Web Security and You

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About Security

Do we really need to worry about this?

Security? Bah!

Whether big or small.
Someone will try to hack you!

It only takes one person!

The Open Web Application Security Project

http://owasp.org/

The best online resource for learning about various attack vectors and solutions to them.

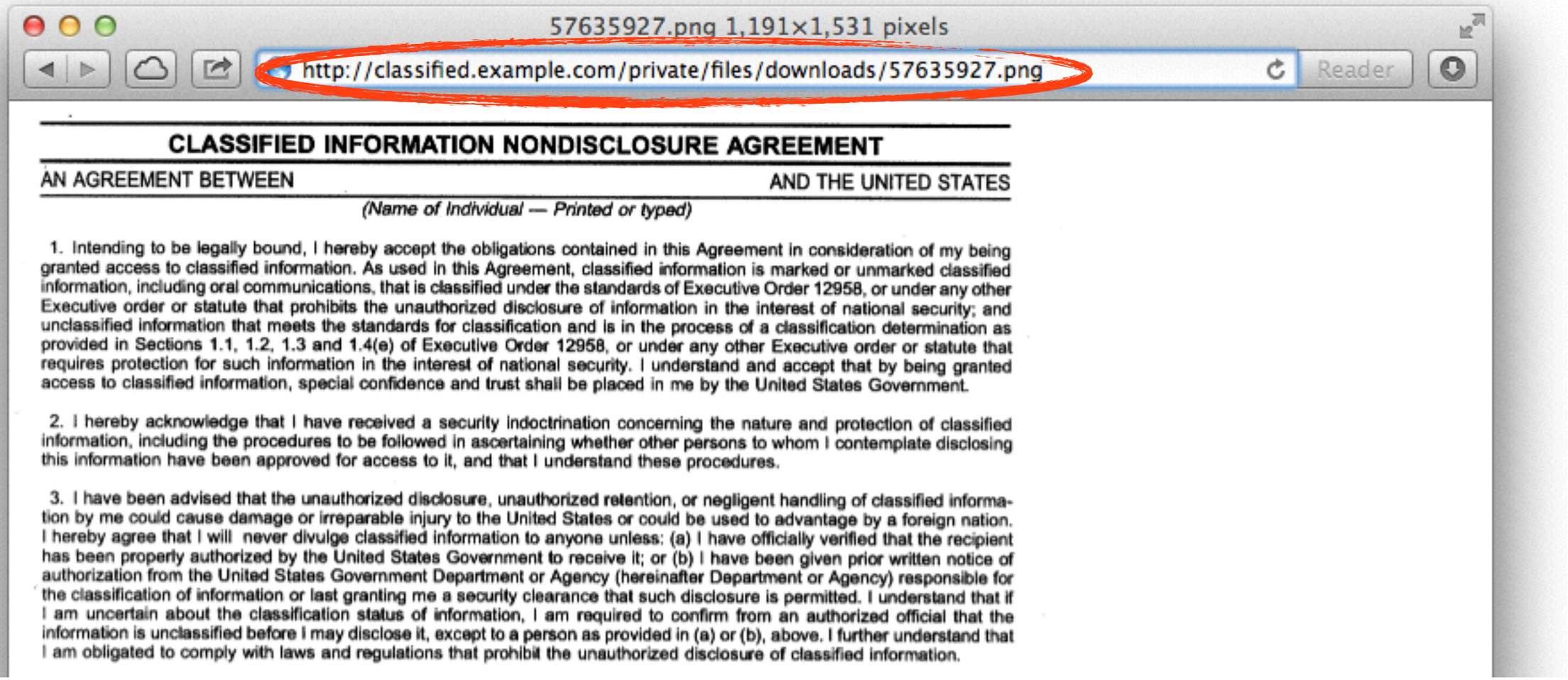
Use good judgement though, often wiki-user edited 'solutions'.

Stupid Programmer Errors

Let's clear the air on these first …

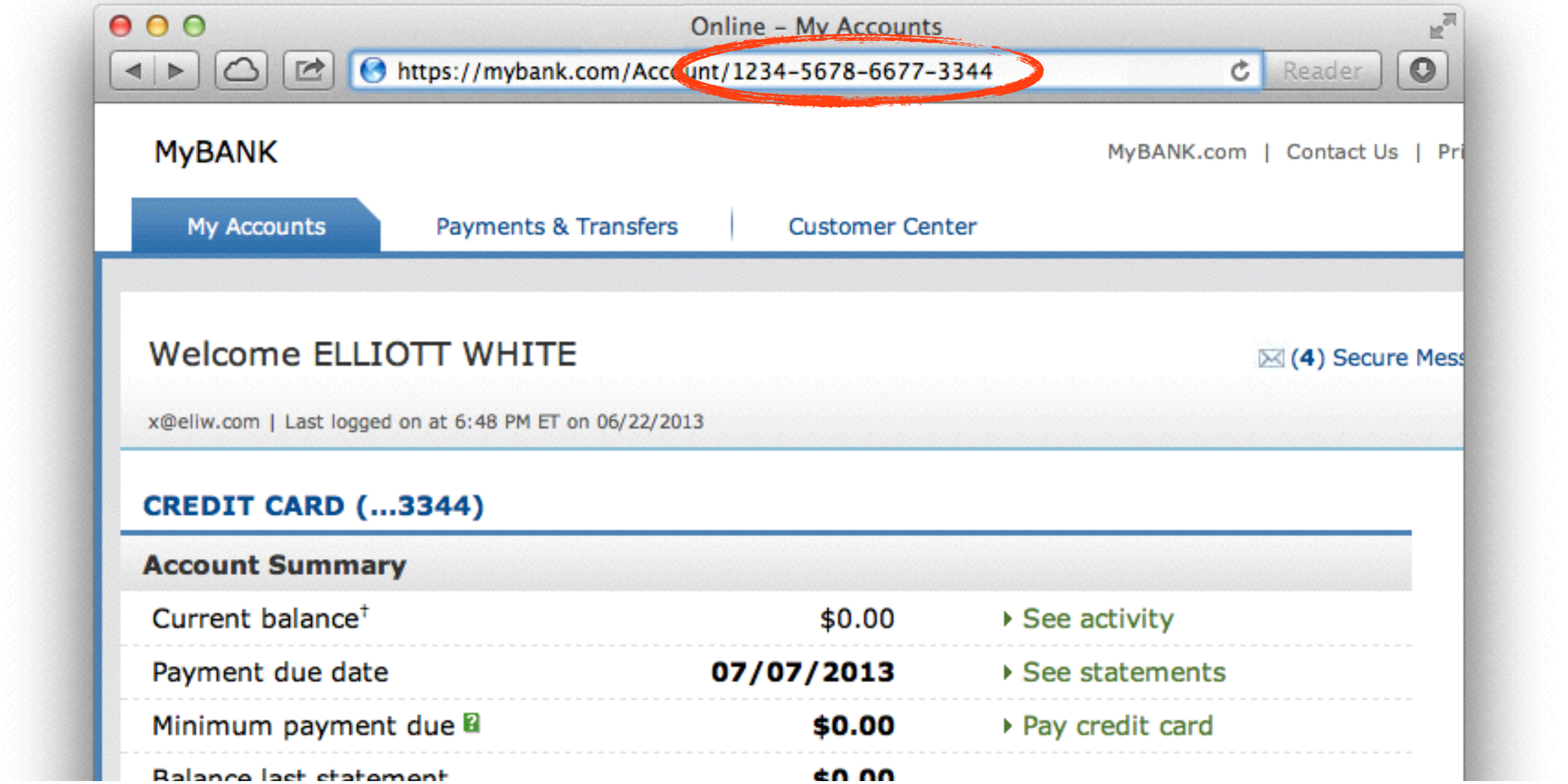
Unchecked Permissions

Direct URL access to a protected file



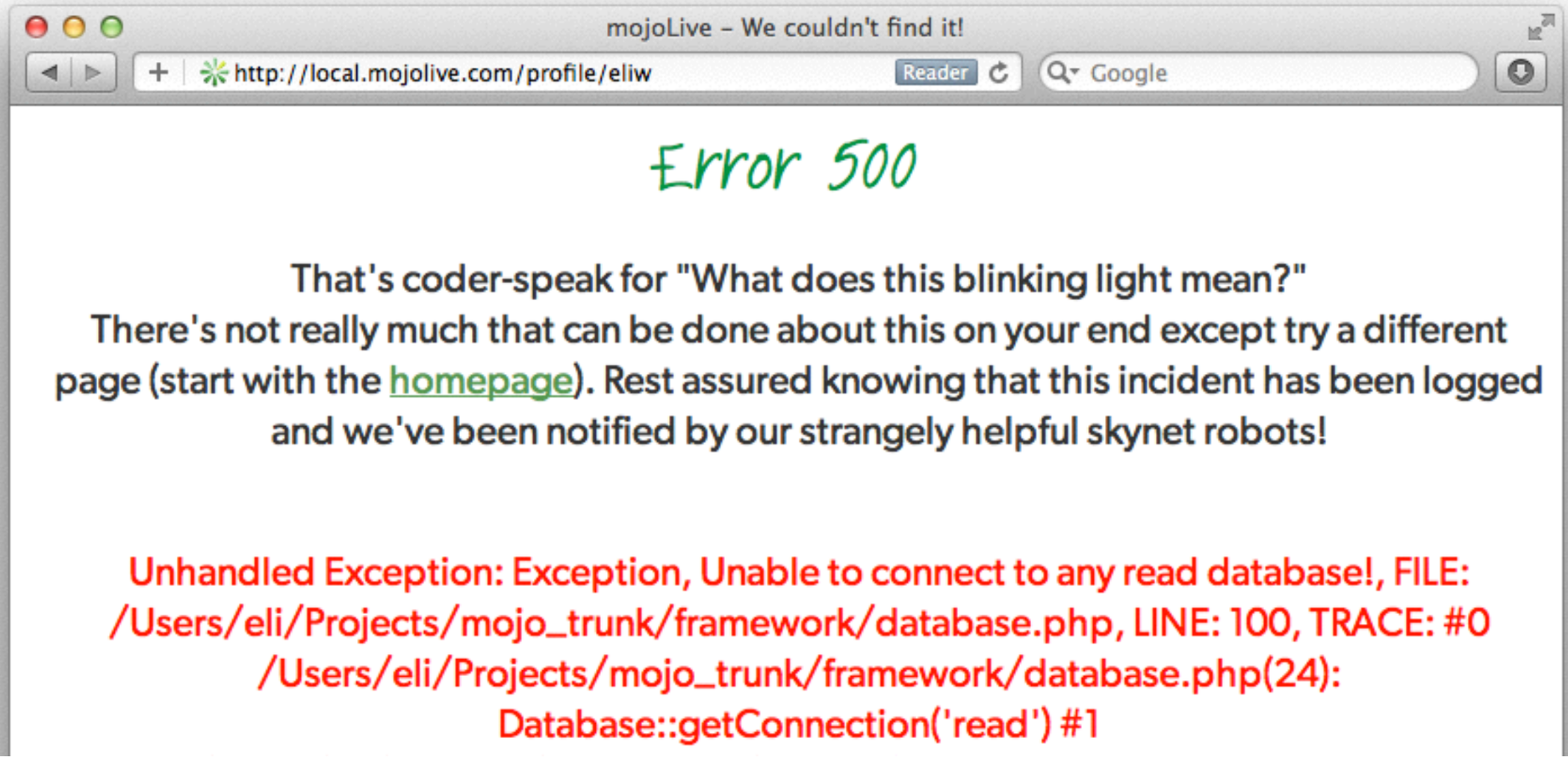
Unchecked Permissions

Ability to URL-hack to access unauthorized data.



Information leaks

Specifically: Visible Error Handling



Low Security Hashes (Encryption)

Don't just use MD5!

Example!

So many other options:
SHA512 SHA256 Blowfish etc!

Heck, even SHA1 is better!

Always salt your hashes!

Various Attack Vectors

Now moving on to true ‘attacks’ …

SQL Injection

A user having the ability to send data that is directly interpreted by your SQL engine.

The Security Hole:

```
$pdo->query("SELECT * FROM users
             WHERE name = '{$_POST['name']}' AND pass = '{$_POST['pass']}'");
```

The Attack:

```
$_GET['name'] = "' or 1=1; //";
```

SQL Injection

A user having the ability to send data that is directly interpreted by your SQL engine.

The Solution:

```php
$query = $pdo->prepare("SELECT * FROM users WHERE name = ? AND pass = ?");
$query->execute(array($_POST['name'], $_POST['pass']));
```

or

```php
$name = $pdo->quote($_POST['name']);
$pass = $pdo->quote($_POST['pass']);
$pdo->query("SELECT * FROM users WHERE name = {$name} AND pass = {$pass}");
```

Other Injection

Command Injection:

The user being able to inject code into a command line.

Unchecked File Uploads:

The user being allowed to upload an executable file.

Code Injection:

User being able to directly inject code. (DON'T USE EVAL!)

Session Hijacking

One user 'becoming' another by taking over their session via impersonation.

Avoid "Session Fixation"
Don't use URL cookies for your sessions.

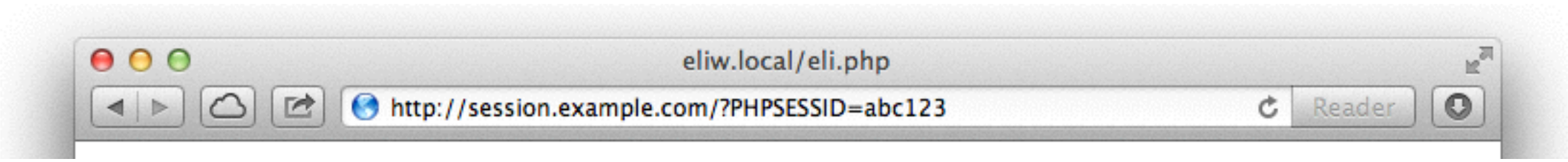
Always regenerate Session IDs on a change of access level.

Save an anti-hijack token to another cookie & session. Require it to be present & match. Salt on unique data (such as User Agent)

Session Fixation

A user being able to provide a known session ID to another user.

The Attack:



The Solution:

```
session.use_cookies = 1
session.use_only_cookies = 1
```

Don't use URL cookies for your sessions.

Session Fixation (Take 2)

Protect from more complicated fixation attacks, by regenerating sessions on change of access level.

The Solution:

```php
session_start();
if ($user->login($_POST['user'], $_POST['pass'])) {
    session_regenerate_id(TRUE);
}
```

and

```php
session_start()
$user->logout();
session_regenerate_id(TRUE);
```

Session Anti-Hijack Measures

Finally use anti-hijack measures to ensure user is legit

The Solution:

Not a few lines of code.
Store whatever unique you can about this user/browser combination and verify it hasn't changed between loads.

Note that IP changes or can be shared.
As happens with most other headers too.

Session Anti-Hijack Measures

```php
private function _sessionStart() {
    session_start();
    if (!empty($_SESSION)) { // Session not empty, verify:
        $token = $this->_hijackToken();
        $sh = empty($_SESSION['hijack']) ? NULL : $_SESSION['hijack'];
        $ch = empty($_COOKIE['data']) ? NULL : $_COOKIE['data'];
        if (!$sh || !$ch || ($sh != $ch) || ($sh != $token)) { // Hijacked!
            session_write_close();
            session_id(md5(time()));
            session_start();
            setcookie('data', 0, -172800);
            header("Location: http://www.example.com/");
        }
    } else { // Empty/new session, create tokens
        $_SESSION['started'] = date_format(new DateTime(), DateTime::ISO8601);
        $_SESSION['hijack'] = $this->_hijackToken();
        setcookie('data', $_SESSION['hijack']);
    }
}

private function _hijackToken() {
    $token = empty($_SERVER['HTTP_USER_AGENT']) ? 'N/A' : $_SERVER['HTTP_USER_AGENT'];
    $token .= '| Hijacking is Bad mmmkay? |'; // Salt
    $token .= $_SESSION['started']; // Random unique thing to this session
    return sha1($token);
}
```

XSS (Cross Site Scripting)

A user sending data that is executed as script

Many ways this attack can come in, but in all cases:
Everything from a user is suspect (forms, user-agent, headers, etc)
When fixing, escape to the situation (HTML, JS, XML, etc)
FIEO (Filter Input, Escape Output)

Don't forget about rewritten URL strings!

XSS - Reflected XSS

Reflected XSS

Directly echoing back content from the user

The Security Hole:

```
<p>Thank you for your submission: <?= $_POST['first_name'] ?></p>
```

The Attack:

First Name: <script>alert('XSS')</script> Submit

XSS - Reflected XSS

Reflected XSS

Directly echoing back content from the user

The Solution (HTML):

```php
$name = htmlentities($_POST['first_name'], ENT_QUOTES, 'UTF-8', FALSE);
```

The Solution (JS):

```php
$name = str_replace(array("\r\n","\r","\n"),
                    array("\n","\n","\\\n"),addslashes($_POST['first_name']));
```

The Solution (XML):

```php
$name = iconv('UTF-8', 'UTF-8//IGNORE',
                preg_replace("#[\\x00-\\x1f]#msi", ' ',
                str_replace('&', '&amp;', $_POST['first_name'])));
```

XSS - Stored XSS

Stored XSS
You store the data, then later display it

The Security Hole:

```php
<?php
$query = $pdo->prepare("UPDATE users SET first = ? WHERE id = 42");
$query->execute(array($_POST['first_name']));
?>

[...]

<?php
$result = $pdo->query("SELECT * FROM users WHERE id = 42");
$user = $result->fetchObject();
?>
<p>Welcome to <?= $user->first ?>'s Profile</p>
```

XSS - Stored XSS

Stored XSS
You store the data, then later display it

The Solution (HTML):

```
$name = htmlentities($user->first, ENT_QUOTES, 'UTF-8', FALSE);
```

The Solution (JS):

```
$name = str_replace(array("\r\n","\r","\n"),
                    array("\n","\n","\\\n"),addslashes($user->first));
```

The Solution (XML):

```
$name = iconv('UTF-8', 'UTF-8//IGNORE',
                preg_replace("#[\\x00-\\x1f]#msi", ' ',
                str_replace('&', '&amp;', $user->first)));
```

The Same!

XSS - DOM XSS

DOM XSS

What happens in JavaScript, stays in JavaScript

The Security Hole:

```
<script>
$('#verify').submit(function() {
    var first = $(this).find("input[name=first]").val();
    $(body).append("<p>Thanks for the submission: " + first + "</p>");
    return false;
});
</script>
```

XSS - DOM XSS

DOM XSS

What happens in JavaScript, stays in JavaScript

The Solution (Simple):

Example!

```
<script>
function escapeHTML(str) {
     str = str + ""; var out = "";
     for (var i=0; i<str.length; i++) {
         if (str[i] === '<') { out += '&lt;'; }
         else if (str[i] === '>') { out += '&gt;'; }
         else if (str[i] === "'") { out += '&#39;'; }
         else if (str[i] === '"') { out += '&quot;'; }
         else { out += str[i]; }
     }
     return out;
}
</script>
```

But you have to deal with attr vs HTML vs CSS etc

So use this: https://github.com/chrisisbeef/jquery-encoder/

CSRF (Cross Site Request Forgery)

A user having the ability to forge or force a request on behalf of another user.

Simplistically via IMG tag or POST forms

Complicated via JavaScript

CSRF (Cross Site Request Forgery)

A user having the ability to forge or force a request on behalf of another user.

The Attack:

```
<img width="1" height="1"
     src="http://quackr.example.com/quackit?msg=CSRF+Attacks+Rock!" />
```

or

```
<script>
$.post({
    url: 'http://quackr.example.com/quackit',
    data: { msg: 'CSRF Attacks Rock!'}
});
</script>
```

CSRF (Cross Site Request Forgery)

Protect via CSRF token

The Solution (on form):

```php
<?php
function generateToken() {
    $token = empty($_SESSION['token']) ? false : $_SESSION['token'];
    $expires = empty($_SESSION['tExpires']) ? false : $_SESSION['tExpires'];
    if (!$token || ($expires < time())) {
        $token = md5(uniqid(mt_rand(), true));
        $_SESSION['token'] = $token;
    }
    $_SESSION['tokenExpires'] = time() + 14400;
    return $token;
}
?>
<form method="POST" action="">
    <input name="msg" value="" />
    <input type="hidden" name="token" value="<?= generateToken() ?>" />
    <input type="submit" />
</form>
```

CSRF (Cross Site Request Forgery)

Protect via CSRF token

The Solution (on submission):

```php
<?php
$token = empty($_SESSION['token']) ? false : $_SESSION['token'];
$expires = empty($_SESSION['tExpires']) ? false : $_SESSION['tExpires'];
$check = empty($_POST['token']) ? false : $_POST['token'];

if ($token && ($token == $check) && ($expires > time())) {
    // SUCCESS - Process the form
} else {
    // FAILURE - Block this:
    header('HTTP/1.0 403 Forbidden');
    die;
}
?>
```

Clickjacking

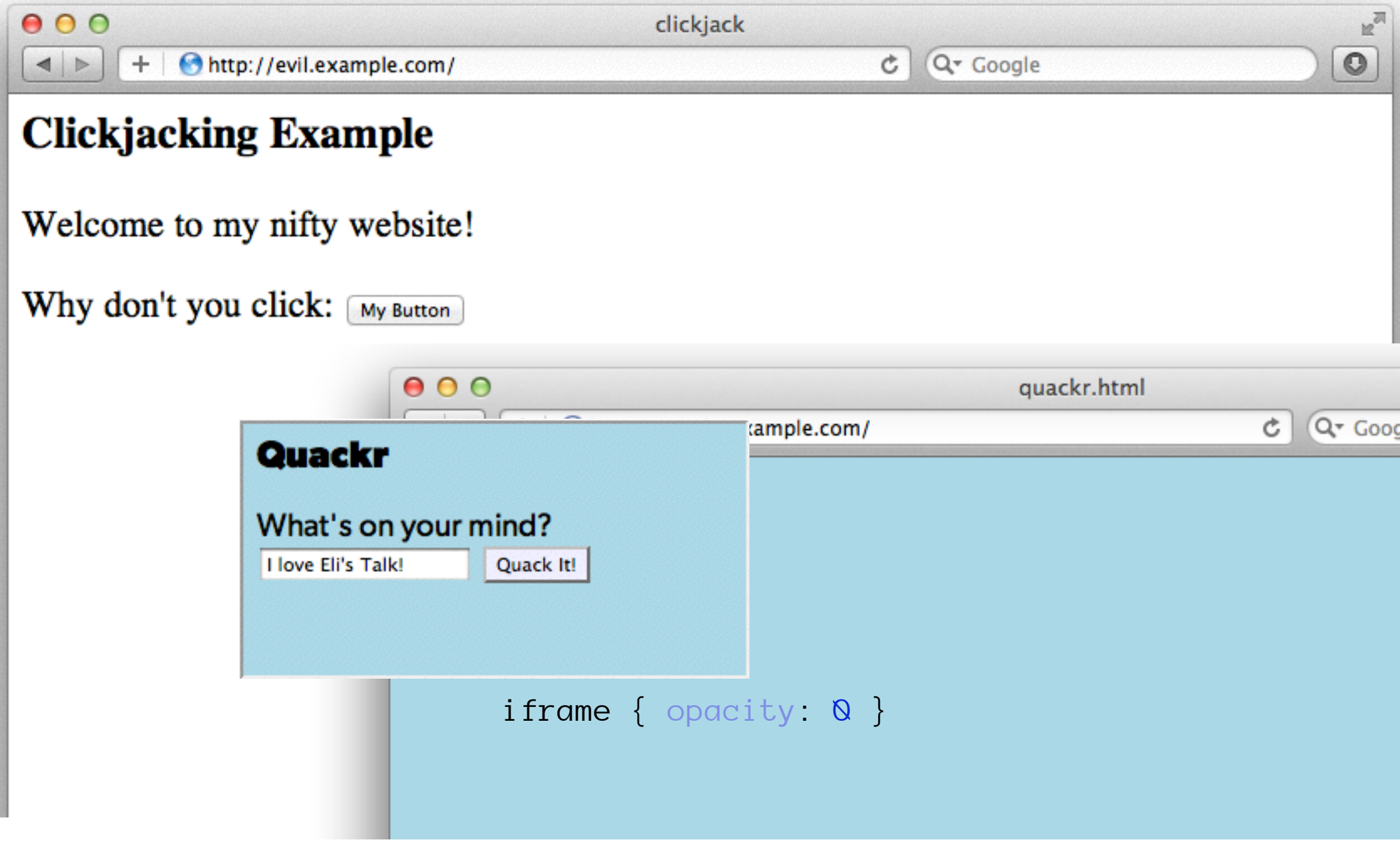
One of the newest threats

Lots of publicity when Twitter was hit

Tricks user into physically making a click on the remote website without realizing it, getting around any CSRF protection.

Watch a demo:

Clickjacking



Clickjacking - Solution 1

Use specific header, to disallow site framing:

The Solution:

```
header('X-Frame-Options: DENY');
```

or

```
header('X-Frame-Options: SAMEORIGIN');
```

Doesn't work in all browsers!

Became IETF standard RFC 7034 in October 2013

Clickjacking - Solution 2

Ensure you aren't displayed in iFrame

The Solution:

```
<html>
    <head>
        <style> body { display : none;} </style>
    </head>
    <body>
        <script>
            if (self == top) {
              var theBody = document.getElementsByTagName('body')[0];
              theBody.style.display = "block";
            } else {
              top.location = self.location;
            }
        </script>
    </body>
</html>
```

Brute Force Attacks (Password)

Really only two primary defenses:

CAPTCHA

IP rate limiting

Brute Force Attacks (CAPTCHA)

reCAPTCHA is free and easy to use

On the Form:

```
<?php require_once('recaptchalib.php'); ?>
<form method="POST" action="">
    <label>Username: <input name="user" /></label><br />
    <label>Password: <input name="pass" type="password"/></label><br />
    <?= recaptcha_get_html("YOUR-PUBLIC-KEY"); ?>
    <input type="submit" />
</form>
```

Brute Force Attacks (CAPTCHA)

On the Server:

```php
<?php
require_once('recaptchalib.php');
$check = recaptcha_check_answer(
    "YOUR-PRIVATE-KEY", $_SERVER["REMOTE_ADDR"],
    $_POST["recaptcha_challenge_field"], $_POST["recaptcha_response_field"]);

if (!$check->is_valid) {
    die("INVALID CAPTCHA");
} else {
    // Yay, it's a human!
}
?>
```

https://developers.google.com/recaptcha/docs/php

Brute Force Attacks (Rate Limit)

Only allow so many fails per IP

The Solution:

```php
$blocked = false;
$cachekey = 'attempts.'.$_SERVER['REMOTE_ADDR'];
$now = new DateTime();
$attempts = $memcached->get($cachekey) ?: [];
if (count($attempts) > 4) {
    $oldest = new DateTime($attempts[0]);
    if ($oldest->modify('+5 minute') > $now) {
        $blocked = true; // Block them
    }
}
if (!$blocked && $user->login()) {
    $memcached->delete($cachekey);
} else {
    array_unshift($attempts, $now->format(DateTime::ISO8601));
    $attempts = array_slice($attempts, 0, 5);
    $memcached->set($cachekey, $attempts);
}
```

Server Level Security

Now moving on to true ‘attacks’ …

Keep Your Stack Patched

No excuses. Keep all your software up to date!

Linux

Apache

MySQL

Ruby

Python

PHP

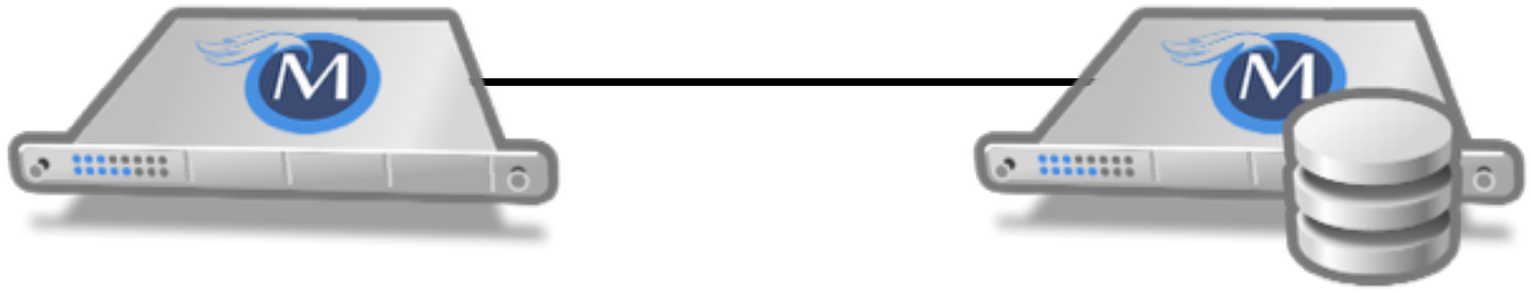
DDOS & Similar Attacks

Good luck!

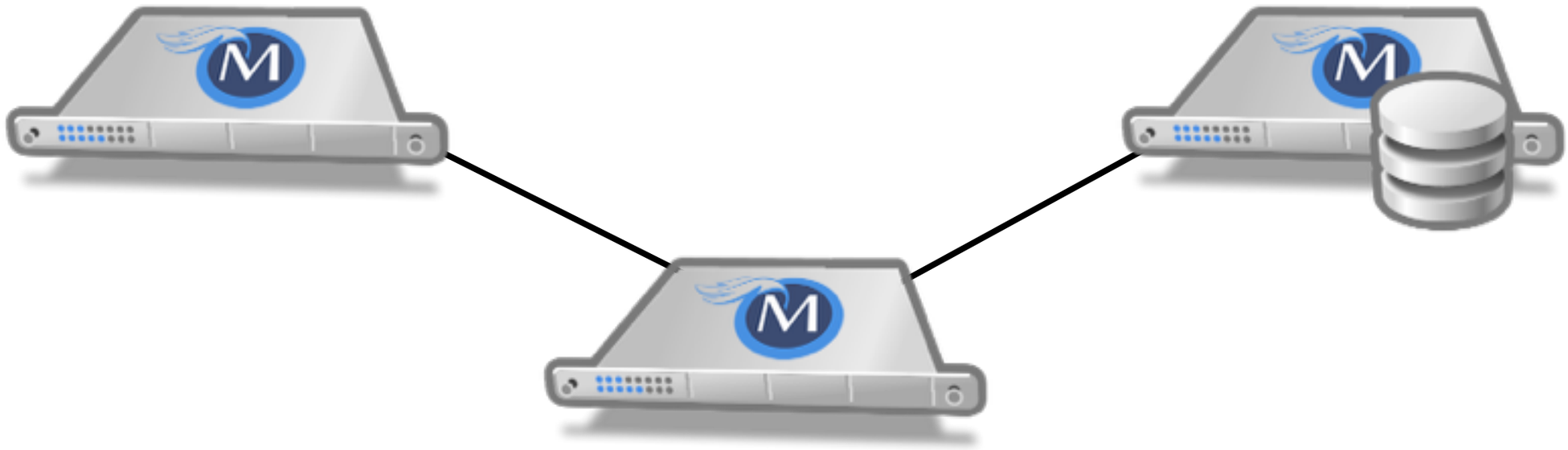
Rely on firewall features of your machines & hosting.

Hire a good ops team

Man in the Middle



Man in the Middle



The Solution: Use SSL

Tips for Recovery

Wait, you just got a 2am phone call?

Logging

You can't react, if you don't know what happened!

Log everything you can:

- Failed SQL queries
- Detected hijack attempts
- Code (PHP) errors
- Failed server connections

Plans of Action

Be ready for a quick decision

Let it Live

Remove Functionality

Shutdown Website

Brief Commercial Interruption…

Back in Print!

Orange ElePHPant Kickstarter!

http://phpa.me/elePHPant

Questions?

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