CIS 551 / TCOM 401

Computer and Network Security

Spring 2008

Lecture 25

Announcements

- Project 4 is Due Friday May 2nd at 11:59 PM
- Final exam:
  - Friday, May 12th. Noon - 2:00pm DRLB A6
- Today:
  - Cookies & State
  - Phishing
- Next (and last!) class:
  - Course Review
  - Course evaluations (please come!)

Maintaining State

- HTTP is a stateless protocol
  - Server doesn't store any information about the connections it handles (each request is treated independently)
  - Makes it hard to maintain session information

- Encode state in the URL:
  - …/cgi-bin/nxt?state=-189534fjk
  - Used commonly on message boards, etc. to track thread
- Use HIDDEN input fields
  - When user fills in web forms, the POST request gives server the data
  - You can embed state in invisible "input" fields
- Cookies
  - Store data on the client's machine

Hidden Fields

```
<html>
<head> <title>My Page</title> </head>
<body>
 <form name="myform"
       action="http://…/handle.cgi"
       method="POST">
 <div align="center">
  <input type="text" size="25" value="Name?">
  <input type="hidden" name="Language" value="English">
 <br><br> </div> </form>
</body>
</html>
```

Cookies (Client-side state)

- Server can store cookies on the client machine by issuing:

```
Set-Cookie: NAME=VALUE; [expires=DATE;]
[path=PATH;] [domain=DOMAIN_NAME;]
[secure]
```

- Domain and Path restrict the servers (and paths on those servers) to which the cookie will be sent
- The "secure" flag says that the cookie should only be sent over HTTPS
- Uses:
  - User authentication
  - Personalization
  - User tracking: e.g. Doubleclick (3rd party cookies)

Cookies (cont'd)

- When the client requests a URL from a server, the browser matches the URL against all cookies on the client.
- If they match, then the client request includes the line:

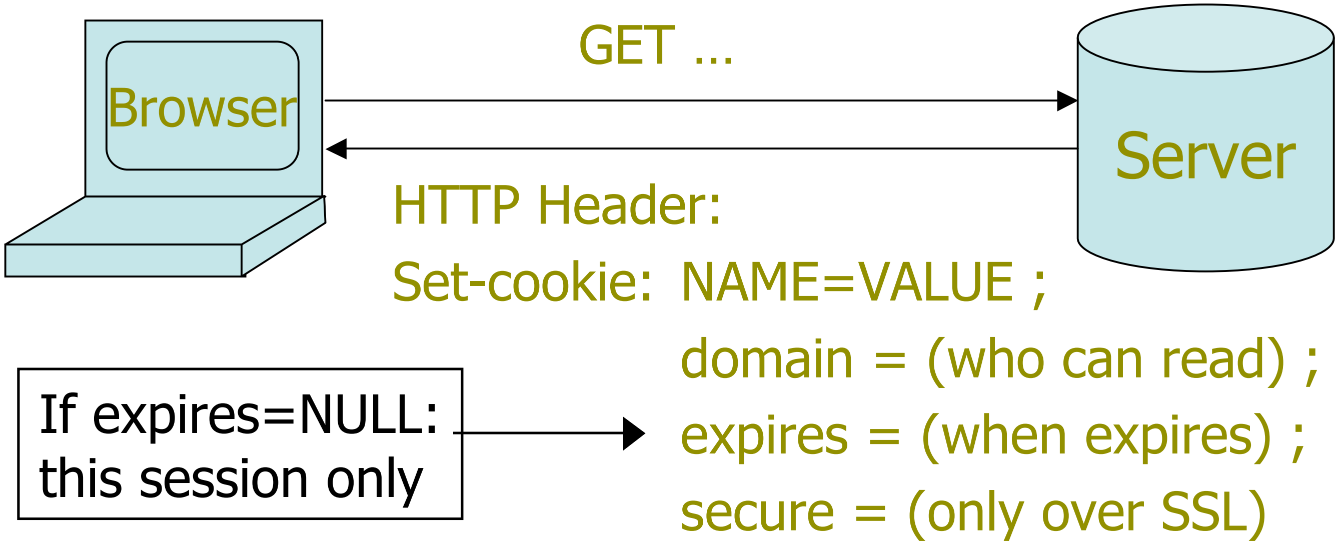
```
Cookie: NAME1=VALUE1; NAME2=VALUE2;…
```

- Notes:
  - New instances of cookies overwrite old ones
  - Clients aren't required to purge expired cookies (though they shouldn't send them)
  - Cookies can be at most 4k, at most 20 per site
  - To delete a cookie, the server can send a cookie with expires set to a past date
  - HTTP proxy servers shouldn't cache Set-cookie headers…

Cookies

Http is stateless protocol; cookies add state

- Used to store state on user's machine

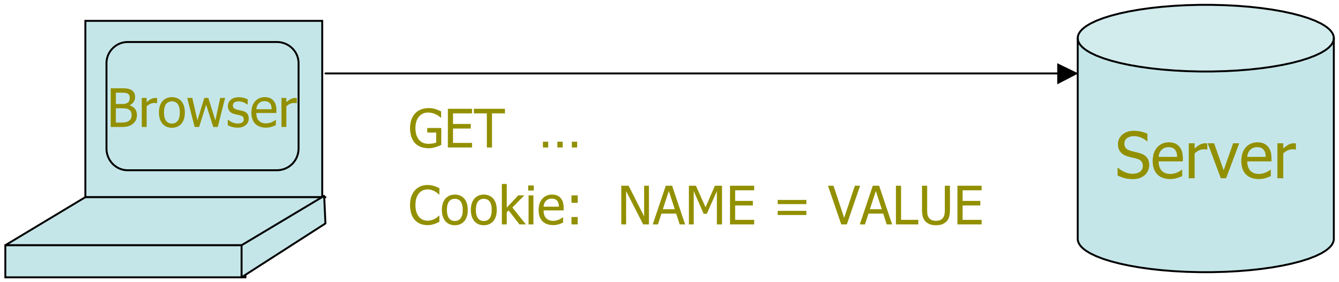


GET …

HTTP Header:

Set-cookie: NAME=VALUE ;
domain = (who can read) ;
expires = (when expires) ;
secure = (only over SSL)

If expires=NULL:
this session only



GET …

Cookie: NAME = VALUE

Cookie/Hidden Field Risks

- Danger of storing data on browser:
  - User can change values
- **<u>Silly example</u>**: Shopping cart software.

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

  - User edits cookie file (cookie poisoning):

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

  - … bargain shopping.
- Similar behavior with hidden fields:

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

Example: dansie.net shopping cart

- http://www.dansie.net/demo.html   (April, 2008)

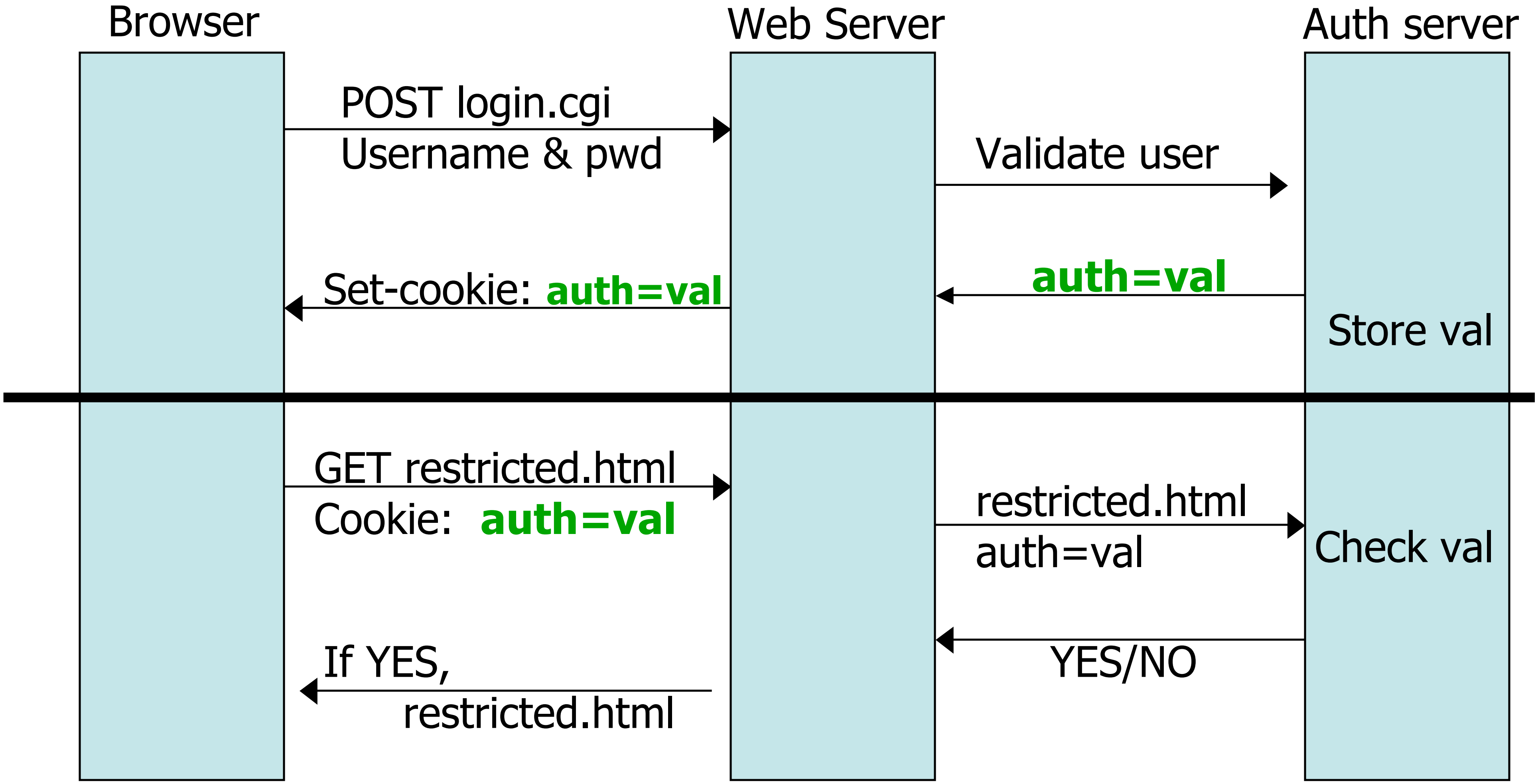
```
<FORM METHOD=POST ACTION="http://www.dansie.net/cgi-
bin/scripts/cart.pl">

<FONT FACE="Times New Roman" COLOR="#000099" SIZE=+1>Black Leather purse
with leather straps<BR>Price: $20.00</FONT><BR>

<INPUT TYPE=HIDDEN NAME=name VALUE="Black leather purse">
<INPUT TYPE=HIDDEN NAME=price VALUE="20.00">
<INPUT TYPE=HIDDEN NAME=sh VALUE="1">
<INPUT TYPE=HIDDEN NAME=img VALUE="purse.jpg">
<INPUT TYPE=HIDDEN NAME=img2 VALUE="purse_large.jpg">
<INPUT TYPE=HIDDEN NAME=return VALUE="http://www.dansie.net/demo.html">
<INPUT TYPE=HIDDEN NAME=custom1 VALUE="Black Leather purse with leather
straps">

<INPUT TYPE=SUBMIT NAME="add" VALUE="Put in Shopping Cart">
</FORM>
```

Solution

- When storing state on browser use a Message Authentication Code (MAC) with server's secret key to enforce data integrity.

- .NET 2.0 (probably similar in 3.0):
  - System.Web.Configuration.MachineKey
    - Secret web server key intended for cookie protection
  - HttpCookie cookie = new HttpCookie(name, val);
    HttpCookie encodedCookie =
    HttpSecureCookie.Encode (cookie);
  - **HttpSecureCookie.Decode** (cookie);

Cookie authentication (over https)



Cookie auth is insufficient

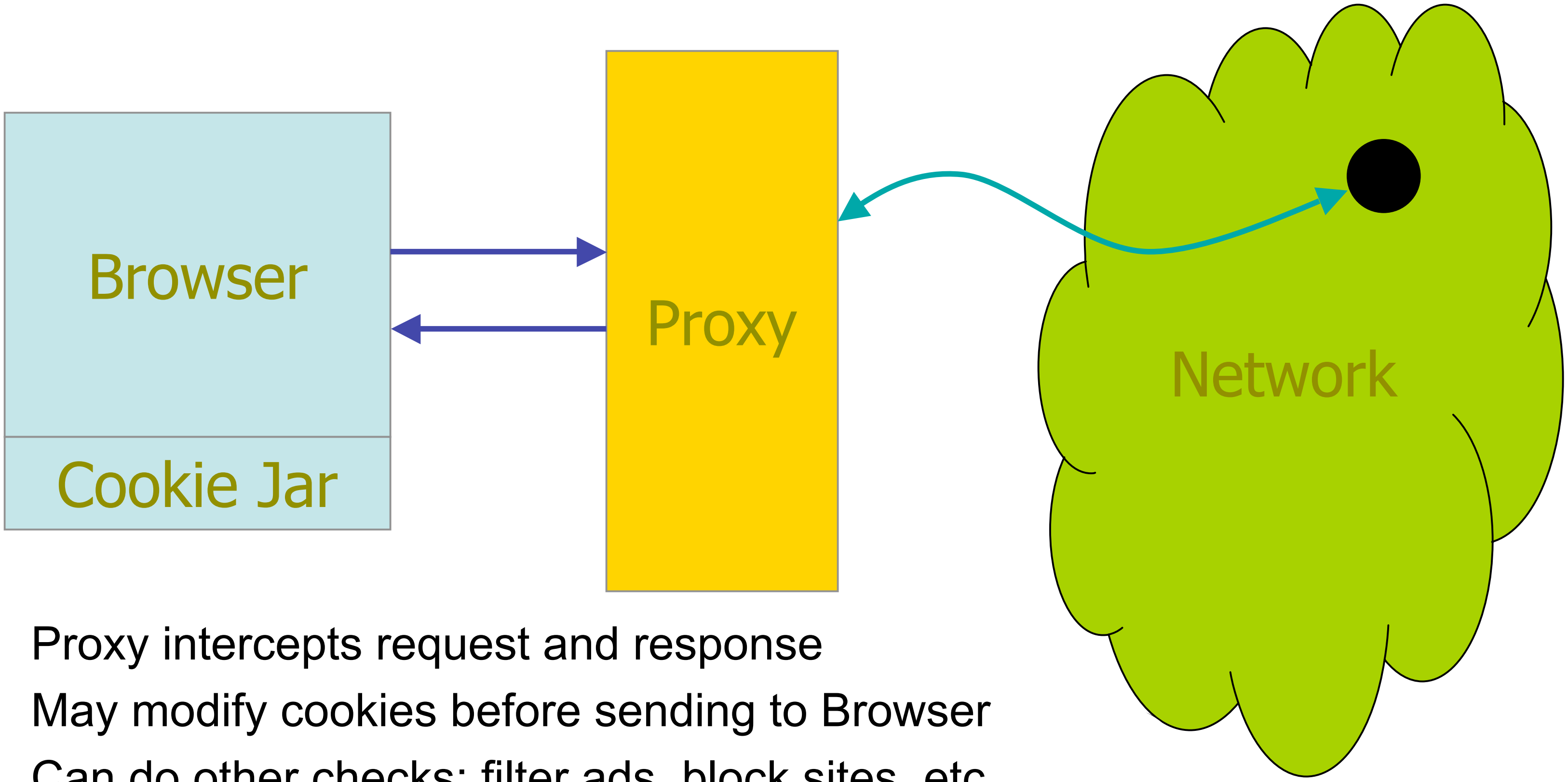
- Example:
  - User logs in to bank.com. Forgets to sign off.
  - Session cookie remains in browser state
  - Then user visits another site containing:

```
<form name=F action=http://bank.com/BillPay.php>
<input name=recipient value=badguy> …
<script> document.F.submit(); </script>
```

  - Browser sends user auth cookie with request
    - Transaction will be fulfilled

- Problem:
  - Cookie auth is insufficient when side effects can happen
  - Correct use: use cookies + hidden fields
  - Hidden fields: store nonces that must be presented to the server
    - Can't be guessed by the malicous web site

Managing cookie policy via proxy



- Proxy intercepts request and response
- May modify cookies before sending to Browser
- Can do other checks: filter ads, block sites, etc.
- This is just a reference monitor for cookies

Sample Proxy:

JUNK**BUSTERS**

- Cookie management by policy in *cookiefile*
  - Default: all cookies are silently crunched
  - Options
    - Allow cookies only to/from certain sites
    - Block cookies to browser (but allow to server)
    - Send vanilla wafers instead
- Block URLs matching any pattern in *blockfile*
  - Example: pattern /*.*/ad matches http://nomatterwhere.com/images/advert/g3487.gif

Easy to write your own http proxy; you can try *this* at home

Phishing

- Phishing:
  - Trojan horse e-mails and web sites designed to trick the user into giving up account/pin/password/credit card information.

- December 17, 2007: Gartner Survey
  - Estimated $3.2 BILLION was lost to phishing attacks
  - 3.3% of those surveyed lost money due to phishing
  - (more than in prior years)
  - Most spoofed: PayPal and eBay
  - See:

  www.doshelp.com/scams-fraud/Services/Ebay-Scams.htm

- Goal: Present a plausible experience to the user

Phishing Techniques

- See "Technical Trends in Phishing Attacks"
  - by Jason Milletary (US-CERT)
- Social Engineering
- Bot nets
  - Same infrastructure as Spam mail
- Web site hosting
  - Redirects / obfuscated URLs etc.
- Phishing Kits
  - Pre-generated HTML/e-mail that looks official (graphics, etc.)
- Browser vulnerabilities
  - Borderless popup windows that don't display the address bar
  - Cross-domain vulnerabilities
- XSS using URL redirectors that don't sanitize inputs

Reading browser history

- CSS properties of hyperlinks
- Can also use cache-based techniques:
  - Images and other data in the cache take less time to load, so a script can time how long it takes to load a resource to get some hints about a user's prior browsing.

Violation of the same-origin principle:

> "One site cannot use information belonging to another site."

Visited link tracking http://www.safehistory.com/

- Visited links displayed in different color (74% of sites)
  - Information easily accessible by javascript
- Attacks also without javascript

```
<html><head>
<style> a { position:absolute; border:0; } a:link { display:none } </style>
</head><body>
<a href='http://www.bankofamerica.com/'><img src='bankofamerica.gif'></a>
<a href='https://www.wellsfargo.com/'><img src='wellsfargo.gif'></a>
<a href='http://www.usbank.com/'><img src='usbank.gif'></a>
...
</body></html>
```

  - Bank logo images are stacked on top of each other
  - CSS rules cause the un-visited links to vanish
  - Page displays bank logo of site that user has visited

Countermeasures?

- Education and awareness training
- "Security indicators" in the web browser
  - E.g. the yellow address background for https connections in FireFox
- Browser extensions that act as a firewall
  - Can blacklist known phishing sites
- Internet lists of known phishing sites:
  - www.phishtank.com

Do they work?

- Paper: "The Emperor's New Security Indicators: An evaluation of website authentication and the effecft of role playing on usability studies" (Schechter *et al.* 2007)
  - Available on the course web pages
- Will customers of an online bank…
  - enter their passwords even if their browsers' HTTPS indicators are missing?
  - enter their passwords even if their site-authentication images are missing?
  - enter their passwords even if they are presented with an IE7 warning page?

Study

- 67 participants:
  - All had accounts at the same bank
  - Mostly Harvard students (not computer scientists/engineers)

- Divided into 3 groups:
  - Group 1: Played a "role" but not told that security was important
  - Group 2: Played a "role" but told that security was important
  - Group 3: Not role playing

- Participants were asked to complete several tasks
  - Check facts about their account balance, last login, last transaction, last statement
- Hints that someone was spoofing:
  - Remove HTTPS indicator
  - Remove site authentication images
  - Present a warning page

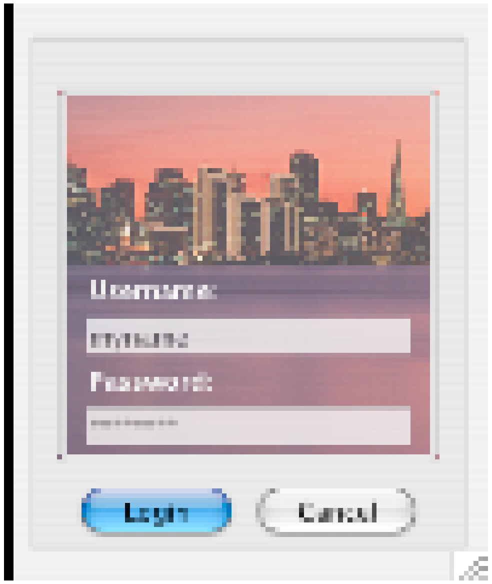
Results

	Group 1 Role playing	Group 2 Role playing	Group 3 Per. Acct.
Upon noticing HTTPS missing	0%	0%	0%
Image removed	0%	0%	9%
After Warning	47%	29%	55%
Never (Always logged in)	53%	71%	36%

Security Skins

- See the paper "The Battle Against Phishing: Dynamic Security Skins" by Dhamija and Tygar (2005)
- Use two techniques to prevent web page spoofing:
  - Trusted path for username/password entry
  - "Visual hash" to identify legitimate web servers

- Trusted path:
  - User picks a personal image
  - Dedicated username/password window uses that image as a background (overlaying the text entry fields too)
  - Hard to spoof



Username: myname

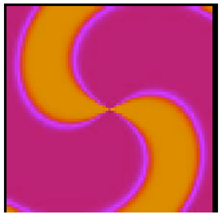
Password:

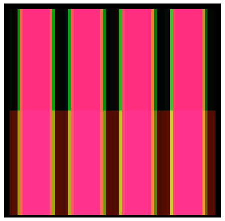
Secure Remote Password Protocol

- Due to Wu
- Setup (done once):
  - Alice picks a password PWD, random salt R, creates V = Hash(PWD,R)
  - Sends her userid, V and R to the server (Bart)
- Authentication and key generation:
  - Alice's client sends random number N_A and userID to B
  - B sends Alice a random number N_B
  - Using N_A, N_B, and V, Alice and Bart compute a fresh key K
  - Alice sends $H_A = \text{Hash}(K,N_A,N_B)$ to B
  - B sends $H_B = \text{Hash}(H_A, K, N_A, N_B)$ to Alice

Security Skins

- Use the final hash value H_B to generate a random image:
  - There are various techniques for doing this

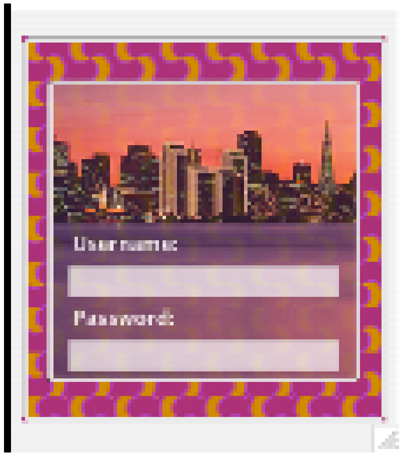




- The client and server can reach the same image by doing the same calculation.
- Client marks the "secure" window with the image
- Server marks its web pages with the image too
- User does a "visual diff" to see that the images are the same

Example from the paper

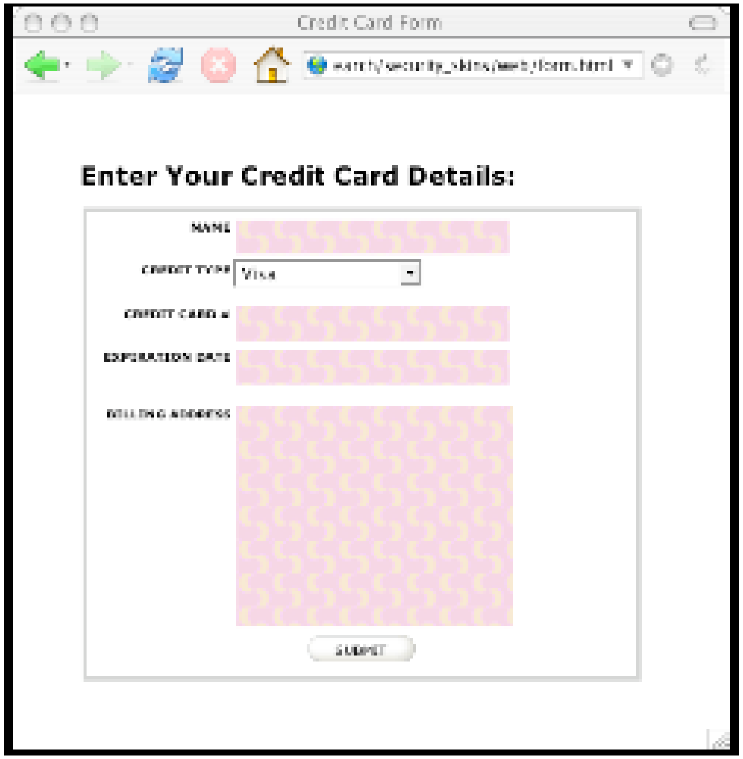
- Client password window:



User name:

Password:

- Server-generated page has the same image embedded in the form backgrounds:



Credit Card Form

earch/security_skins/web_form.html

Enter Your Credit Card Details:

NAME

CREDIT TYPE Visa

CREDIT CARD #

EXPIRATION DATE

BILLING ADDRESS

SUBMIT