CS 161

Web Browser Security

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Slides adapted from Collin Jackson

Running Remote Code is Risky

- Integrity
  - Compromise your machine
  - Install malware rootkit
  - Transact on your accounts
- Confidentiality
  - Read your information
  - Steal passwords
  - Read your email

Browser Sandbox

- Goal
  - Run remote web applications safely
  - Limited access to OS, network, and browser data
- Approach
  - Isolate sites in different security contexts
  - Browser manages resources, like an OS
  - Access control: same-origin principle
    - Pages from the "same site" can interact
    - Pages from "different sites" separated

Why study browser security?

... if you're not Microsoft, Mozilla, Apple, Google or Opera?

- Build better browsers
  - Contribute to open source browsers (Firefox, Safari)
  - Embed a renderer in your program (Gecko, WebKit)
- Build better web applications
  - Servers and firewalls can mitigate browser limitations
  - Take advantage of opt-in browser security features
- Be a safer surfer
  - Make informed security decisions
  - Distinguish harmless warnings from attacks

Threat Models

- Web attacker
  - Controls attacker.com
  - Has HTTPS certificate for attacker.com ($0)
  - User visits attacker.com
- Network attacker
  - Passive: Wireless eavesdropper
  - Active: Evil router, DNS poisoning
- Malware attacker
  - Escaped from browser sandbox

Security User Interface

When is it safe to type my password?

URLs

- Global identifiers of network-retrievable documents

http://user:pass@stanford.edu:81/class?name=cs155#homework

Protocol, Username, Password, Host, Port, Path, Query, Fragment

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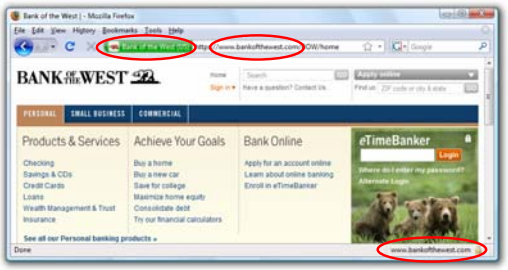
Safe to type your password?



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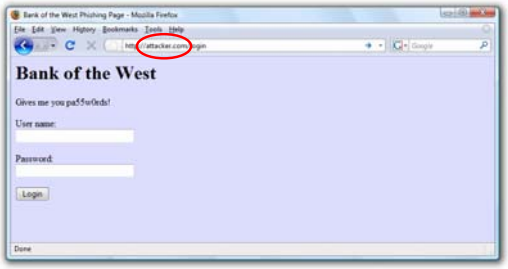
Safe to type your password?



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Safe to type your password?

thewvest.com/

thewest.com/

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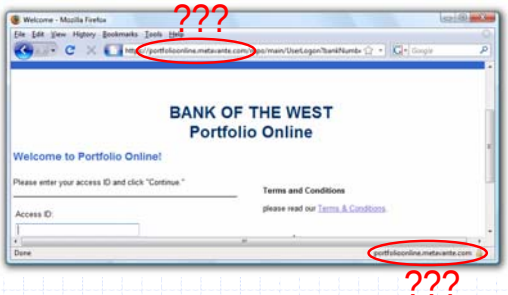
Safe to type your password?

???



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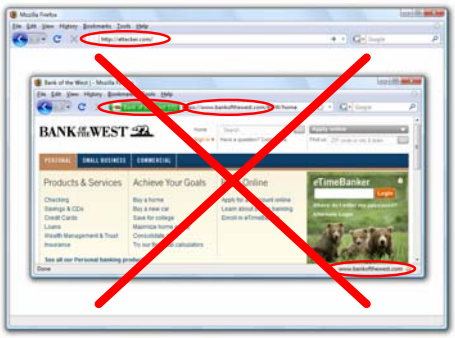
Safe to type your password?



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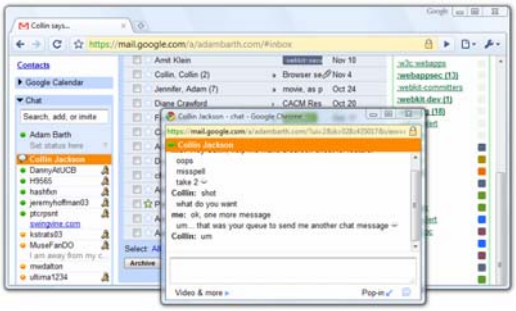
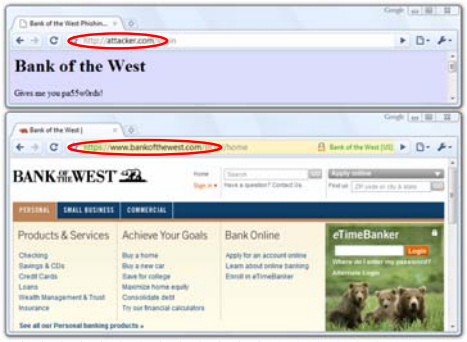
Same-Origin Policy

How does the browser isolate different sites?

Windows Interact



Are all interactions good?



Browser Same-Origin Policy

- Different origins have limited interaction
- Origin is the tuple <domain, port, protocol>

http://www.example.com:80/whoami
http://www.example.com:80/hello

✓ Full access

https://www.example.com:443/hello
http://www.example.com:443/hello

✘ Limited access

Same-Origin Policy Examples

- Example HTML at **http://www.site.com/**

```
<iframe src="http://othersite.com/"></iframe>
<img src="http://othersite.com/logo.gif">
```

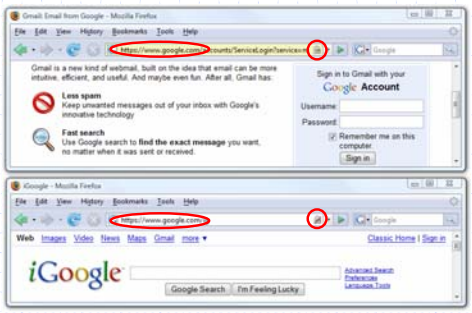
- Disallowed:

```
alert(frames[0].document.body.innerHTML)
alert(frames[0].location)
```

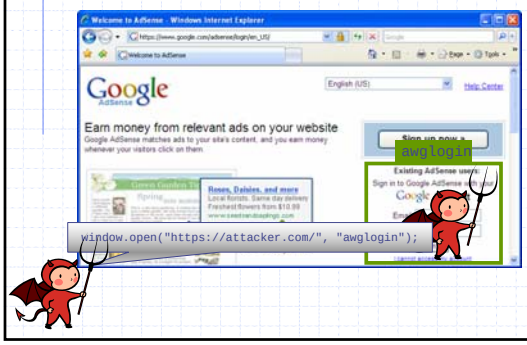
- Allowed:

```
alert(images[0].height)
frames[0].location =
"http://othersite.com/foo";
```

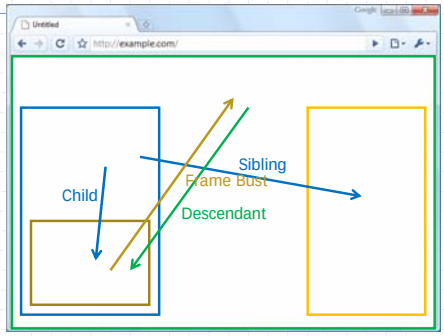

Mixed Content



A Guninski Attack



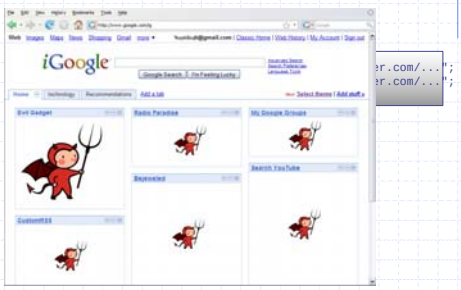
What should the policy be?



Legacy Browser Behavior

Browser	Policy
IE 6 (default)	Permissive
IE 6 (option)	Child
IE7 (no Flash)	Descendant
IE7 (with Flash)	Permissive
Firefox 2	Window
Safari 3	Permissive
Opera 9	Window
HTML 5	Child

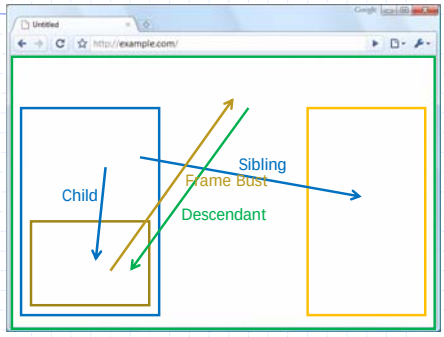
Window Policy Anomaly



Principle: Pixel Delegation

- Frames delegate screen pixels
  - Child cannot draw outside its frame
  - Parent **can** draw over the child's pixels
- Navigation similar to drawing
  - Navigation replaces frame contents
  - "Simulate" by drawing over frame
- Policy ought to match pixel delegation
  - Navigate a frame if can draw over the frame

What should the policy be?



Why Frame Busting Matters

Adoption of Descendant Policy

Browser	Policy
IE7 (no Flash)	Descendant
IE7 (with Flash)	Descendant
Firefox 3	Descendant
Safari 3	Descendant
Opera 9	(many policies)
HTML 5	Descendant

Intermission

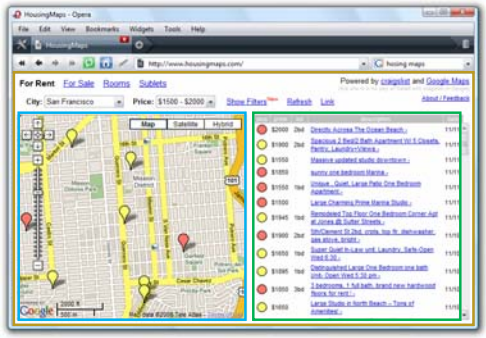
Ask me about:

- 1000 lines of regression tests
- Frame busting and Yahoo
- PR for “extended validation” user study

Mashups

How can different sites communicate?

HousingMaps.com

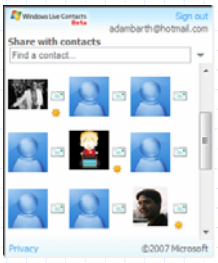


Windows Live Contacts

Integrator

Add a contact

Share contacts



window.postMessage

- Secure channel between frames

```
frames[0].postMessage("Attack at dawn!",
                      "http://gadget.com/");
```

```
window.addEventListener(function (e) {
  if (e.origin == "http://integrator.com") {
    ... e.data ... }
}, false);
```

- Supported in brand-new browsers

Why include “targetOrigin”?

- What goes wrong?

```
frames[0].postMessage("Attack at dawn!");
```

- Messages sent to *frames*, not principals
  - When would this happen?

Facebook Anecdote

Thanks!

You’ve been a great audience