

XSRF

Cross-Site Request Forgery

XSRF

- Cross-Site Request Forgery
- A request that is sent from a different "origin"
- Origin:
 - The combination of protocol, host, and port
 - If all three do not match, it is a cross-site request
- What's the danger?

XSRF - Example

Potential outcomes:

- An attack page can make a request to AutoLab
 - Requests your grades
 - Makes a submission on your behalf
- Attack page makes a request to your bank and transfers your funds to the attacker's account
- Attack page makes embarrassing posts on social media

XSRF

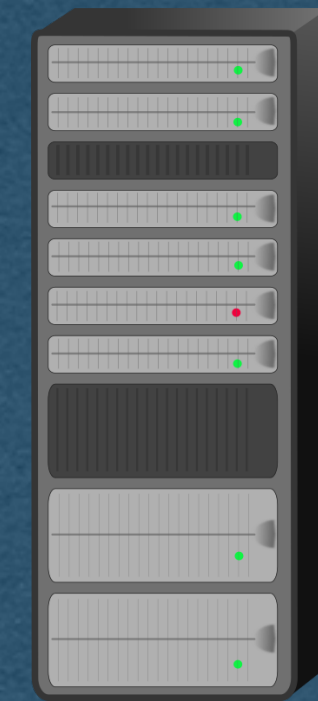
- We have a form that sends authenticated POST requests to our server
 - You host this app at mycoolproject.com
- The format of these POST requests is known (Anyone can visit and view your front end)
- An attacker makes their own web app
- The app will send a POST request to mycoolproject.com in the proper format
 - They host this app at freebitcoin.com and get someone to goto their site
 - The site sends the POST request on behalf of the user -> Hacked!

XSRF

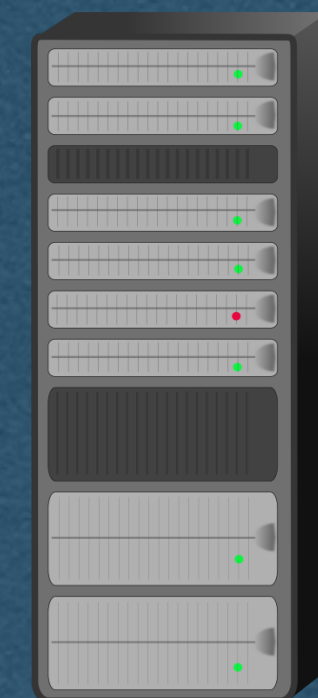


User/Client

- Client Creates an account on your app
- Client logs in and you issue an auth token in a cookie
- They enjoy your site very much and trust you with private information



mycoolproject.com



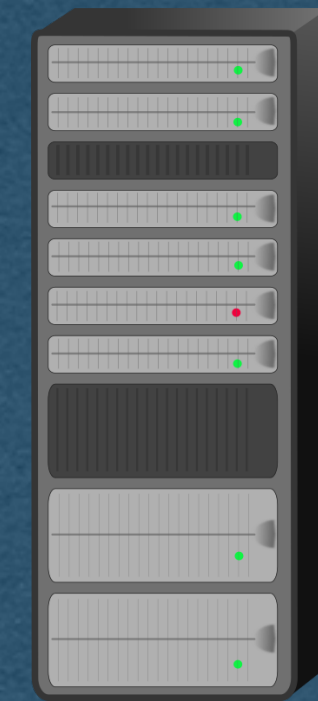
freebitcoin.com

XSRF

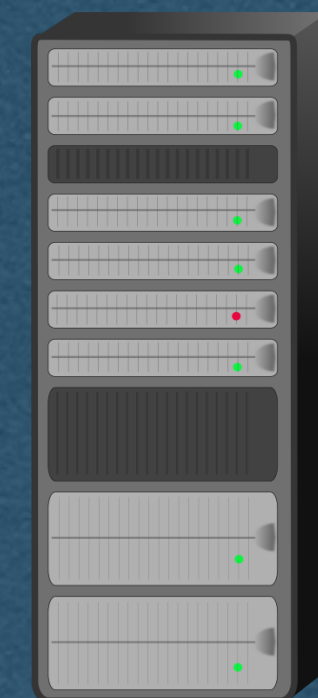


User/Client

- Client gets an email
 - ALL YOUR DREAMS WILL COME TRUE!! JUST CLICK HERE!!!
- Naive client clicks the link and gets the attackers HTML/CSS/Javascript



mycoolproject.com



freebitcoin.com



XSRF



User/Client

- The attack site sends a cross-site request to your app
- The origin is **freebitcoin.com**
- The request is sent to **mycoolproject.com**
- The attacker controls this request
 - Client may not even know it was sent until it's too late



mycoolproject.com



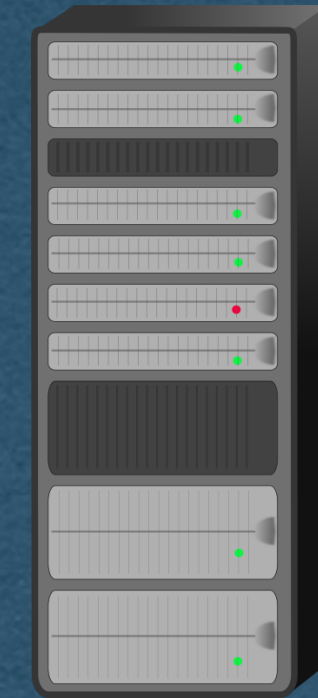
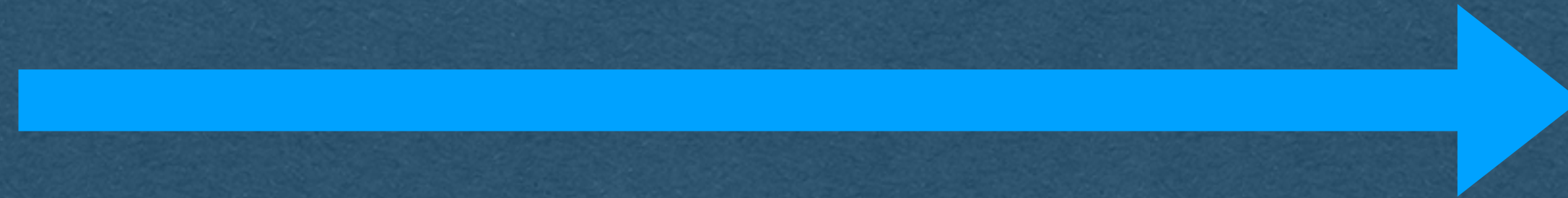
freebitcoin.com

XSRF



User/Client

- Since the request did come from your user
 - It may contain auth cookies
 - It may look real to your server
- Your server will process it as a legitimate, authenticated, request if you don't have protections in place



mycoolproject.com



freebitcoin.com

XSRF

- How to send a XSRF attack?
- As the src of an image
 - Can send a GET request
 - If your server uses query strings, these can be set by the attacker
 - Easy to setup. Embed an image in an email
 - Client only has to open the email (Doesn't even require them to click a shady link)
 - This is why images are often blocked in email

XSRF

- How to send a XSRF attack?
- Submit an HTML form
 - Get the user to navigate to your page
 - The page automatically submits an HTML form on their behalf (They don't have to click a button. Send it with JS)
 - The user will be navigated to the site that was attacked
 - Can send GET and POST requests
 - Must follow specific encodings supported by HTML forms
 - Attacker cannot see the response of the request (No stealing private data with this method)

XSRF

- How to send a XSRF attack?
- Make an AJAX request
 - Get the user to navigate to your page
 - Page automatically sends an AJAX request, or several, onload
- Attacker has full control
 - They can read the responses and have multiple interactions with the attacked site
 - They can use any HTTP method
 - They can put anything in the body of the requests

How do we protect against XSRF attacks?

Referrer?

- Every request should have a referrer header
 - Specifies the origin of the request
- If the referrer doesn't match your app
 - Deny the request
- Simple enough
- Unfortunately, the referrer can be spoofed and must not be relied upon for security reasons

SOP

- Same-Origin Policy (SOP)
- The SOP is implemented in modern browsers and blocks many cross-origin requests by default
- **All AJAX responses are blocked by the SOP**
- This is a relief since AJAX is so powerful

SOP

- The SOP does **NOT** block "safe" requests
- Safe requests include
 - Any GET request
 - Any request that navigates away from the origin (Including HTML Form submissions using POST)
- A GET request should be idempotent AND not change the state of the server
 - Your GET requests should only retrieve data since they are not protected by CORS

SOP

- The SOP does **NOT** block "safe" requests
- HTML form submissions are more difficult to protect against since they can make POST requests
- We need better protections

Recall SameSite - Cookie Directive

- SameSite
 - Determines when the cookie will be sent on 3rd party requests
 - Lax - Cookie only sent when navigating to your page (**Includes HTML form submissions**)
 - Or "safe" requests including all GET requests (Except Cross-Site AJAX GET requests)
 - The default setting if SameSite is not set
 - Strict - The cookie is only sent on 1st party requests
 - ie. The cookie is only sent to your server
 - None - The cookie is always sent. Requires the secure directive to also be set
- Set-Cookie: id=X6kAwpgW29M; SameSite=Lax
- Set-Cookie: id=X6kAwpgW29M; SameSite=Strict
- Set-Cookie: id=X6kAwpgW29M; SameSite=None; Secure

SOP Limitations

- Since the SOP is enforced by the browser, we have limited control over its enforcement
 - What if a user has a very outdated browser that doesn't implement the SOP?
 - What if the user installed a plug-in that disables the SOP?
 - What if the user is using an obscure browser that does not implement the SOP properly?
- The SOP will protect most users, but not 100%
 - And won't protect any users from a GET or HTML form attack

XSRF - Tokens

- Let's add server-side protection from XSRF attacks
- Will work for all users and all XSRF attacks

XSRF - Tokens

- On the Server:
 - Generate a long random XSRF token on page load (Attacker must not be able to guess the token)
 - Embed this XSRF token in the page
 - Store this XSRF token as being sent to this user
- In the browser:
 - XSRF token can be a hidden input on the form
 - Send this XSRF token along with form submissions

XSRF - Tokens

- Back to the Server on HTTP requests:
 - Read the XSRF token value and the auth token from the request
 - Authenticate the user based on their auth token
 - Verify that this XSRF token was sent to this user
- If the XSRF token was issues to this user
 - Accept the request as valid
- If the XSRF token was NOT issued to **this** user
 - This is an invalid request and might be a XSRF attack

XSRF Token

- Add a new input to your form for the token
- Generate and inject the token as a value using HTML templates
- Add the hidden attribute so the token is not displayed to the user
- Read the token from the request and verify

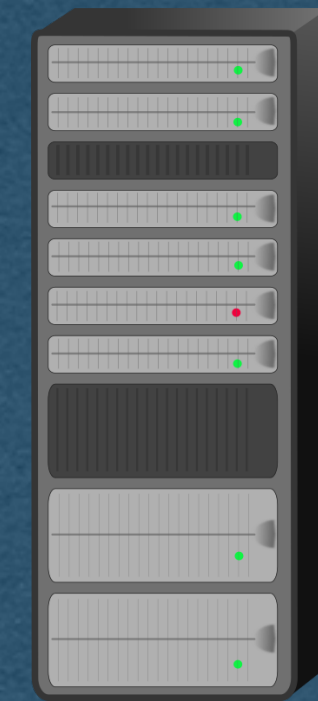
```
<form action="/image-upload" id="image-form" method="post" enctype="multipart/form-data">  
  <input value="AQAAAjppCA8mhugn2Uvw0TaKnVY" name="xsrftoken" hidden>  
  <label for="form-file">Image: </label>  
  <input id="form-file" type="file" name="upload">  
  <br/>  
  <label for="image-form-name">Caption: </label>  
  <input id="image-form-name" type="text" name="name">  
  <input type="submit" value="Submit">  
</form>
```


XSRF

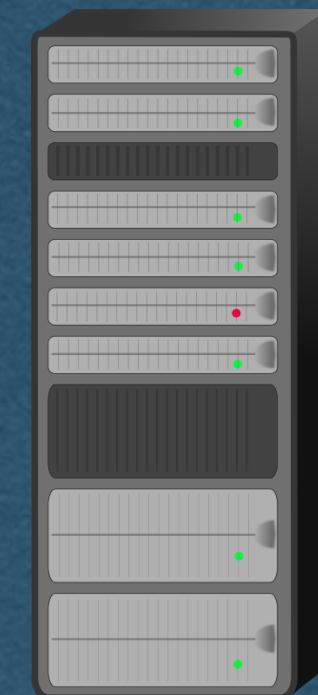


User/Client

- Now, when freebitcoin.com send their request it cannot contain your XSRF token
- Your server will reject the request
- Attacker can get their own token linked to their account
- Since they can get a valid token for the users account, they cannot send a valid cross-site request



mycoolproject.com



freebitcoin.com

CORS

- The SOP can be too restrictive in some cases
 - eg. You host an API that is consumed by other apps via AJAX
- Cross-Origin Resource Sharing
 - A policy that lets you relax the SOP
- Can explicitly allow cross-origin requests with the header:

```
Access-Control-Allow-Origin: *
```


CORS

- The * is a wildcard that allows all cross-site requests
- It is very dangerous and exposes you to XSRF attacks
- Can specify specific origins as well
- Common if you have an app with multiple servers

Access-Control-Allow-Origin: cse312.com

CORS

- CORS determines which cross-origin requests are allowed and which are blocked
- By default, browsers will block many cross-origin requests

```
Access-Control-Allow-Origin: *
```