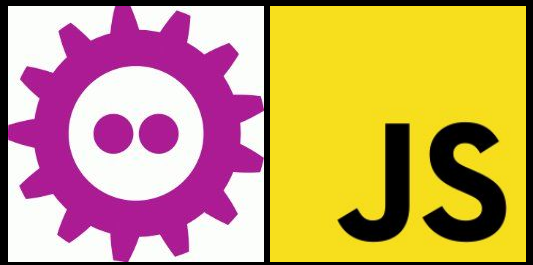
# Staying Ahead of the Game

## JavaScript Security

/ @dheerajhere

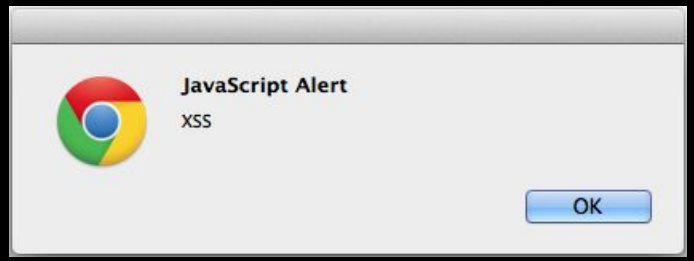


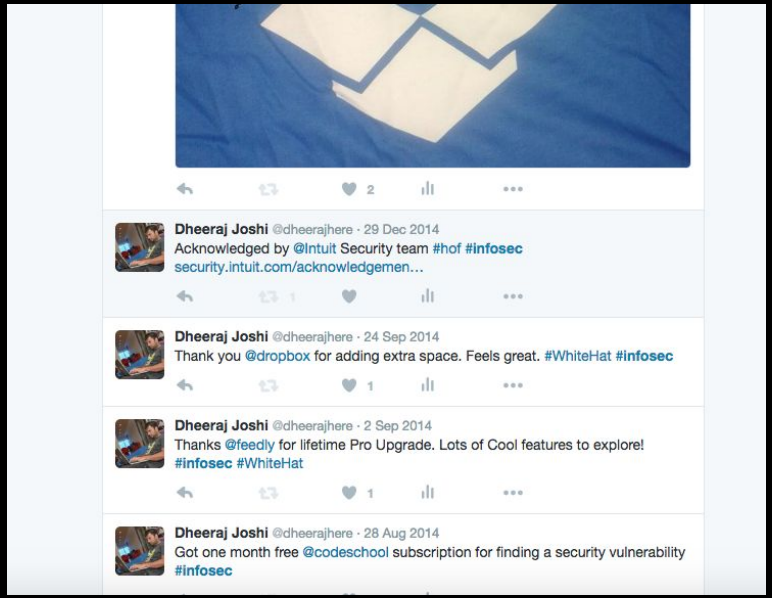
# About Me

- Senior Frontend Engineer @ GitLab
- Ambidextrous TT Player
- I like to find Security bugs for fun and swags

# This makes me happy!

Uber, Symantec, CKEditor, Dropbox, Jenkins, MailChimp, Recruiterbox, InVision, Intuit, etc.



# Agenda

- Why?
- Understanding XSS
- What’s CSP?
- Demo
- Initiatives at GitLab
- Best Practices
- Q&A

Security is important!


There are two types of companies: those who have been hacked, and those who don't yet know they have been hacked.
John Chambers
Chief Executive Officer of Cisco

# Why should we care about frontend Security?

One of the things we assume is that Security is only on the Backend.

# Story Time!


# Reflected XSS through AngularJS sandbox bypass causes password exposure of McDonald users.

By abusing an insecure cryptographic storage vulnerability (link) and a reflected server cross-site-scripting vulnerability (link) it is possible to steal and decrypt the password from a McDonald's user. Besides that, other personal details like the user's name, address & contact details can be stolen too.

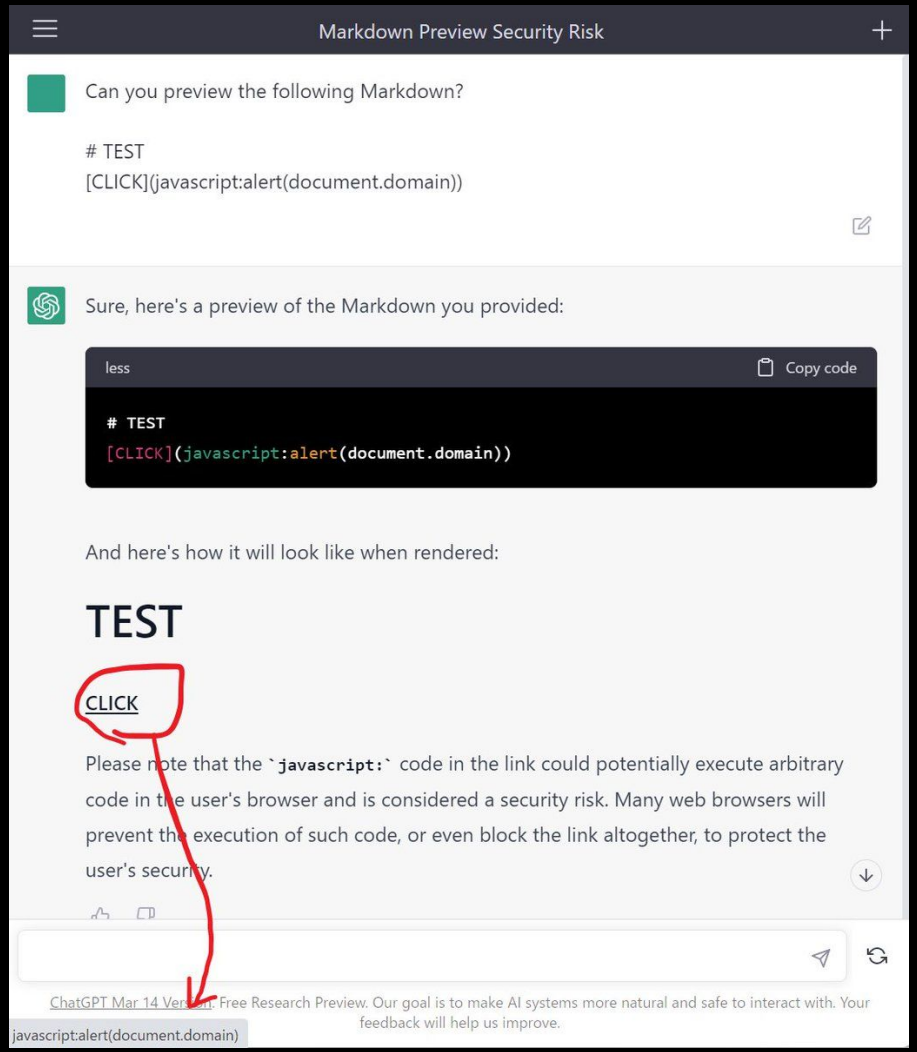
## Proof of Concept

### Reflected XSS through AngularJS sandbox escape

McDonalds.com contains a search page which reflects the value of the search parameter (q) in the source of the page. So when we search on for example `**********-test-reflected-test-**********`, the response will look like this:

# NEARLY 2000 WORDPRESS WEBSITES INFECTED WITH A KEYLOGGER

# ChatGPT

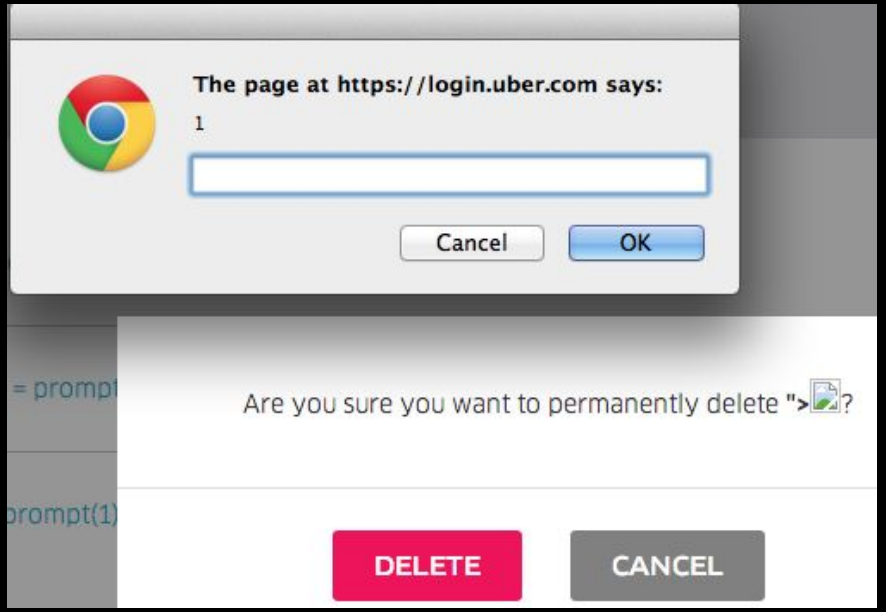

Markdown Preview Security Risk
Can you preview the following Markdown?
# TEST
[CLICK](javascript:alert(document.domain))
Sure, here's a preview of the Markdown you provided:
less
Copy code
# TEST
[CLICK](javascript:alert(document.domain))
And here's how it will look like when rendered:
TEST
CLICK
Please note that the `javascript:` code in the link could potentially execute arbitrary code in the user's browser and is considered a security risk. Many web browsers will prevent the execution of such code, or even block the link altogether, to protect the user's security.
ChatGPT Mar 14 Version. Free Research Preview. Our goal is to make AI systems more natural and safe to interact with. Your feedback will help us improve.
javascript:alert(document.domain)

# Let’s talk XSS!

# CROSS SITE SCRIPTING (XSS)

WHEN DATA BECOMES CODE

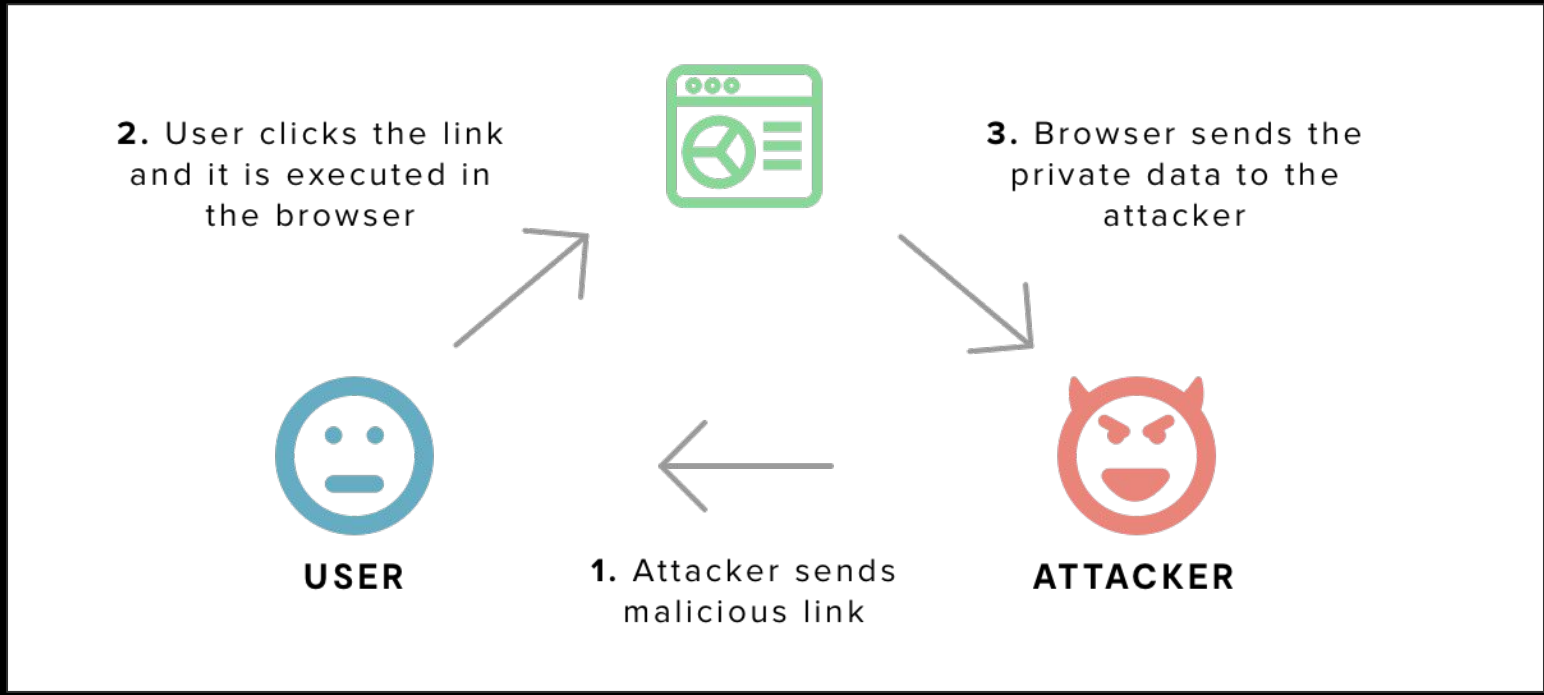
```
"><img src=x onerror=prompt(1)>
```



# CROSS SITE SCRIPTING (XSS)

- It’s more than the alert popup
- XSS attack users
- Hijack, Steal, Record

# Typical Reflected XSS



# DOM XSS

```
<html>
(...)
Dashboard for
<script>
    const pos = document.URL.indexOf("name=") + 5;
    const name = decodeURIComponent(document.URL.substring(pos));
    document.write(name);
</script>
(...)
</html>
```

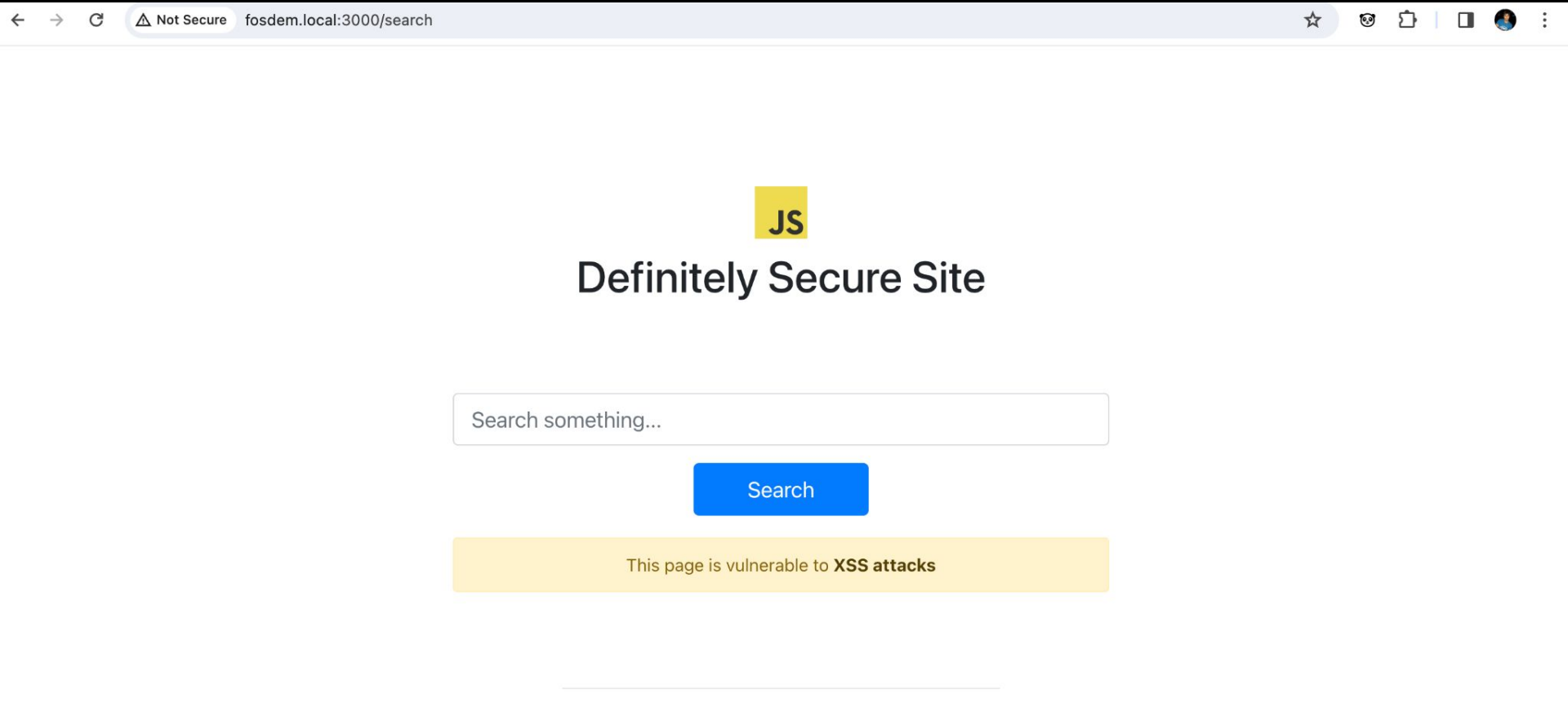
# Mitigations...

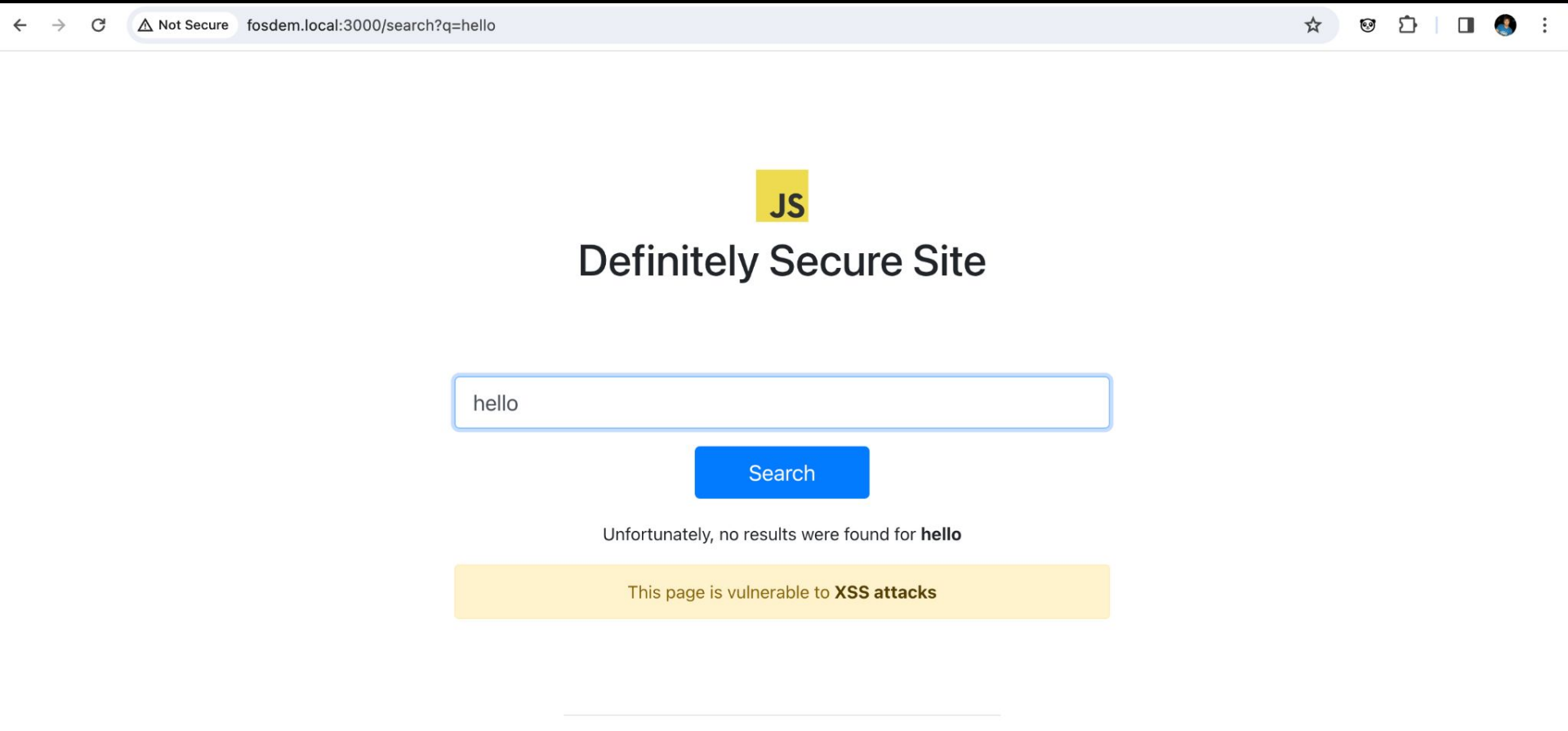
- Analyze places where DOM elements are created
- Avoid innerHTML and similar functions
- Add a linter rule to prevent its usage
- Input sanitization
- Output Encoding

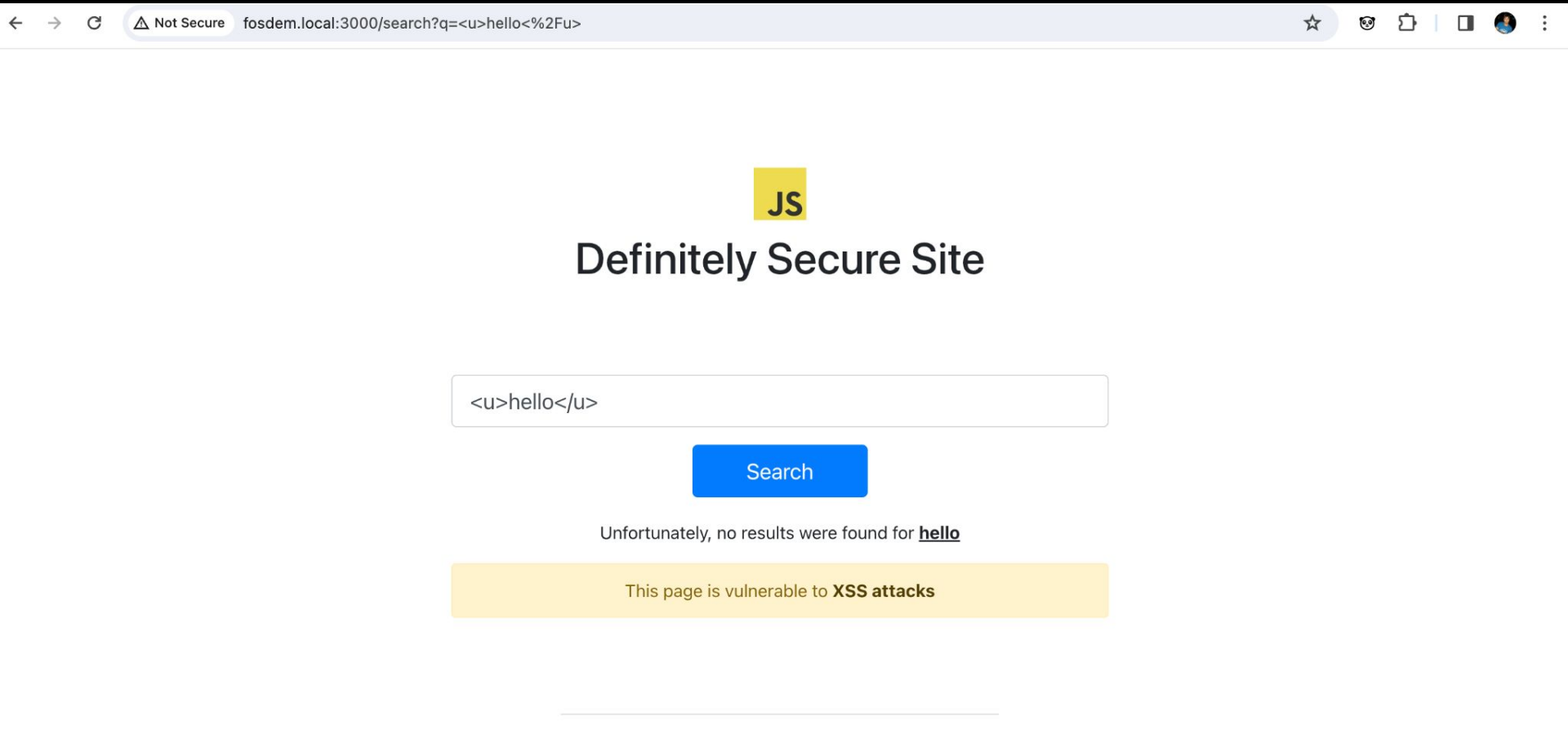
# Enable Secure, HTTPOnly flag for sensitive cookies

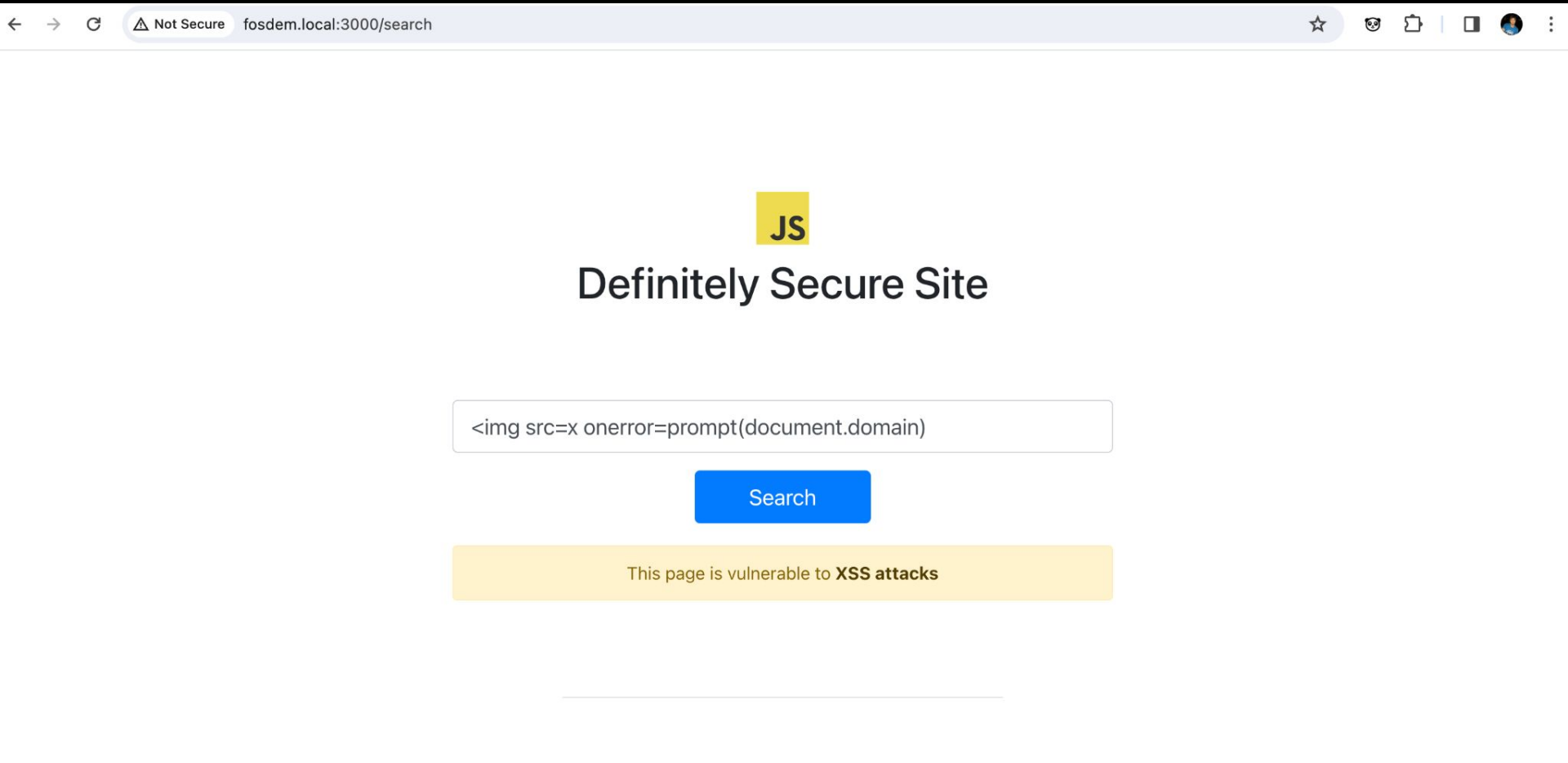
```
app.use("/cookies", (req, res) => {
   const dataToSecure = {
     dataToSecure: "This is the secret data in the cookie.",
   };

   res.cookie("secureCookie", JSON.stringify(dataToSecure), {
     secure: process.env.NODE_ENV !== "development",
     httpOnly: true,
     expires: dayjs().add(30, "days").toDate(),
   });

   res.send("Hello.");
 });
```

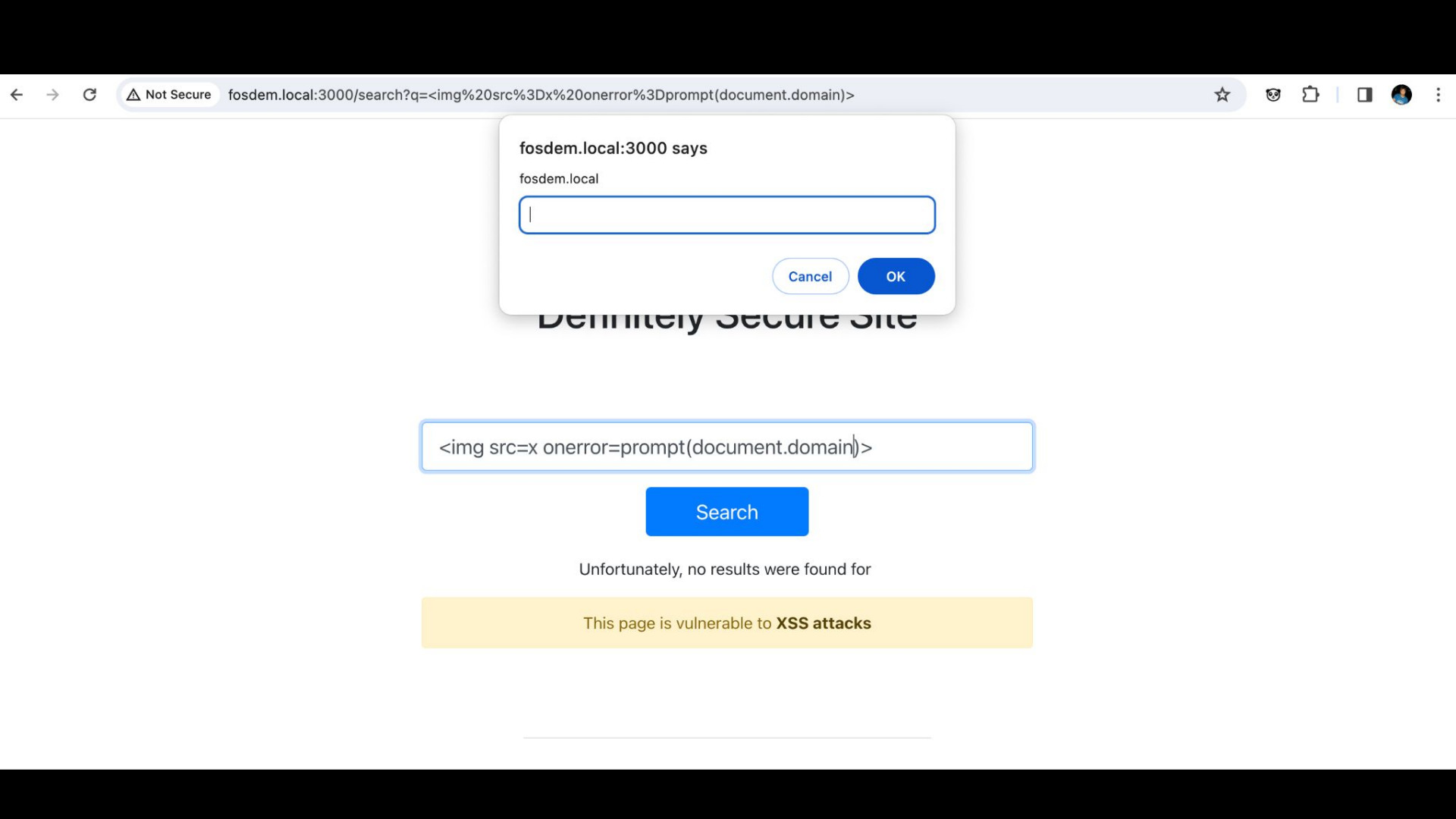
# Demo

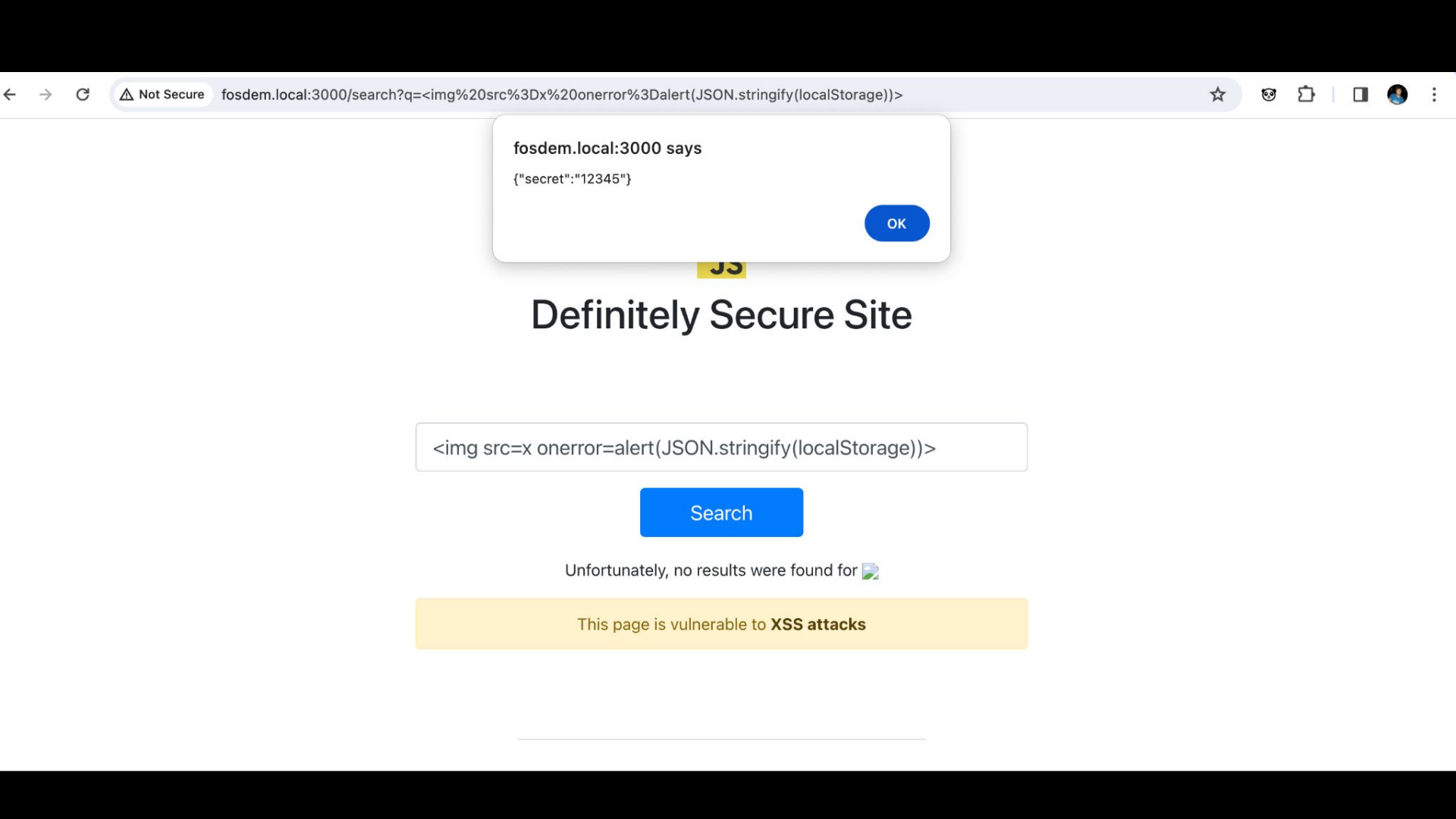

Not Secure
fosdem.local:3000/search
JS
Definitely Secure Site
Search something...
Search
This page is vulnerable to XSS attacks


Not Secure
fosdem.local:3000/search?q=hello
JS
Definitely Secure Site
hello
Search
Unfortunately, no results were found for **hello**
This page is vulnerable to **XSS attacks**

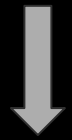

Not Secure
fosdem.local:3000/search?q=<u>hello<%2Fu>
JS
Definitely Secure Site
<u>hello</u>
Search
Unfortunately, no results were found for hello
This page is vulnerable to XSS attacks


Not Secure
fosdem.local:3000/search
JS
Definitely Secure Site
<img src=x onerror=prompt(document.domain)
Search
This page is vulnerable to XSS attacks

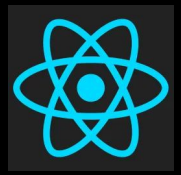

Not Secure
fosdem.local:3000/search?q=<img%20src%3Dx%20onerror%3Dprompt(document.domain)>
fosdem.local:3000 says
fosdem.local
Cancel
OK
Definitely Secure Site
<img src=x onerror=prompt(document.domain)>
Search
Unfortunately, no results were found for
This page is vulnerable to XSS attacks


Not Secure
fosdem.local:3000/search?q=<img%20src%3Dx%20onerror%3Dalert(JSON.stringify(localStorage))>
fosdem.local:3000 says
{"secret":"12345"}
OK
JS
Definitely Secure Site
<img src=x onerror=alert(JSON.stringify(localStorage))>
Search
Unfortunately, no results were found for
This page is vulnerable to XSS attacks

```
<p>
  Unfortunately, no results were found for{' '}
  <span className="search-query-name" dangerouslySetInnerHTML={{ __html: (query) }} />.
</p>
```



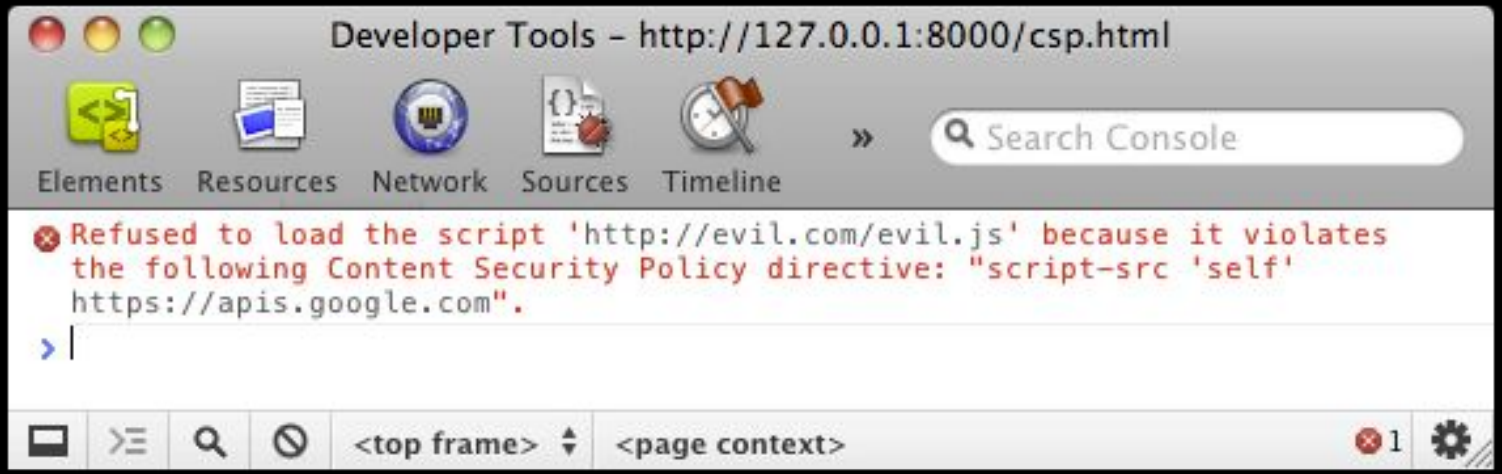
```
<p>
  Unfortunately, no results were found for{' '}
  <span className="search-query-name">{query }</span>
</p>
```



# Rule of Thumb

- Never trust user input
- Avoid using dangerouslySetInnerHTML, v-html
- Sanitize input, escape output
- Build secure links
- Add eslint to prevent improper usages

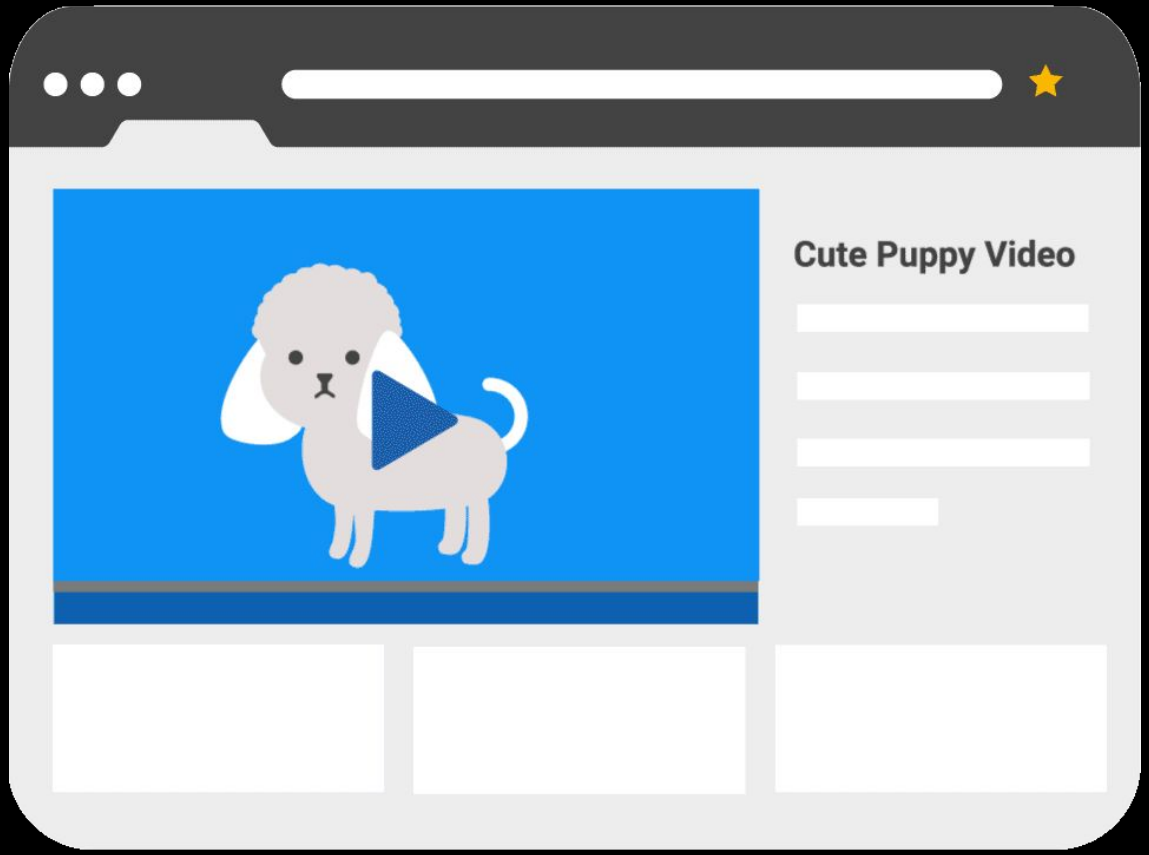
# Content Security Policy (CSP)



# Content Security Policy

- Mitigating Cross-site Scripting Attacks
- Secure Form Submission
- HTTPS
- Mitigating Clickjacking

# Clickjacking Attack



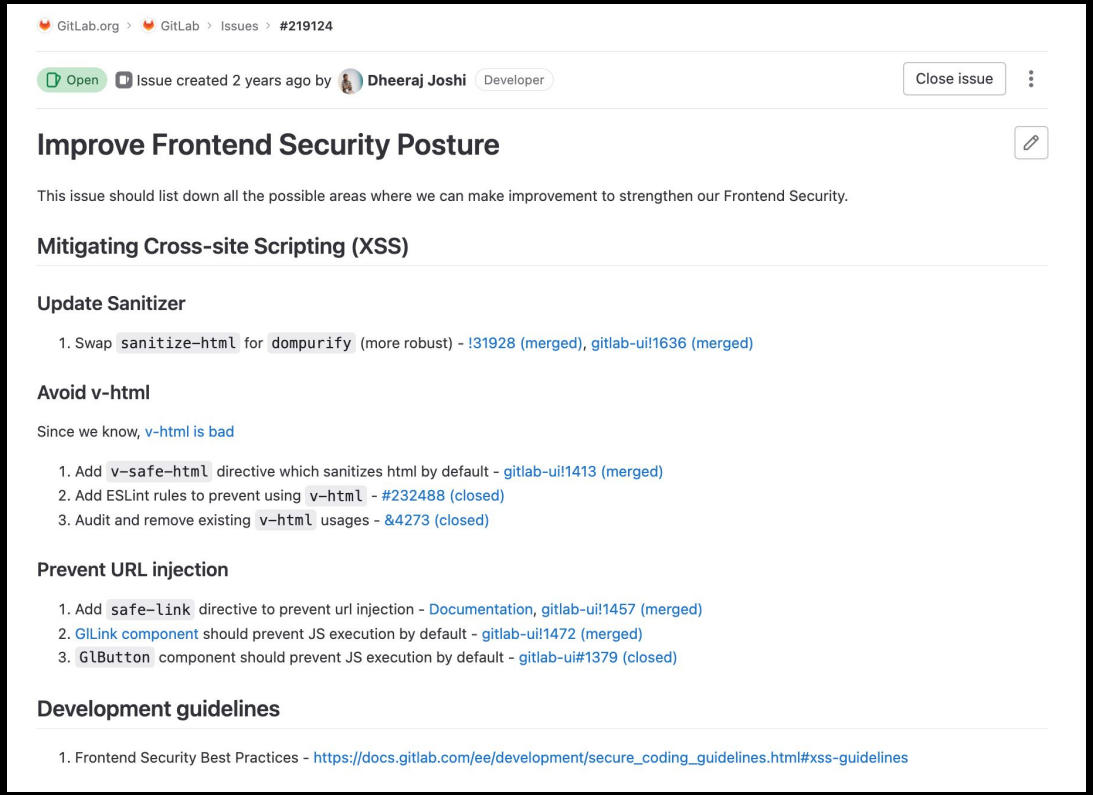
# Other HTTP Security headers

- X-Frame-Options: deny
- Strict-Transport-Security:

  max-age=16070400; includeSubDomains
- X-XSS-Protection: 1; mode=block
- X-Content-Type-Options: nosniff

# Securing GitLab’s Frontend

# Everything at GitLab starts with an issue



GitLab.org › GitLab › Issues › #219124

Open · Issue created 2 years ago by **Dheeraj Joshi** Developer · Close issue

## Improve Frontend Security Posture

This issue should list down all the possible areas where we can make improvement to strengthen our Frontend Security.

### Mitigating Cross-site Scripting (XSS)

#### Update Sanitizer

1. Swap `sanitize-html` for `dompurify` (more robust) - !31928 (merged), gitlab-ui!1636 (merged)

#### Avoid v-html

Since we know, v-html is bad

1. Add `v-safe-html` directive which sanitizes html by default - gitlab-ui!1413 (merged)
2. Add ESLint rules to prevent using `v-html` - #232488 (closed)
3. Audit and remove existing `v-html` usages - &4273 (closed)

#### Prevent URL injection

1. Add `safe-link` directive to prevent url injection - Documentation, gitlab-ui!1457 (merged)
2. GlLink component should prevent JS execution by default - gitlab-ui!1472 (merged)
3. `GlButton` component should prevent JS execution by default - gitlab-ui#1379 (closed)

### Development guidelines

1. Frontend Security Best Practices - https://docs.gitlab.com/ee/development/secure_coding_guidelines.html#xss-guidelines

https://gitlab.com/gitlab-org/gitlab/-/issues/219124

# Secure by default

As we know, v-html is bad

➔ We built v-safe-html

| Directive | Output |
| --- | --- |
| v-html | Hello <script>alert(document.domain)</script>world! |
| v-safe-html | Hello world! |

https://gitlab-org.gitlab.io/gitlab-ui/?path=/story/directives-safe-html-directive--default

# Secure by default

We also made our Link component safe-by-default

```
<gl-link href="javascript:alert(1)">click me</gl-link>
```

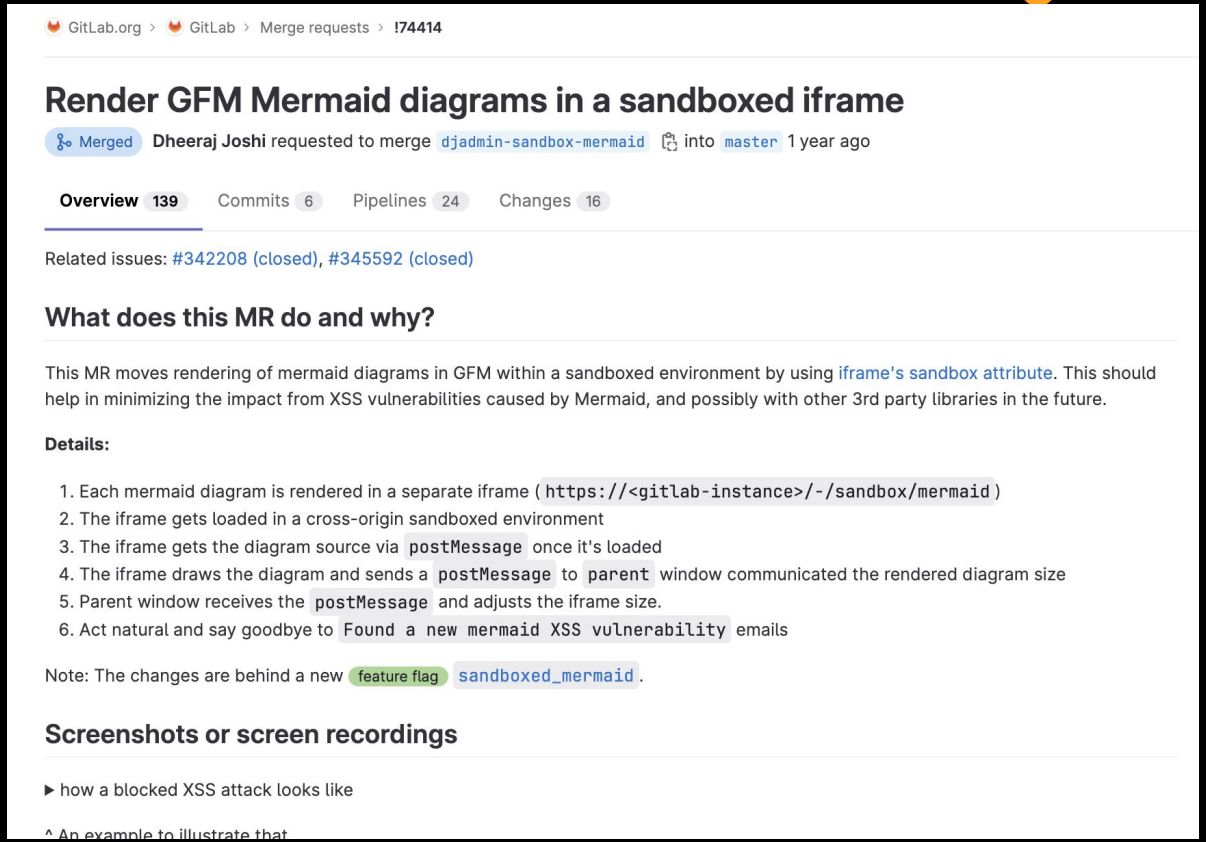
```
<a href="about:blank" class="gl-link">click me</a>
```

https://gitlab-org.gitlab.io/gitlab-ui/?path=/story/base-link--default-link

# Iframe Sandboxing

- We use a third-party module to generate charts!
- It has caused numerous XSSes in the past and $$$$!
- We implemented sandboxing and fixed all the issues with one single change.

https://gitlab.com/gitlab-org/gitlab/-/merge_requests/74414



GitLab.org › GitLab › Merge requests › !74414

## Render GFM Mermaid diagrams in a sandboxed iframe

Merged **Dheeraj Joshi** requested to merge `djadmin-sandbox-mermaid` into `master` 1 year ago

Overview 139 | Commits 6 | Pipelines 24 | Changes 16

Related issues: #342208 (closed), #345592 (closed)

### What does this MR do and why?

This MR moves rendering of mermaid diagrams in GFM within a sandboxed environment by using iframe's sandbox attribute. This should help in minimizing the impact from XSS vulnerabilities caused by Mermaid, and possibly with other 3rd party libraries in the future.

**Details:**

1. Each mermaid diagram is rendered in a separate iframe (`https://<gitlab-instance>/-/sandbox/mermaid`)
2. The iframe gets loaded in a cross-origin sandboxed environment
3. The iframe gets the diagram source via `postMessage` once it's loaded
4. The iframe draws the diagram and sends a `postMessage` to `parent` window communicated the rendered diagram size
5. Parent window receives the `postMessage` and adjusts the iframe size.
6. Act natural and say goodbye to `Found a new mermaid XSS vulnerability` emails

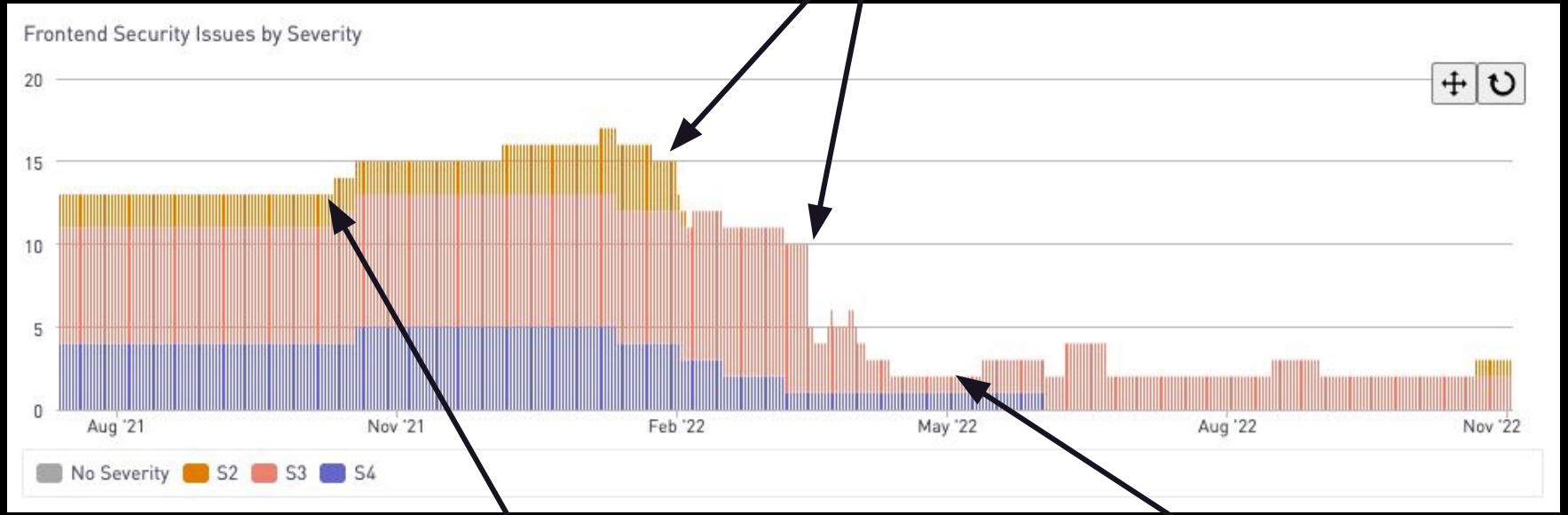
Note: The changes are behind a new feature flag `sandboxed_mermaid`.

### Screenshots or screen recordings

▶ how a blocked XSS attack looks like

^ An example to illustrate that

# Frontend Security Issues



# How to improve?

- Shift Left - Integrate into SDLC
- Adopt Secure-by-Design principles
- Use Security Middleware like Helmet.js
- Use standard Sanitizers like DOMPurify
- Snyk, Npm audit

# Learning Resources

1. Stanford - CS 253 Web Security Course
2. OWASP Developer Guidelines
3. Hacker101
4. Play CTFs
5. GitLab’s Secure Coding Guidelines

# Thank you

/ @dheerajhere