Web Security

Ethical Hacking

Alessandro Brighente
Eleonora Losiouk

Master Degree on Cybersecurity

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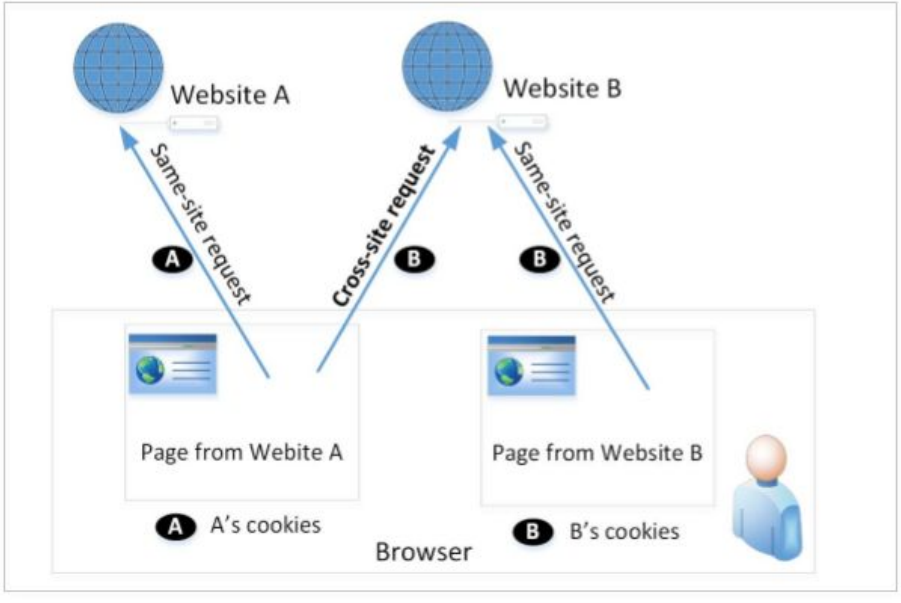
Cross-Site Requests and Its Problems



- When a page from a website sends an HTTP request back to the website, it is called same-site request
- If a request is sent to a different website, it is called cross-site request because where the page comes from and where the request goes are different
- E.g.: A web page (not Facebook) can include a Facebook link, so when users click on the link, HTTP request is sent to Facebook

Cross-Site Requests and Its Problems

- When a request is sent to example.com from a page coming from example.com, ***the browser attaches all the cookies*** belonging to example.com
- Now, when a request is sent to example.com from another site (different from example.com), the browser will attach the cookies too
- Because of above behaviour of the browsers, ***the server cannot distinguish between the same-site and cross-site requests***
- ***It is possible for third-party websites to forge requests that are exactly the same as the same-site requests***
- This is called Cross-Site Request Forgery (***CSRF***)

Cross-Site Request Forgery Attack

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- **Environment Setup:**
  - Target website
  - Victim user who has an active session on the target website
  - Malicious website controlled
- **Steps:**
  - The attacker crafts a webpage that can forge a cross-site request to be sent to the targeted website
  - The attacker needs to attract the victim user to visit the malicious website
  - The victim is logged into the targeted website

CSRF Attacks on HTTP Get Services

- HTTP GET requests: data (foo and bar) are attached in the URL

```
GET /post_form.php?foo=hello&bar=world HTTP/1.1   ← Data are attached here!
Host: www.example.com
Cookie: SID=xsdfgergbghedvrbeadv
```

- HTTP POST requests: data (foo and bar) are placed inside the data field of the HTTP request

```
POST /post_form.php HTTP/1.1
Host: www.example.com
Cookie: SID=xsdfgergbghedvrbeadv
Content-Length: 19
foo=hello&bar=world                ← Data are attached here!
```

CSRF Attack on GET Requests - Basic Idea

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- Consider an online banking web application www.bank32.com which allows users to transfer money from their accounts to other people's accounts
- An user is logged in into the web application and has a session cookie which uniquely identifies the authenticated user
- HTTP request to transfer $500 from his/her account to account 3220:

  http://www.bank32.com/transfer.php?to=3220&amount=500

- In order to perform the attack, ***the attacker needs to send out the forged request from the victim's machine so that the browsers will attach the victim's session cookies with the requests***

CSRF Attack on GET Requests - Basic Idea

- The attacker can place the piece of code (to trigger request) in the form of Javascript code in the attacker's web page.
- HTML tags like img and iframe can trigger GET requests to the URL specified in src attribute. Response for this request will be an image/webpage.

```
<img src="http://www.bank32.com/transfer.php?to=3220&amount=500" alt="image"
width="1" height="1"/>

<iframe src="http://www.bank32.com/transfer.php?to=3220&amount=500">
</iframe>
```

CSRF Attacks on HTTP POST Services

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- POST requests can be generated using HTML forms
- When the user clicks on a Submit button, POST request will be sent out to the URL specified in the action field with the parameters included in the body
- Attacker's job is to click on the button without the help from the user
- The attacker can rely on hidden forms and Javascript code

CSRF Attacks on HTTP POST Services

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```
<script type="text/javascript">
function forge_post()
{

   var fields;
   fields += "<input type='hidden' name='to' value='3220'>";
   fields += "<input type='hidden' name='amount' value='500'>";

   var p = document.createElement("form");                    ①
   p.action = "http://www.example.com/action_post.php";
   p.innerHTML = fields;
   p.method = "post";
   document.body.appendChild(p);                              ②
   p.submit();                                                ③
}

window.onload = function() { forge_post();}                   ④
</script>
```

- Line ①: Creates a form dynamically; request type is set to “POST”
- Line ②: The fields in the form are “hidden”. Hence, after the form is constructed, it is added to the current web page
- Line ③: Submits the form automatically
- Line ④: The JavaScript function “forge_post()” will be invoked automatically once the page is loaded

Fundamental Causes of CSRF

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- The server cannot distinguish whether a request is cross-site or same-site
  - Same-site request: coming from the server's own page. Trusted
  - Cross-site request: coming from other site's pages. Not Trusted
  - We cannot treat these two types of requests the same
- Does the browser know the difference?
  - Of course. The browser knows from which page a request is generated
  - Can browser help?
- How to help server?
  - Referer header (browser's help)
  - Same-site cookie (browser's help)
  - Secret token (the server helps itself to defend against CSRF)

Countermeasures: Referer Header

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- HTTP header field identifying ***the address of the web page from where the request is generated***
- A server can check whether the request is originated from its own pages or not
- This field reveals part of browsing history causing privacy concern and hence, this field is mostly removed from the header
- The server cannot use this unreliable source

Countermeasures: Secret Token

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- The server embeds a ***random secret value*** inside each web page
- When a request is initiated from this page, the secret value is included with the request
- The server checks this value to see whether a request is cross-site or not
- Pages from a different origin will not be able to access the secret value This is guaranteed by browsers (the same origin policy)
- The secret is randomly generated and is different for different users. So, there is no way for attackers to guess or find out this secret

Countermeasures: Same-Site Cookies

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- A ***special type of cookie*** in browsers like Chrome and Opera, which provide a ***special attribute to cookies called SameSite***
- This attribute is set by the servers and it tells the browsers whether a cookie should be attached to a cross-site request or not
- Cookies with this attribute are ***always sent along with same-site requests***, but whether they are sent along with cross-site depends on the value of this attribute
- Values
  - ***Strict*** (Not sent along with cross-site requests)
  - ***Lax*** (Sent with cross-site requests)