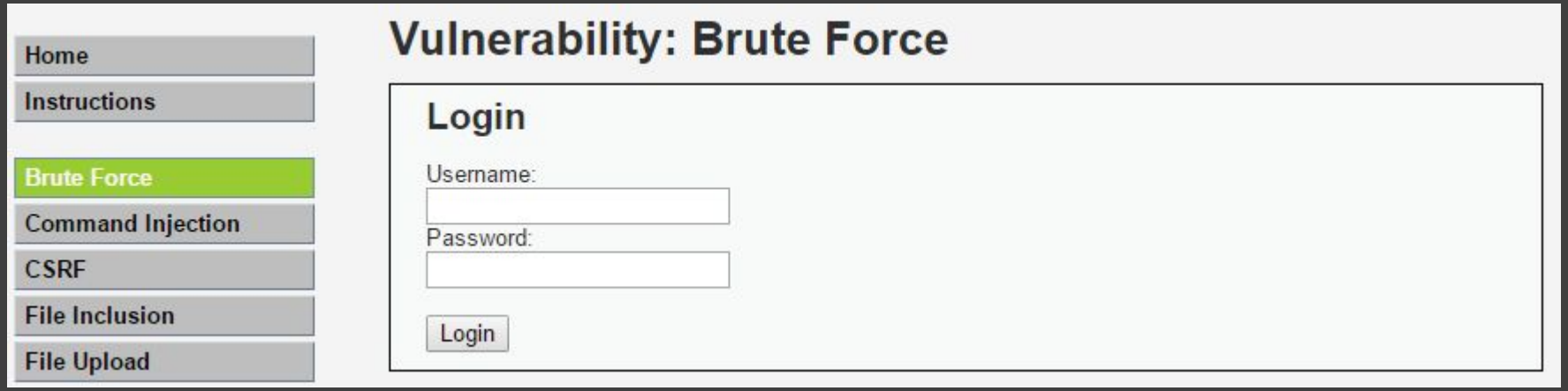
- Many routers ship with default passwords that are left unchanged by users
- Root account on jailbroken iPhones (the default password is ‘alpine’)
- Many web administrators don’t change their default passwords either

Default Passwords

Remedy:

- Change your default passwords!!

Weak Passwords



Weak Passwords

Even when we do not use the default password, we use weak/common passwords (e.g. 123456, qwerty)

These passwords are easily guessable, and with a little bit of scripting, we can automate this brute forcing process:

- We can also make it a little smarter by using dictionaries

#:	Password
1	password
2	123456
3	12345678
4	1234
5	qwerty
6	12345
7	dragon
8	pussy
9	baseball
10	football
11	letmein
12	monkey
13	696969
14	abc123
15	mustang

Weak Passwords

As a web developer, you can:

- Temporarily lock an account after multiple attempts
- Require captchas after a threshold (https://www.google.com/recaptcha/intro/index.html)
- Enforce strong password policies:
  - Alphanumeric + upper and lower case + symbols + sufficient length
  - Regular password renewals

#:	Password
1	password
2	123456
3	12345678
4	1234
5	qwerty
6	12345
7	dragon
8	pussy
9	baseball
10	football
11	letmein
12	monkey
13	696969
14	abc123
15	mustang

SQL Injection

Go to http://206.189.38.220/DVWA/vulnerabilities/sqli/

SQL Injection

What does it do?

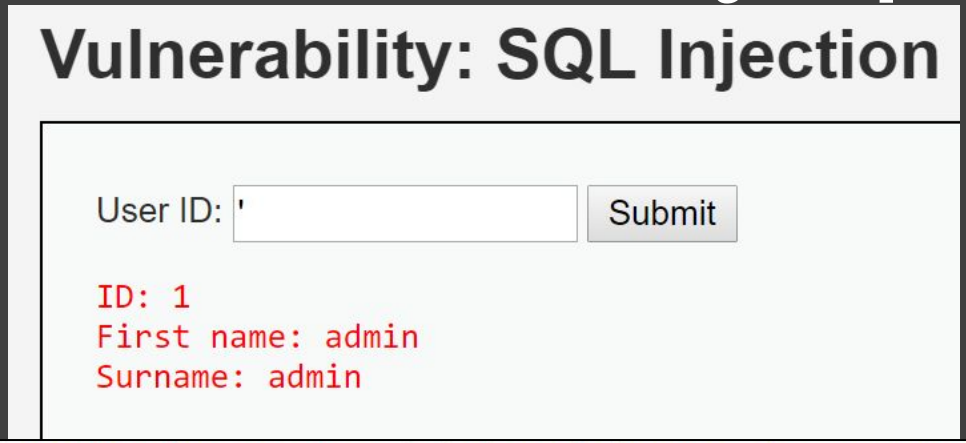
Introduction to an important concept: **Fuzzing**

Fuzz testing - Wikipedia, the free encyclopedia
https://en.wikipedia.org/wiki/Fuzz_testing ▾ Wikipedia ▾
Fuzz testing or **fuzzing** is a software testing technique, often automated or semi-automated, that involves providing invalid, unexpected, or random data to the inputs of a computer program.
History - Uses - Techniques - Reproduction and isolation

SQL Injection

User ID seems to be a number

What if we submit something unexpected?




```
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 ''''' at line 1
```

SQL Injection

What's happening?

SQL Injection Source

```php
<?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>' );
```

SQL Injection

Normally, say $id = 1, we get:

```
// Check database
$query  = "SELECT first_name, last_name FROM users WHERE user_id = '1';";
```

This is a valid SQL statement and execution turns out fine

SQL Injection

But with $id = ‘ we get:

```
// Check database
$query  = "SELECT first_name, last_name FROM users WHERE user_id = ''';";
```

That is an invalid SQL statement!

SQL Injection

How can we be nasty?

Say I wanna view everyone's usernames and passwords. I can craft such an SQL statement:

No rows would match an empty user_id

```
    // Check database
    $query  = "SELECT first_name, last_name FROM users WHERE user_id = ''
UNION SELECT user, password FROM users where '1'='1';";
```

On the other hand, this would return the username and password from all rows

SQL Injection

I simply inject the text highlighted in blue

- ‘ UNION SELECT user, password FROM users WHERE ‘1’=’1

Voila

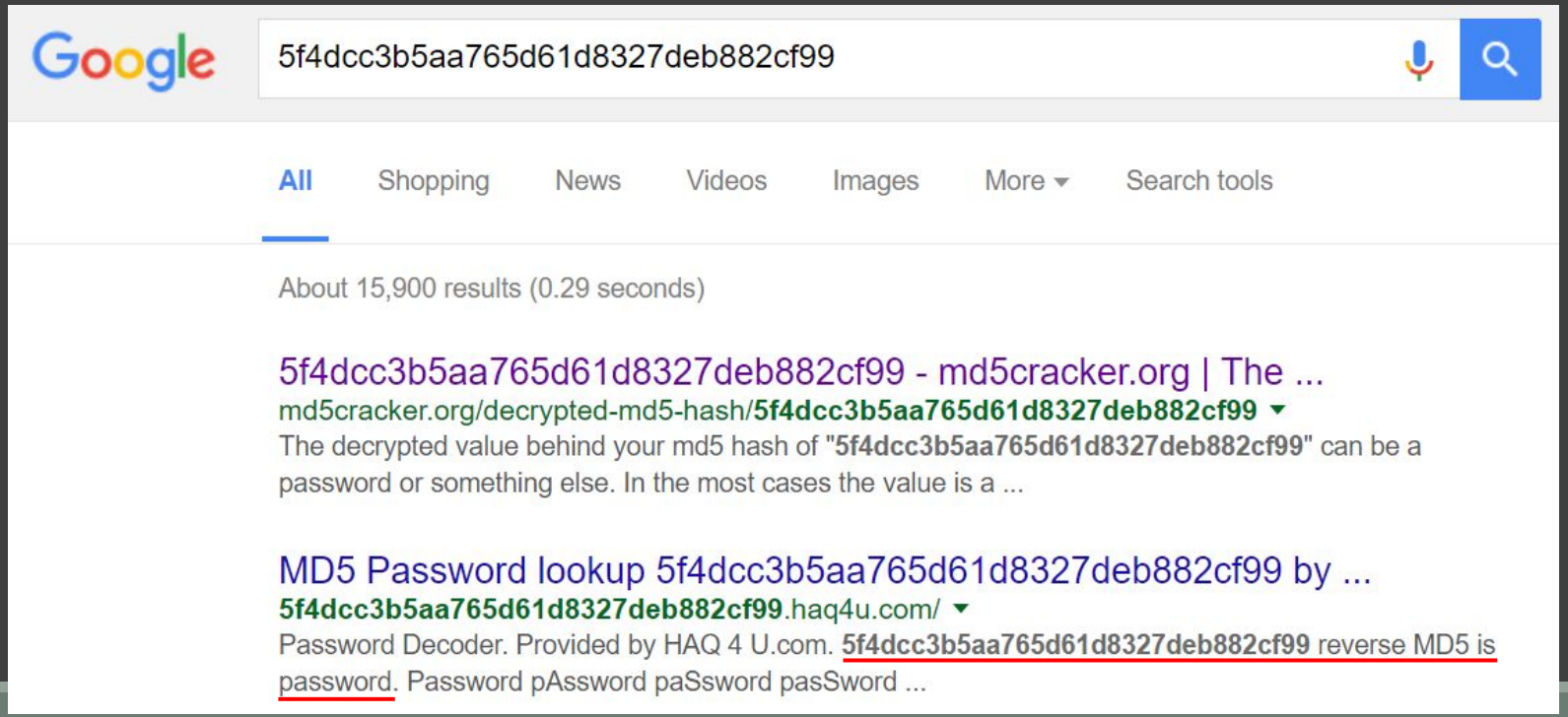
```
ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: admin
Surname: 5f4dcc3b5aa765d61d8327deb882cf99

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: gordonb
Surname: e99a18c428cb38d5f260853678922e03

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: 1337
Surname: 8d3533d75ae2c3966d7e0d4fcc69216b

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: pablo
Surname: 0d107d09f5bbe40cade3de5c71e9e9b7

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: smithy
Surname: 5f4dcc3b5aa765d61d8327deb882cf99
```

Storing Passwords

Can anybody guess what password is smithy using?

```
ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: admin
Surname: 5f4dcc3b5aa765d61d8327deb882cf99

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: gordonb
Surname: e99a18c428cb38d5f260853678922e03

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: 1337
Surname: 8d3533d75ae2c3966d7e0d4fcc69216b

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: pablo
Surname: 0d107d09f5bbe40cade3de5c71e9e9b7

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: smithy
Surname: 5f4dcc3b5aa765d61d8327deb882cf99
```

Storing Passwords



Storing Passwords

The passwords are stored as MD5 hashes

- Prevents passwords from being stored in plaintext
- However, MD5 is weak
- Also, can you tell which users are using the same passwords?

```
ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: admin
Surname: 5f4dcc3b5aa765d61d8327deb882cf99

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: gordonb
Surname: e99a18c428cb38d5f260853678922e03

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: 1337
Surname: 8d3533d75ae2c3966d7e0d4fcc69216b

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: pablo
Surname: 0d107d09f5bbe40cade3de5c71e9e9b7

ID: ' UNION SELECT user, password FROM users WHERE '1'='1
First name: smithy
Surname: 5f4dcc3b5aa765d61d8327deb882cf99
```

Storing Passwords

What can you do?

- Use stronger hashes (e.g. SHA256)
- If possible, delegate this task to a framework/library
- Also, add salt on top of your hashes (yummy) to prevent identical passwords

	Username	PasswordHash	Salt
1	User1	104f4807e28e401c1b9e1c43ac80bdde	nkV38+/eHsI=
2	User2	827e877ba7fa4676ee4903f2b60de13a	NwHowZ63RVw=
3	User3	e901b26b3ec928db2753150d04736c44	Z8uDOfE90gE=

SQL Injection

What can you do?

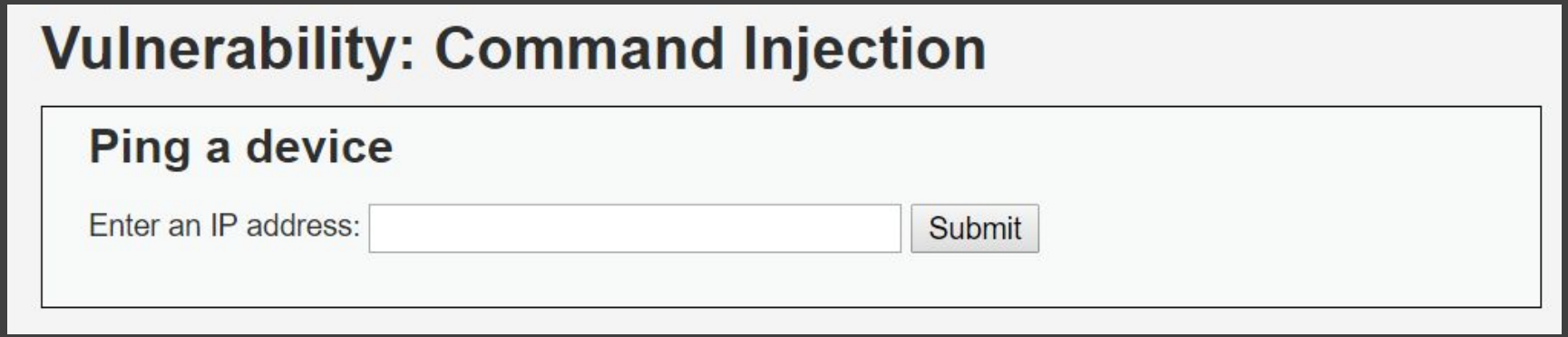
- Use prepared statements (if you must construct raw SQL statements)
- Otherwise, use the models provided by your ORM (e.g. ActiveRecord for Ruby on Rails, Doctrine for Symfony, Django's ORM)

```
// 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();
```

Command Injection

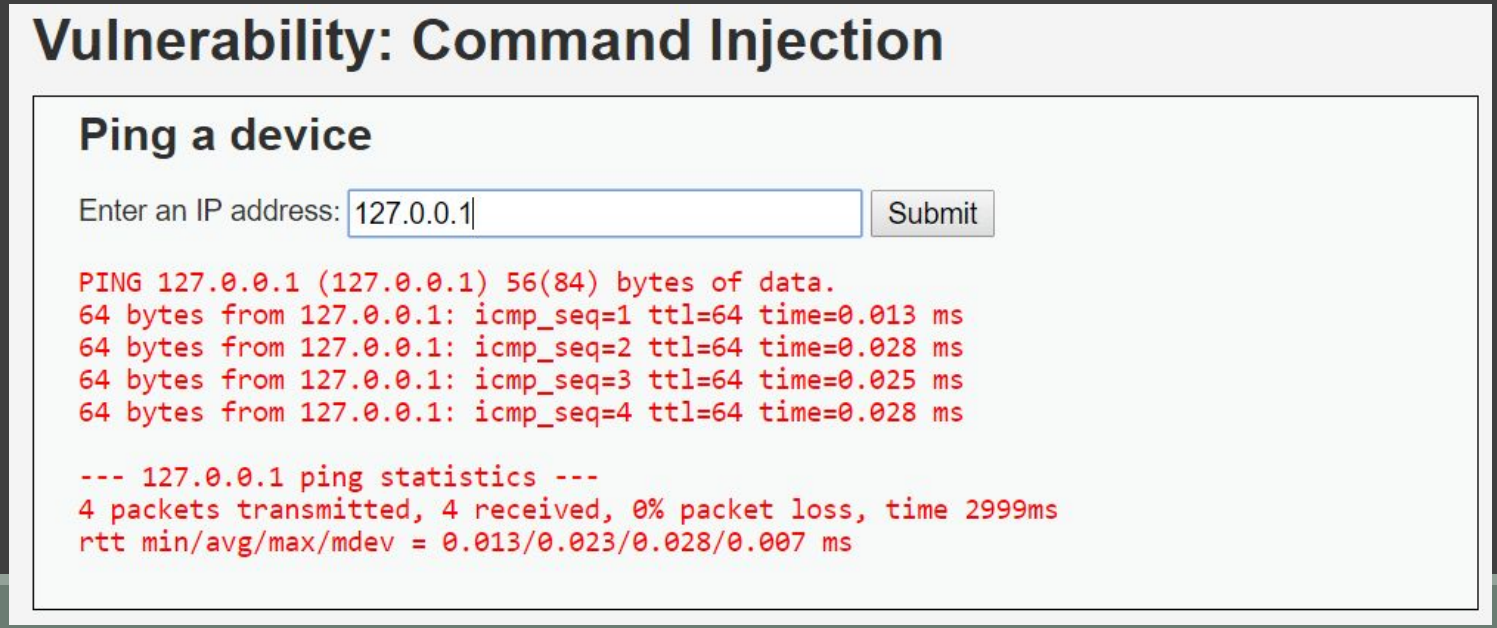
Is SQL injection the only form of code injection around?

Nope. Goto http://206.189.38.220/DVWA/vulnerabilities/exec/



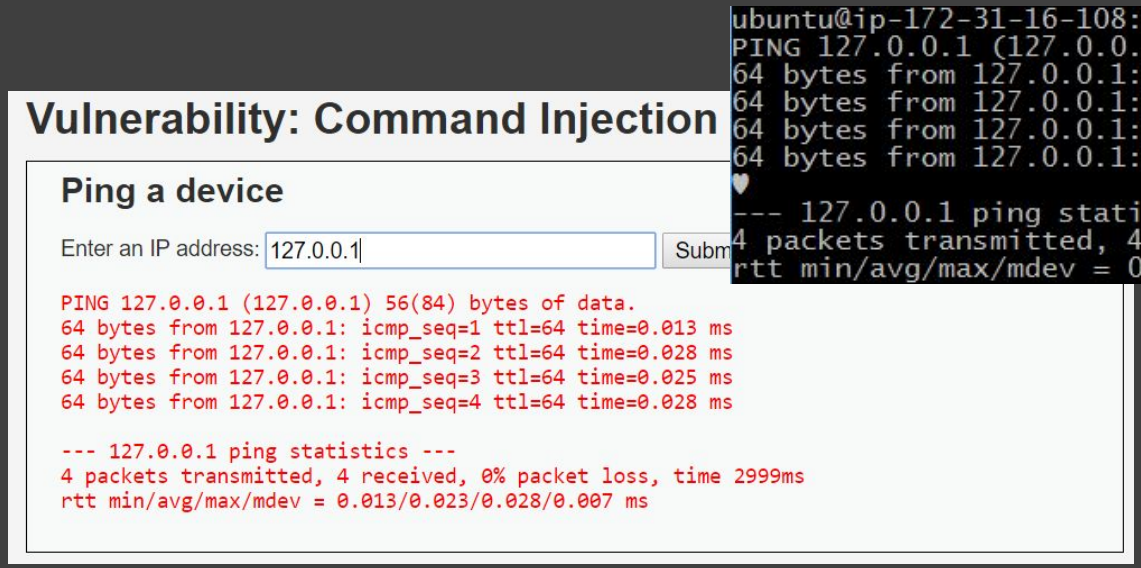
Command Injection

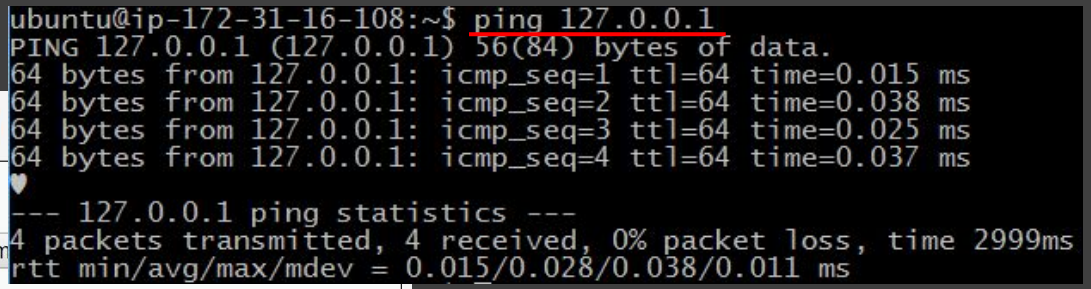
Normal usage:



Command Injection

Does this look familiar to any of you?





Command Injection

In shell, we can separate commands on a single line using semicolon

```
ubuntu@ip-172-31-16-108:~$ echo hi; echo there;
hi
there
```

If the website is executing the ping command in shell, we can append more commands at the back using the semicolon

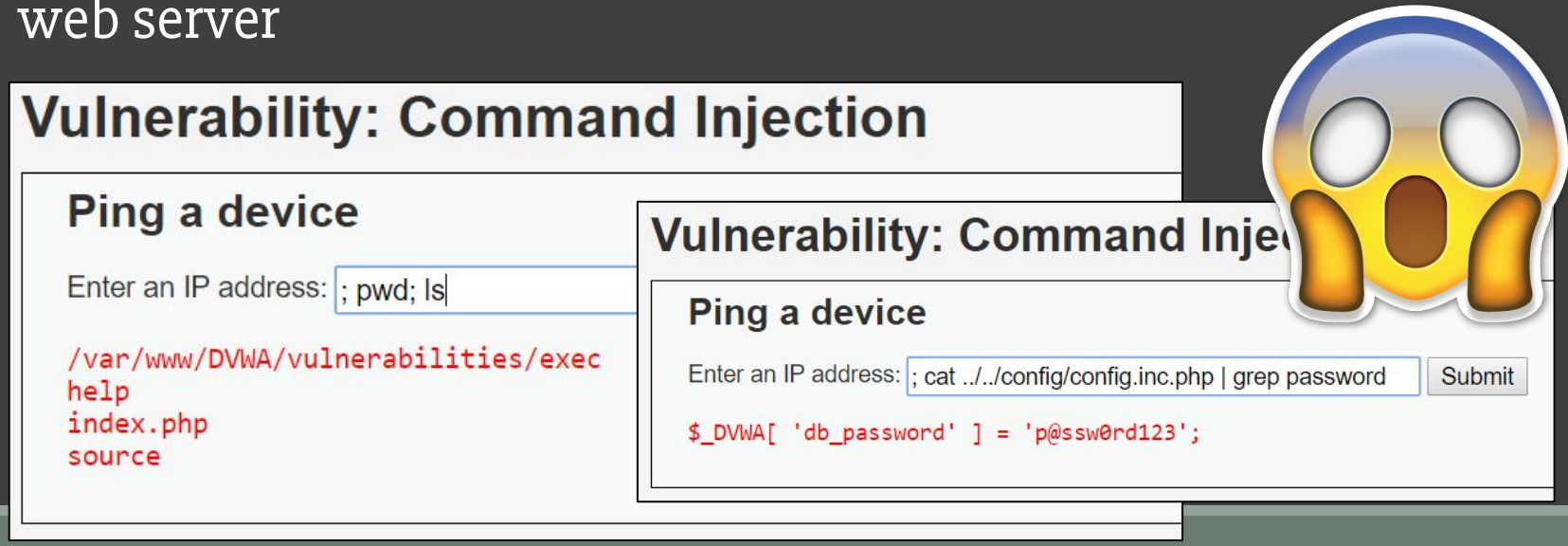
ping 127.0.0.1

pwd

```
ubuntu@ip-172-31-16-108:~$ ping 127.0.0.1; pwd
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
64 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.013 ms
64 bytes from 127.0.0.1: icmp_seq=2 ttl=64 time=0.027 ms
64 bytes from 127.0.0.1: icmp_seq=3 ttl=64 time=0.029 ms
64 bytes from 127.0.0.1: icmp_seq=4 ttl=64 time=0.029 ms
♥
--- 127.0.0.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2999ms
rtt min/avg/max/mdev = 0.013/0.024/0.029/0.008 ms
/home/ubuntu
```

Command Injection

In other words, we have arbitrary command execution on the web server



Command Injection

If you MUST have such a service, what can you do?

- Perform input validation (e.g. check that the given input strictly matches a valid IP address)

```
// 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 ) ) {
```

Cross-Site Request Forgeries (CSRF)

Goto http://206.189.38.220/DVWA/vulnerabilities/csrf/

Cross-Site Request Forgeries (CSRF)

Try changing your password

Do you notice something in the URL?

- http://206.189.38.220/DVWA/vulnerabilities/csrf/?password_new=my_new_password&password_conf=my_new_password&Change=Change#

What if someone lured you to click on such a link?

- Your password would have been changed without your consent!

Cross-Site Request Forgeries (CSRF)

You say it won't happen one lah. After all, who makes applications like that?

Do you use uTorrent?

uTorrent WebUI Cross-Site Request Forgery Vulnerability

To exploit this issue, an attacker must entice an unsuspecting victim into following a malicious URI.

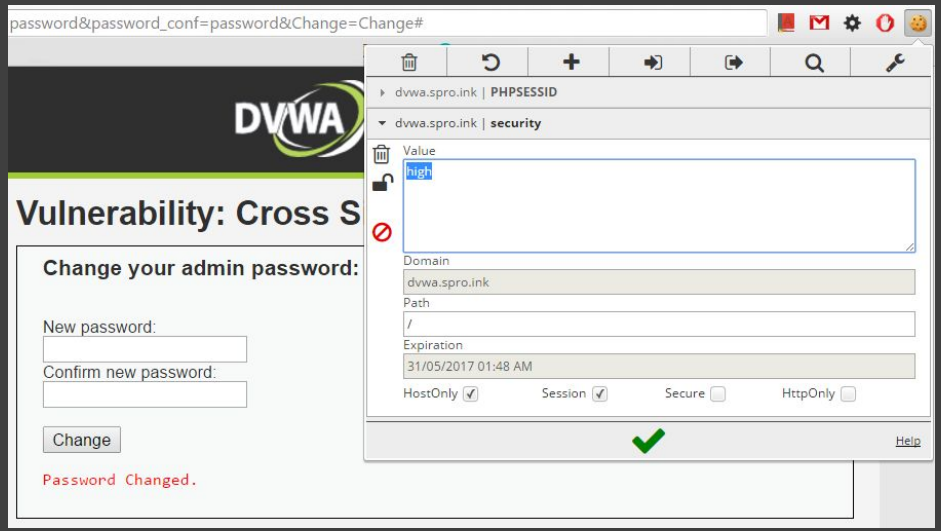
The following example URIs are available:

To force a file download:
http://www.example.com:8080/gui/?action=add-url&s=http://localhost/backdoor.torrent

To change administrative credentials and settings:
http://www.example.com:8080/gui/?action=setsetting&s=webui.username&v=badmin
http://www.example.com:8080/gui/?action=setsetting&s=webui.password&v=badmin
http://www.example.com:8080/gui/?action=setsetting&s=webui.port&v=4096 http://www.example.com:8080/gui/?action=setsetting&s=webui.restrict&v=127.0.0.1/24,10.1.1.1

Cross-Site Request Forgeries (CSRF)

How do we tackle this? Let's change the security level to 'high'



Cross-Site Request Forgeries (CSRF)

Now when you change your password, what do you see?

That's right, a CSRF token!

- http://206.189.38.220/DVWA/vulnerabilities/csrf/?password_new=my_new_password&password_conf=my_new_password&Change=Change&user_token=ceccca9128357edc9c59dab72add364c#
- A unique token is generated every time the user loads the form

Cross-Site Request Forgeries (CSRF)

CSRF Token

- Comes enabled on most frameworks (e.g. Ruby on Rails, Django, Symfony)

Directory Traversal

When dealing with files, there are multiple ways of thinking of them in Linux

Let's assume you're in the /home/orbital directory

The following representations of file 'testfile' are equivalent:

- /home/orbital/testfile
- ./testfile
- ../orbital/testfile

Directory Traversal

Imagine if your web application had to handle serving files from locations that are dynamic

Obviously, it is not practical to create a case for each file you want to serve

So you'd probably like to automate it

Directory Traversal

Now let's say the user can request for any of these files, and if they exist, print the contents

Go to this link:

http://206.189.38.220/DVWA/vulnerabilities/

Directory Traversal

Show source

```
<html>
<head></head>
<body>

<a href="?file=one">One</a>
<a href="?file=two">Two</a>
<a href="?file=three">Three</a>
<a href="?file=four">Four</a>
<a href="?file=five">Five</a>

<br />
<a href="?src=1">Show source</a>
<?php
$f = $_GET['file'];
$s = $_GET['src'];
if (isset($f)) {
    echo "Number Ascii Art++";
    echo "<pre>";
    echo file_get_contents("nums/" . $f);
    echo "</pre>";
}
else if (isset($s)) {
    show_source(__FILE__);
}
?>

</body>
</html>
```

Directory Traversal

It looks fine at the first glance but wait!

Remember that ./testfile is == ../orbital/testfile if we are in the orbital directory?

We can leverage this relative property of paths to obtain juicy information on the system

Perhaps /etc/passwd?

```
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin
gnats:x:41:41:Gnats Bug-Reporting System (admin):/var/lib/gnats:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
systemd-timesync:x:100:102:systemd Time Synchronization,,,:/run/systemd:/bin/false
systemd-network:x:101:103:systemd Network Management,,,:/run/systemd/netif:/bin/false
systemd-resolve:x:102:104:systemd Resolver,,,:/run/systemd/resolve:/bin/false
systemd-bus-proxy:x:103:105:systemd Bus Proxy,,,:/run/systemd:/bin/false
syslog:x:104:108::/home/syslog:/bin/false
_apt:x:105:65534::/nonexistent:/bin/false
messagebus:x:106:110::/var/run/dbus:/bin/false
lxd:x:107:65534::/var/lib/lxd/:/bin/false
uuidd:x:108:112::/run/uuidd:/bin/false
dnsmasq:x:109:65534:dnsmasq,,,:/var/lib/misc:/bin/false
sshd:x:110:65534::/var/run/sshd:/usr/sbin/nologin
pollinate:x:111:1::/var/cache/pollinate:/bin/false
mysql:x:112:116:MySQL Server,,,:/nonexistent:/bin/false
```

Directory Traversal

Many real life examples

Some NUS student group and research sites are vulnerable

Directory Traversal

How do we fix this?

Again, consider using mappings between an index and whitelisted values

Chroot jails can provide a restricted environment

Validate that the normalised absolute path contains a pre-approved prefix

Local File Inclusion

A modular approach to building your application is a good idea

In programming, we often import or include source files that provide extra functionality

However, when we give the user the power to decide which source files are included, this can turn nasty

Local File Inclusion

This arises a lot in PHP due to the its paradigm but it can happen in any framework

In fact, it can happen and probably has happened in every conceivable web framework that uses templates

Inclusion of the file works as if the code from that file was copy and pasted into the including script

Local File Inclusion

Local File Inclusion is very serious because in some cases, it can lead to arbitrary code execution

At the very least, it can provide an information leakage primitive

Local File Inclusion

```
<html>
<head></head>
<body>
<h1>Hackers</h1><br />
<a href="?page=main">Main</a>
<a href="?page=zerocool">Zero Cool</a>
<a href="?page=acidburn">Acid Burn</a>
<!-- we had a page for The Plague but he's gone now -->

<br />
<a href="?src=1">Show source</a>
<br />
<?php
$p = $_GET['page'];
$s = $_GET['src'];
if (isset($p)) {
    chdir("pages");
    include($p . ".php");
    echo "Bio info: " . $bio;
}
else if (isset($s)) {
    show_source(__FILE__);
}
?>

</body>
</html>
```

Hackers

Main Zero Cool Acid Burn
Show source
Bio info: Dade Murphy's a total loser

Local File Inclusion

Let’s try that path traversal attack again

Hackers

Main Zero Cool Acid Burn
Show source
Bio info:

Local File Inclusion

It did not work because now we have a new constraint!

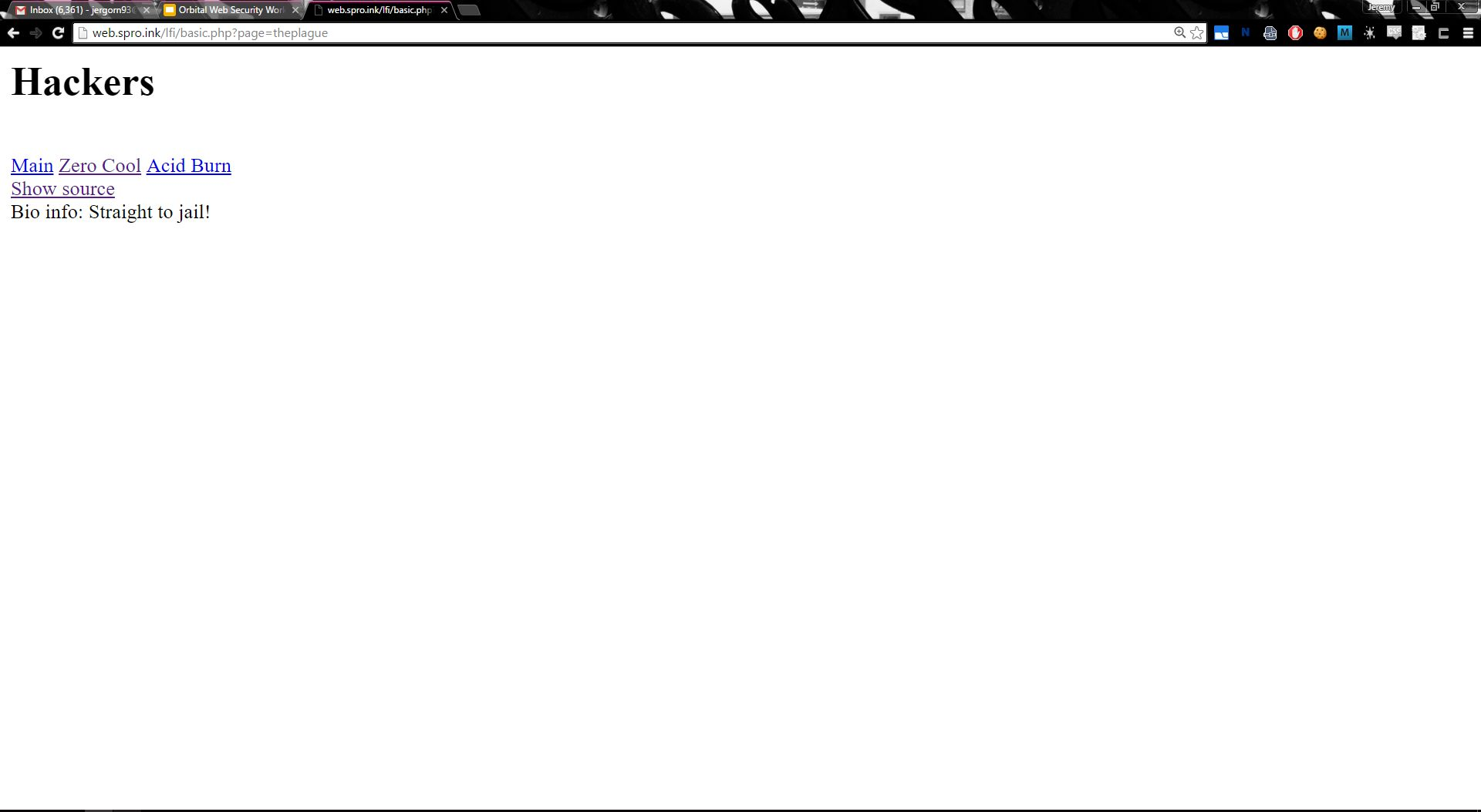
The suffix “.php” is prepended to the user supplied input

We cannot include files of any other extension without some tricks

Local File Inclusion

However, let’s go on that hint given in the source

There seems to be an undocumented bio that we might be able to access through our control of the page parameter


Inbox (6,361) - jergorn93
Orbital Web Security Wor
web.spro.ink/lfi/basic.php
web.spro.ink/lfi/basic.php?page=theplague
Hackers
Main Zero Cool Acid Burn
Show source
Bio info: Straight to jail!
ENG
11:07 AM

Local File Inclusion

Indeed, it exists

Let’s go one step further and try to read the source code

Remember that when a file is included in PHP, the contents are treated as if they are copied and pasted into the including script so if its PHP code, we will never be able to view it

Local File Inclusion

There is a very useful trick, however

We can use PHP filters to convert the source file into something that is not recognisable as PHP and then we can get past the code being executed

```
php://filter/convert.base64-encode/resource=theplague
```

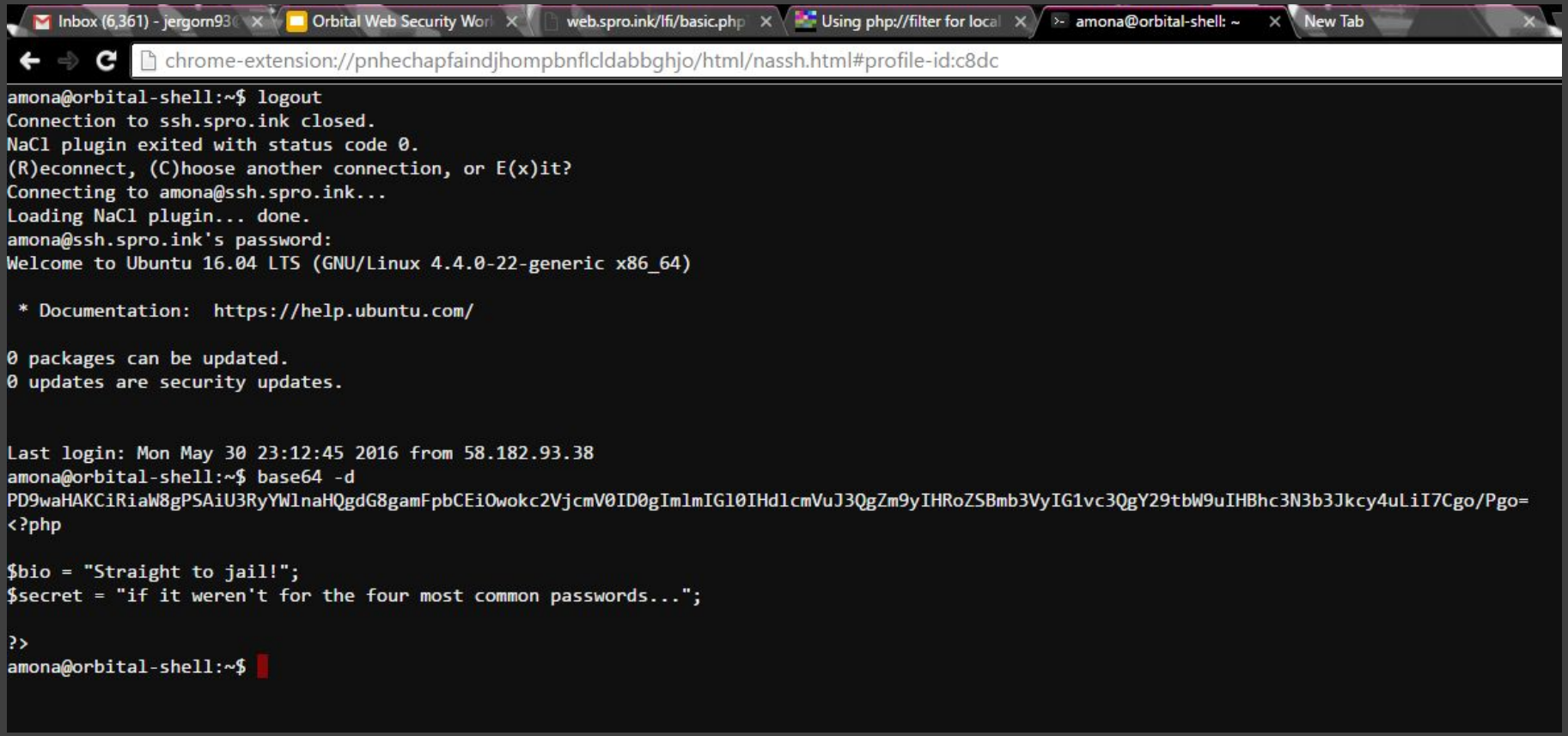
Hackers

Main Zero Cool Acid Burn
Show source
PD9waHAKCiRiaW8gPSAiU3RyYWlnaHQgdG8gamFpbCEiOwokc2VjcmV0ID0gImlmIGl0IHdlcmVuJ3QgZm9yIHRoZSBmb3VyIG1vc3QgY29tbW9uIHBhc3N3b3Jkcy4uLiI7
info:

Local File Inclusion

It’s base64, so let’s decode it

Use your shell or an online tool!


Inbox (6,361) - jergorn93
Orbital Web Security Wor
web.spro.ink/lfi/basic.php
Using php://filter for local
amona@orbital-shell: ~
New Tab
chrome-extension://pnhechapfaindjhompbnflcldabbghjo/html/nassh.html#profile-id:c8dc
amona@orbital-shell:~$ logout
Connection to ssh.spro.ink closed.
NaCl plugin exited with status code 0.
(R)econnect, (C)hoose another connection, or E(x)it?
Connecting to amona@ssh.spro.ink...
Loading NaCl plugin... done.
amona@ssh.spro.ink's password:
Welcome to Ubuntu 16.04 LTS (GNU/Linux 4.4.0-22-generic x86_64)
* Documentation: https://help.ubuntu.com/
0 packages can be updated.
0 updates are security updates.
Last login: Mon May 30 23:12:45 2016 from 58.182.93.38
amona@orbital-shell:~$ base64 -d
PD9waHAKCiRiaW8gPSAiU3RyYWlnaHQgdG8gamFpbCEiOwokc2VjcmV0ID0gImlmIGl0IHdlcmVuJ3QgZm9yIHRoZSBmb3VyIG1vc3QgY29tbW9uIHBhc3N3b3Jkcy4uLiI7Cgo/Pgo=
<?php
$bio = "Straight to jail!";
$secret = "if it weren't for the four most common passwords...";
?>
amona@orbital-shell:~$

Local File Inclusion

How do we fix this? (Mapping)

Never allow any user input to be present in the argument to include

Once an attacker can control an include, its game over

Whitelist source files if you absolutely must have the parameter sent by the client

Insecure Objects

There are many ways to make a system insecure

If you aren’t careful, you can introduce bugs

Many are tempted to roll their own authentication systems

Often, they fail

Insecure Objects

One such way to do that is by not making use of a secure means of maintaining persistent data for a user

Insecure Objects

How can we fix this?

Never use any data that you cannot verify the integrity of

Prefer storing the data on the server side through the session and only let the user’s browser carry and identifying session id

Fin.