Web Security II: Sessions and Requests, CSRF

CS1660 Introduction to Computer Security

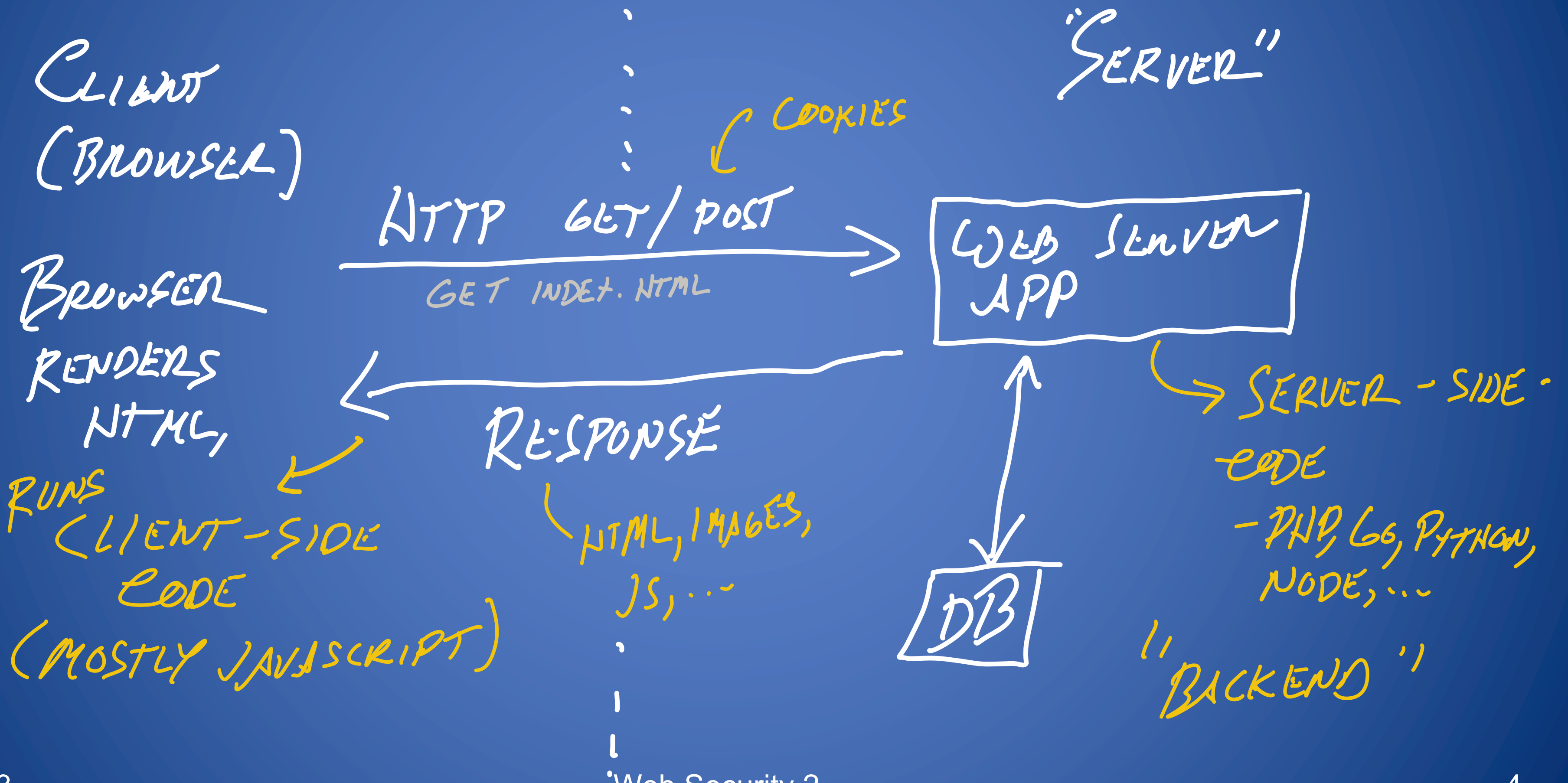
What we know so far

- HTTP and Browsers
- Cookies (and what happens if you steal them)
- “Client-side controls”

Today

- More about requests: cross-origin/same-origin
- CSRF attacks
- Session token entropy

A generic web architecture



Review: Cookies

Key-value pairs (stored in browser) that keep track of certain information

- User preferences, session ID, session expiration, etc.
- Key attributes (so far):
  - **`Domain`**: eg. cs.brown.edu .brown.edu

↳ A COOKIE'S "SCOPE"

Review: Cookies

Key-value pairs (stored in browser) that keep track of certain information

- User preferences, session ID, tracking, ad networks, etc.
- Key attributes (so far):
  - **`Domain`**: eg. cs.brown.edu .brown.edu

PART OF SAME-ORIGIN POLICY

When a request is made, all cookies with a matching domain are sent with it
…subject to certain other browser restrictions (today's topic!)

Same origin policy (SOP): so far

- Limits how a site can set cookies*
- Limits which cookies are sent on each request

IF ①,②,③ ALL MATCH, SITE IS CONSIDERED "SAME ORIGIN"

In general, "origin" must match: "SITE"

```
https://site.example.com[:443]/some/path
```

① PROTOCOL (HTTP OR HTTPS)

② HOSTNAME

③ PORT NUMBER. (DEFAULT IF OMITTED)

Cookies: examples

- Session ID: cookie used for authentication
- App state: Shopping cart, page views
- Ad networks/tracking
- …

Javascript

- Scripting language interpreted by browser
- Fetched as part of a page (just like HTML, images)

Capabilities

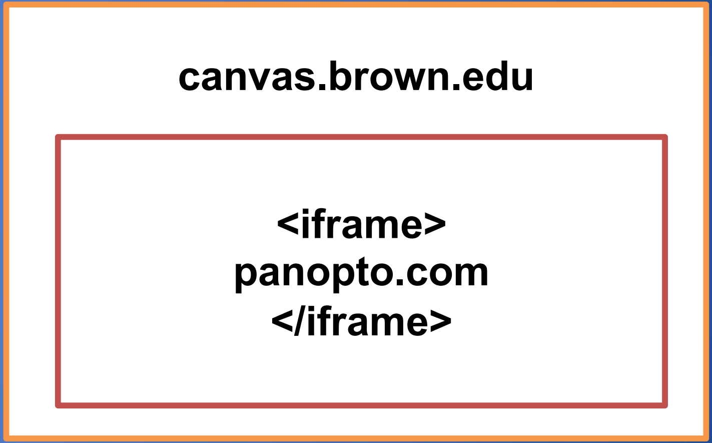
- Read/modify most page elements
  - DOM: Document Object Model
- Make requests (often asynchronously)
- Powers essentially all modern webapps

Same Origin Policy: JavaScript

- Scripts loaded from a website have restrictions on accessing content from another website (e.g., in another tab)
- All code within `<script> … </script>` tags is restricted to the context of the embedding website
  - However, this includes embedded, external scripts
  - `<script src="http://mal.com/library.js"></script>`
  - The code from mal.com can access HTML elements and cookies on our website
  - **Notice**: Different from the SOP for third-party cookies

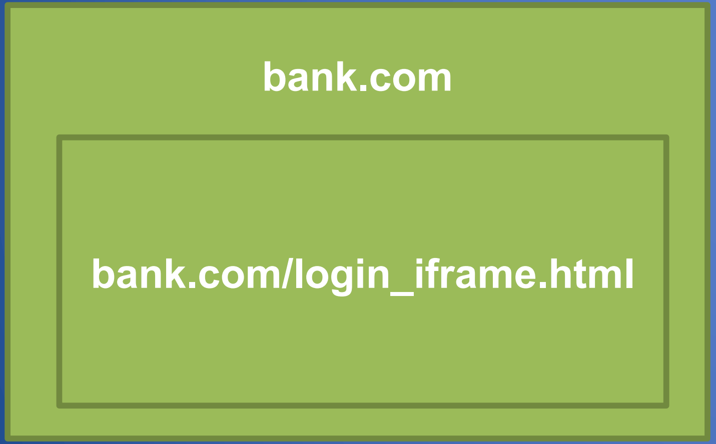
iframes

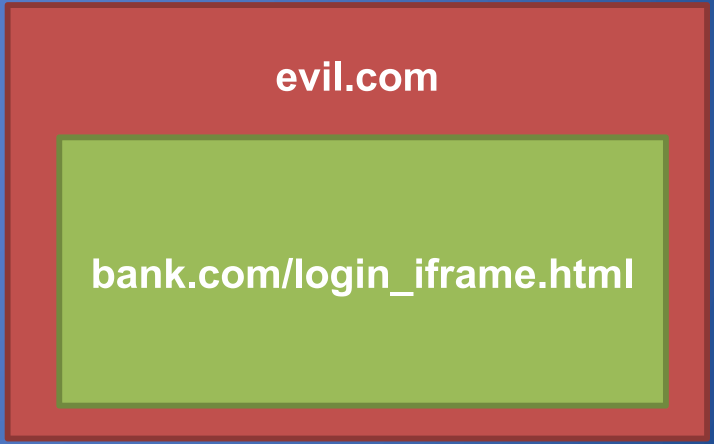
- Allows a website to “embed” another website’s content
- Examples:
  - YouTube video embeds
  - Embedded Panopto lectures on Canvas
- Same origin policy?



SOP: iframes

Only code from the same origin can access HTML elements on another site (or in an iframe).





bank.com <u>can</u> access HTML elements in the iframe (and vice versa)

evil.com <u>cannot</u> access HTML elements in the iframe (and vice versa).

SOP: Requests

Websites can submit requests to another site (e.g., sending a GET / POST request, image embedding, `Javascript requests (XMLHttpRequest)`

- Can generally embed (display in browser) cross-origin response
  - Embedding an image
  - Opening content / opening the response to a request in an iframe

- Usually can't read (cross-origin response (i.e. via a script)
  - Sometimes websites <u>always</u> allow cross-origin reads
  - Why might this be bad?

Examples

What can we do with this?

Break!

Cross-Site Request Forgery (CSRF)

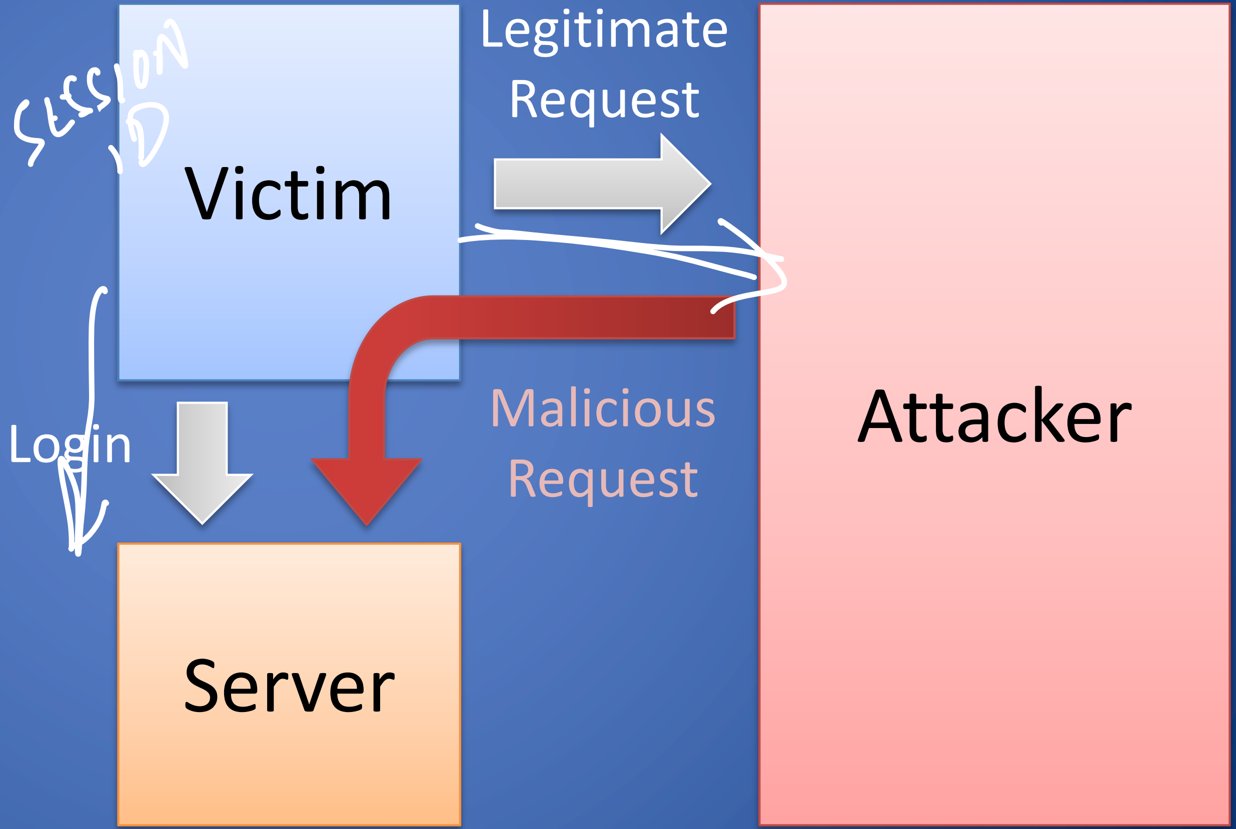
- Attacker’s site has script that issues a request on target site
- Example

```
<form action="https://bank.com/wiretransfer" method="POST" id="rob">
<input type="hidden" name="recipient" value="Attacker">
<input type="hidden" name="account" value="2567">
<input type="hidden" name="amount" value="$1000.00">
…
document.getElementById("rob").submit();
```

- If user is already logged in on target site …
- Request is executed by target site on behalf of user
  – E.g., funds are transferred from the user to the attacker

CSRF Trust Relationships

- Server trusts victim (login)
- Victim trusts attacker enough to click link/visit site
- Attacker could be a hacked legitimate site



CSRF Mitigation

- To protect against CSRF attacks, we can use a cookie in combination with a POST variable, called CSRF token
- POST variables are not available to attacker
- Server validates both cookie and CSRF token

MORE NEXT CLASS!

CSRF Demo

What We Have Learned

- Motivation and specifications for session management
- Session ID implementations
  - Cookie
  - GET variable
  - POST variable
- Cross-Site Request Forgery (CSRF) attack
- CSRF mitigation techniques