Same-origin policy
SQL Injection

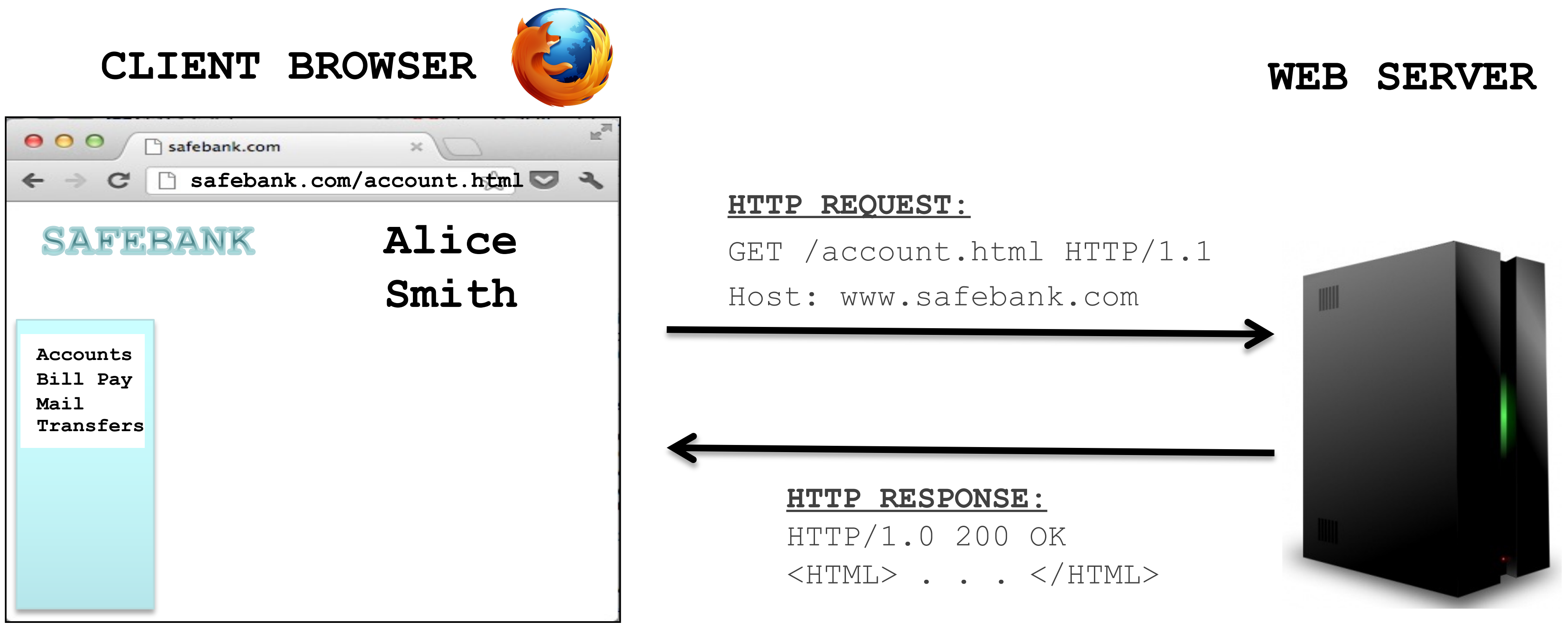
CS 161 Fall 2021 - Lecture 20

Some content adapted from materials by David Wagner or Dan Boneh

Announcements

- Recording
- Discussions cancelled this week
- Midterm grades are out
- Homework 4 will be released today
- Project 2 will be released Wednesday

Quick recap: HTTP



HTTP REQUEST:

```
GET /account.html HTTP/1.1
Host: www.safebank.com
```

HTTP RESPONSE:

```
HTTP/1.0 200 OK
<HTML> . . . </HTML>
```

Web page

$$\begin{tikzcd}
 & \text{HTML} \\
\text{web page} \arrow[ur] \arrow[r] \arrow[dr] & \text{CSS} \\
 & \text{Javascript}
\end{tikzcd}$$

JS

Javascript

Programming language used to manipulate web pages. It is a high-level, untyped and interpreted language with support for objects.

Supported by all web browsers

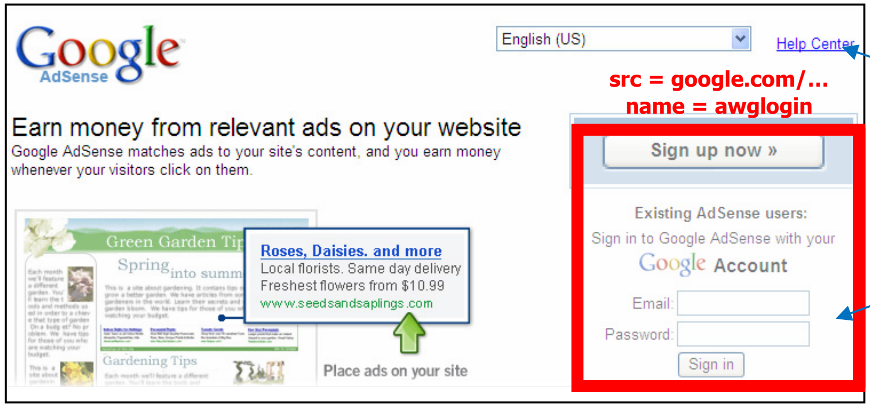
```
<script>
function myFunction() {
document.getElementById("demo").innerHTML = ”Text changed.";
}
</script>
```

Very powerful!

Frames

- Enable embedding a page within a page

```
<iframe src="URL"></iframe>
```



Google AdSense

English (US)

Help Center

src = google.com/…
name = awglogin

Earn money from relevant ads on your website

Google AdSense matches ads to your site's content, and you earn money whenever your visitors click on them.

Sign up now »

Existing AdSense users:

Sign in to Google AdSense with your Google Account

Email:

Password:

Sign in

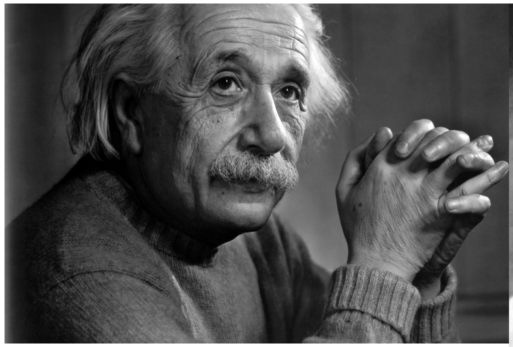
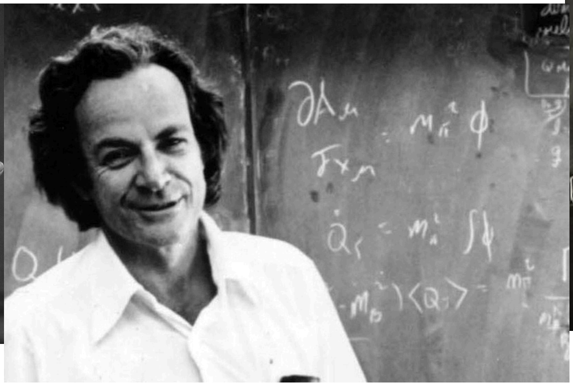
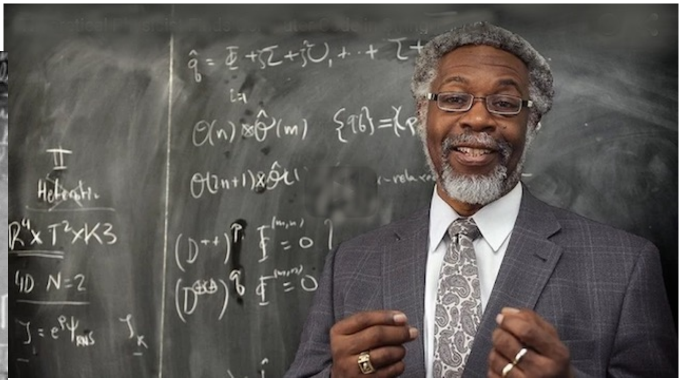
outer page

inner page

Web security

A historical perspective

- The web is an example of "bolt-on security", the security was added as an after thought
- Originally, the web was invented to allow physicists to share their research papers
  - Only textual web pages + links to other pages; no threat model to speak of

The web became complex and adversarial quickly

- Then we added embedded images
  - Crucial decision: a page can embed images loaded from another web server
- Then, Javascript, dynamic HTML, AJAX, CSS, frames, audio, video, …
- Today, a web site is a distributed application
- Attackers have various motivations

Web security is a challenge!

Desirable security goals

- **Integrity:** malicious web sites should not be able to tamper with integrity of my computer or my information on other web sites
- **Confidentiality:** malicious web sites should not be able to learn confidential information from my computer or other web sites
- **Privacy:** malicious web sites should not be able to spy on me or my activities online
- **Availability**: attacker cannot make site unavailable

Security on the web

- Risk #1: we don't want a malicious site to be able to trash my files/programs on my computer
  - Browsing to `awesomevids.com` (or `evil.com`) should not infect my computer with malware, read or write files on my computer, etc.

Security on the web

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- Defense: Javascript is sandboxed;
  try to avoid security bugs in browser code;
  privilege separation; automatic updates; etc.

Security on the web

- Risk #2: we don't want a malicious site to be able to spy on or tamper with my information or interactions with other websites
  - Browsing to `evil.com` should not let `evil.com` spy on my emails in Gmail or buy stuff with my Amazon account

Security on the web

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  - Browsing to `evil.com` should not let `evil.com` spy on my emails in Gmail or buy stuff with my Amazon account
- Defense: the same-origin policy
  - A security policy grafted on after-the-fact, and enforced by web browsers

Security on the web

- Risk #3: we want data stored on a web server to be protected from unauthorized access

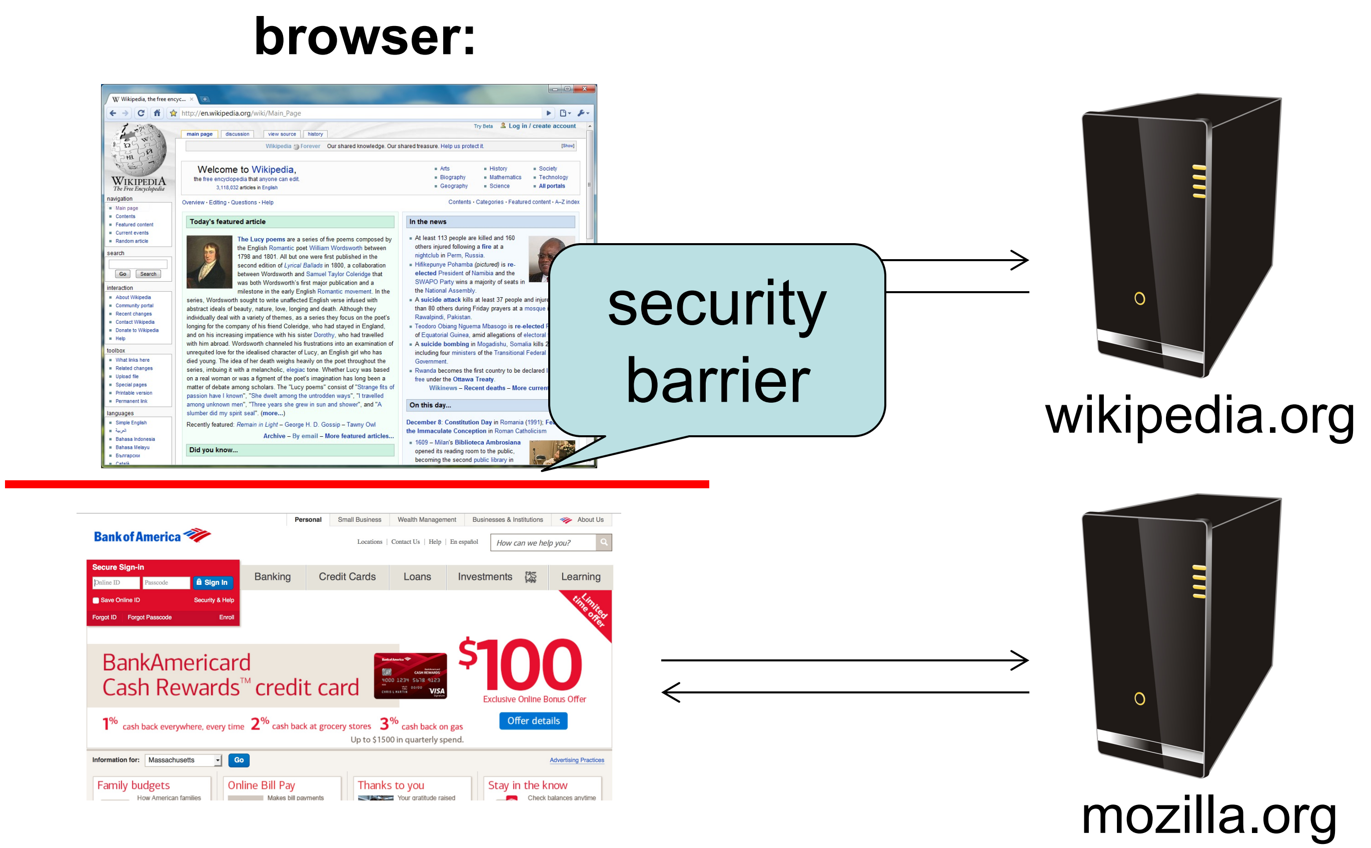
Security on the web

- Risk #3: we want data stored on a web server to be protected from unauthorized access
- Defense: server-side security

Same-origin policy

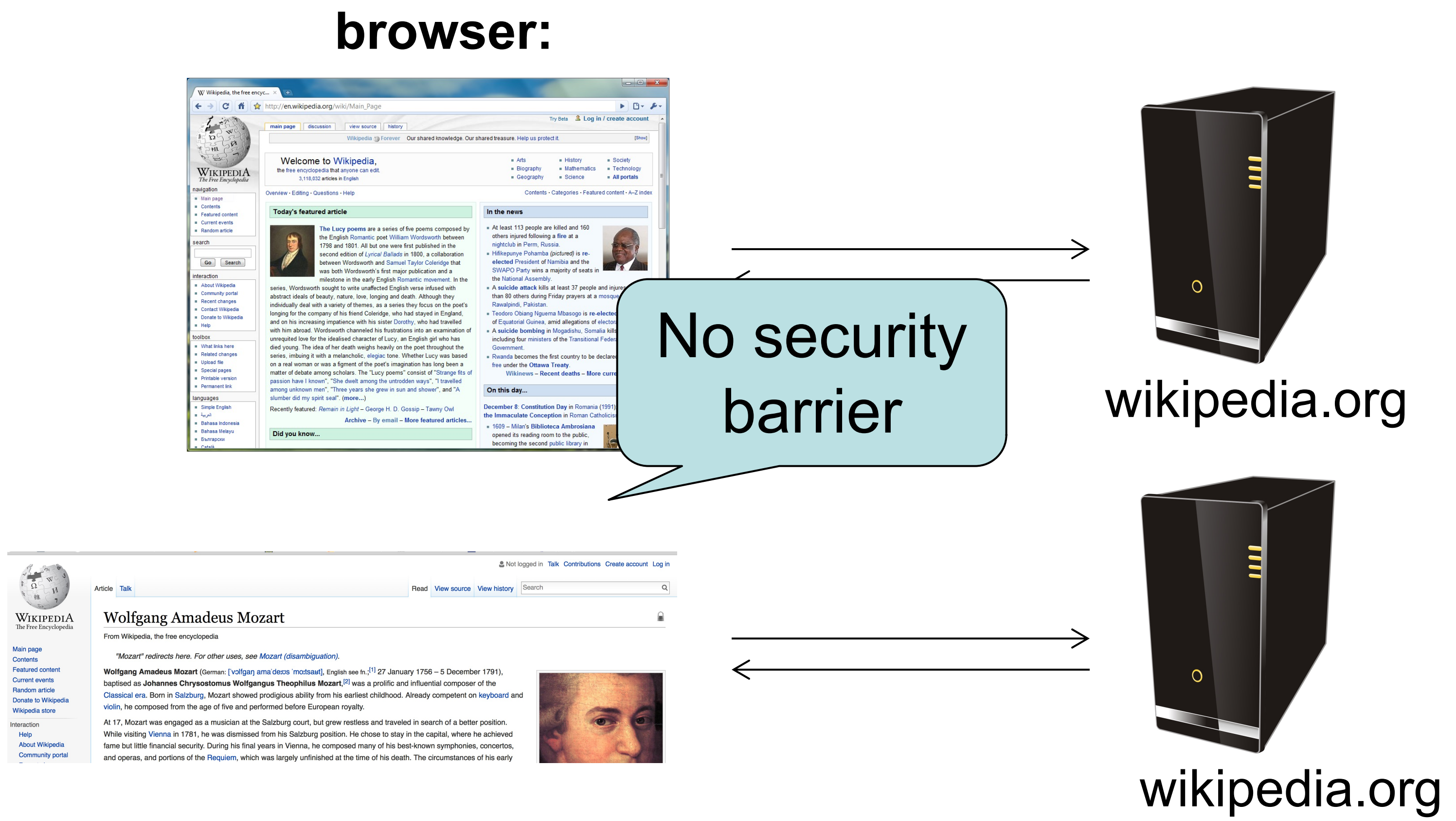
Same-origin policy

- Each site in the browser is isolated from all others



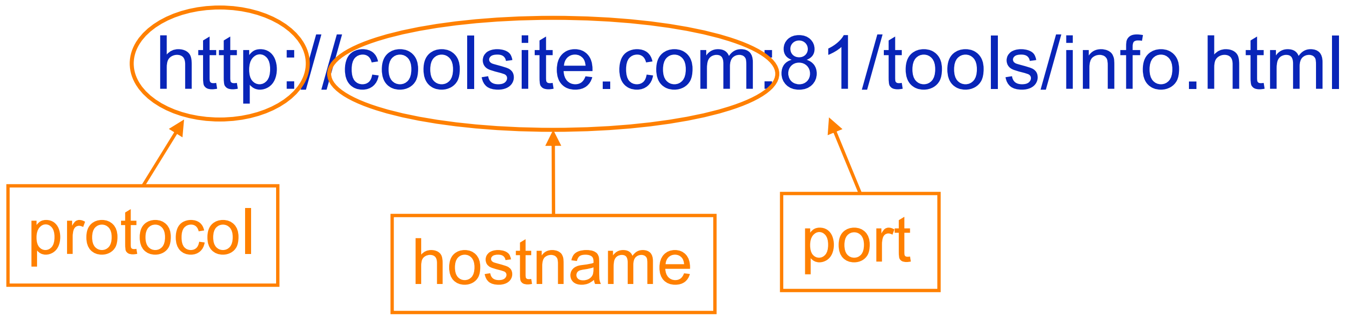
Same-origin policy

- Multiple pages from the same site are not isolated



Origin

- Granularity of protection for same origin policy
- Origin = (protocol, hostname, port)



- It is **string matching**! If these match, it is same origin, else it is not. Even though in some cases, it is logically the same origin, if there is no match, it is not

Same-origin policy

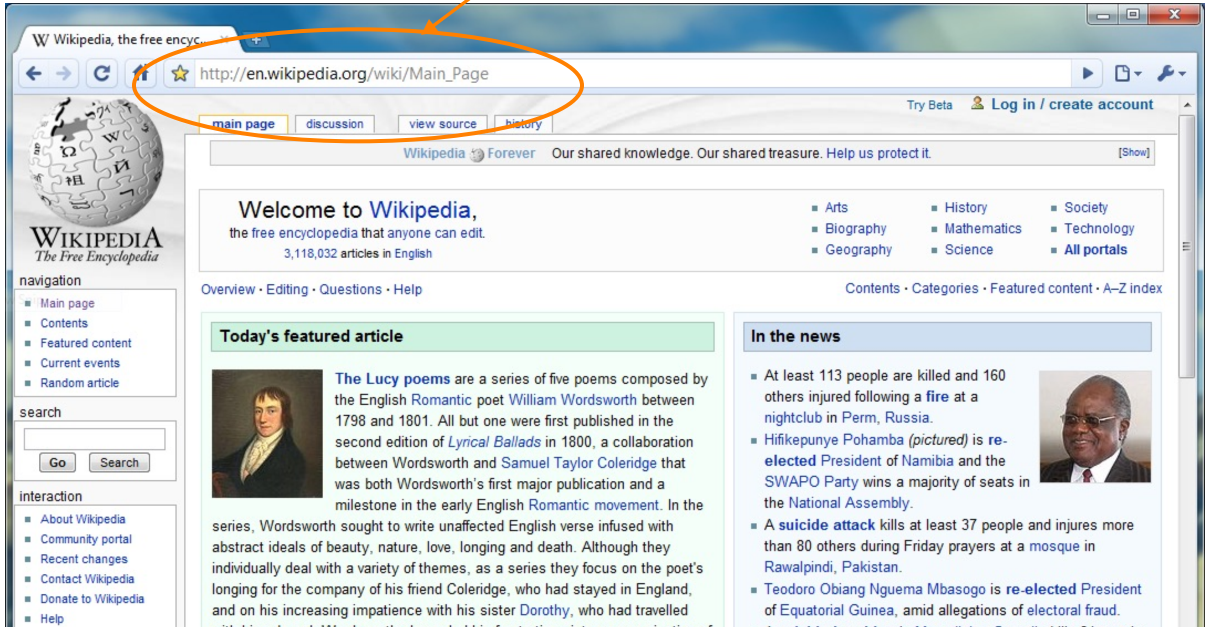
One origin should not be able to access the resources of another origin

Javascript on one page cannot read or modify pages from different origins

Same-origin policy

- The origin of a page is derived from the URL it was loaded from

http://en.wikipedia.org



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Today's featured article

The Lucy poems are a series of five poems composed by the English Romantic poet William Wordsworth between 1798 and 1801. All but one were first published in the second edition of *Lyrical Ballads* in 1800, a collaboration between Wordsworth and Samuel Taylor Coleridge that was both Wordsworth's first major publication and a milestone in the early English Romantic movement. In the series, Wordsworth sought to write unaffected English verse infused with abstract ideals of beauty, nature, love, longing and death. Although they individually deal with a variety of themes, as a series they focus on the poet's longing for the company of his friend Coleridge, who had stayed in England, and on his increasing impatience with his sister Dorothy, who had travelled

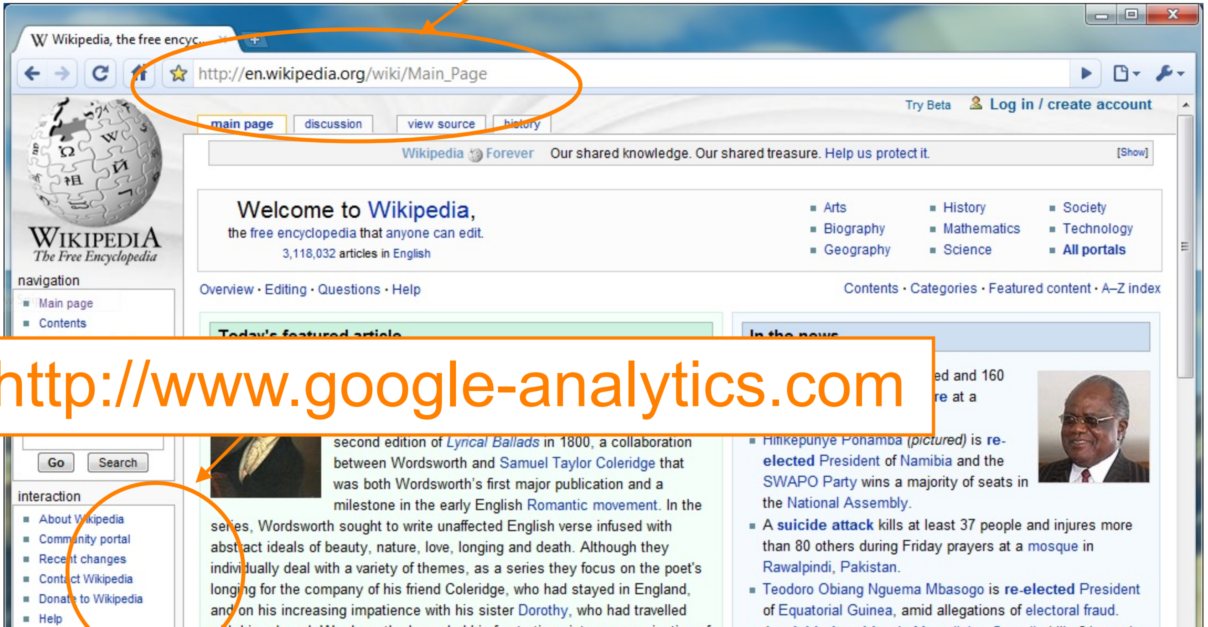
In the news

- At least 113 people are killed and 160 others injured following a **fire** at a nightclub in Perm, Russia.
- Hifikepunye Pohamba *(pictured)* is **re-elected** President of Namibia and the SWAPO Party wins a majority of seats in the National Assembly.
- A **suicide attack** kills at least 37 people and injures more than 80 others during Friday prayers at a mosque in Rawalpindi, Pakistan.
- Teodoro Obiang Nguema Mbasogo is **re-elected** President of Equatorial Guinea, amid allegations of electoral fraud.

Same-origin policy

- The origin of a page is derived from the URL it was loaded from
- Special case: Javascript runs with the origin of the page that loaded it

http://en.wikipedia.org



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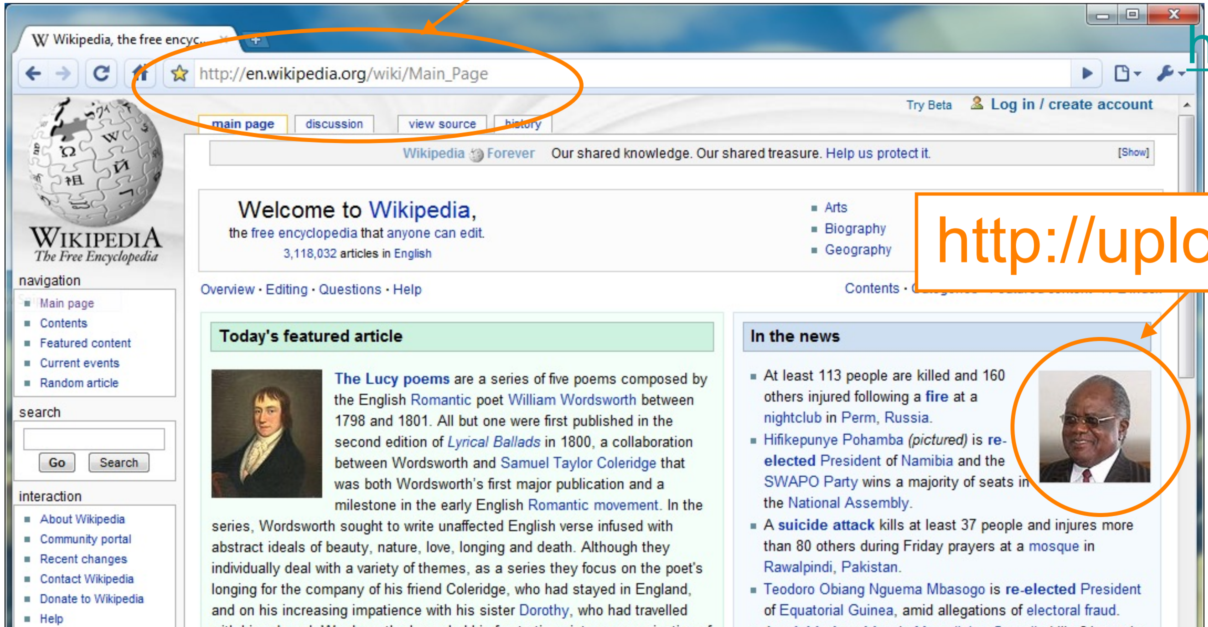
Origins of other components

- **<img src=“”>** the image is “copied” from the remote server into the new page so it has the origin of the embedding page (like JS) and not of the remote origin

http://en.wikipedia.org

Image still has http://en.wikipedia.org origin

http://upload.wikimedia.org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Origins of other components

- iframe: origin of the URL from which the iframe is served, and not the loading website.

Exercises: Same origin?

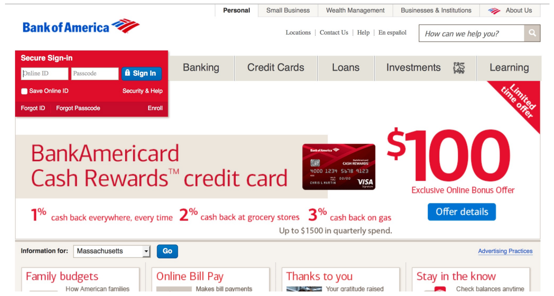
Originating document	Accessed document	
http://wikipedia.org/**a**/	http://wikipedia.org/**b**/	✓
http://wikipedia.org/	http://**www.**wikipedia.org/	✗
http://wikipedia.org/	**https**://wikipedia.org/	✗
http://wikipedia.org**:81**/	http://wikipedia.org**:82**/	✗
http://wikipedia.org**:81**/	http://wikipedia.org/	✗

except !!!

Cross-origin communication

- Allowed through a narrow API: **postMessage**
- Receiving origin decides if to accept the message based on origin (whose correctness is enforced by browser)

```
postMessage
("run this
script",
script)
```



Check origin, and request!

Web security attacks

What can go bad if a web server is compromised?

- Steal sensitive data (e.g., data from many users)
- Change server data (e.g., affect users)
- Gateway to enabling attacks on clients
- Impersonation (of users to servers, or vice versa)
- Others

A set of common attacks

- SQL Injection
  - Browser sends malicious input to server
  - Bad input checking leads to malicious SQL query
- XSS – Cross-site scripting
  - Attacker inserts client-side script into pages viewed by other users, script runs in the users' browsers
- CSRF – Cross-site request forgery
  - Bad web site sends request to good web site, using credentials of an innocent victim who "visits" site