How to Build a Secure Login

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Pre-Login

- Pre-Login
- Login Page
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- Users get to the site in many ways: Search engine, Bookmarks, Links from emails, Direct URL entry, iframes from other sites.
- Request/Response model.
- Users shouldn't be able to complete most actions before logging in, but they may be able to begin actions such as adding items to a cart or setting up a session.
- Account Creation
- Password Reset
GET / HTTP/1.1
Host: www.example.com
User-Agent: Mozilla/5.0 (X11; U; Lin...
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Keep-Alive: 115

HTTP/1.1 200 OK
Date: Fri, 29 Apr 2011 17:12:13 GMT
Set-Cookie: skin=noskin; path=/; domain=.example.com; expires=Fri, 29-Apr-2011 17:12:13 GMT
Content-Type: text/html; charset=ISO-8859-1
Set-cookie: session-id=176-9381406-6210335; path=/; domain=.example.com; expires=Tue Jan 01 08:00:01 2036 GMT
Content-Length: 156046

<html>
... web page
Login Page

- Pre-Login
- **Login Page**
- Login Redirect
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• Users can get to the login page by:
  o Clicking on the login link on the site or from an email or another site.
  o Attempting to go to a logged in page without being logged in.
  o Making a request to a logged in page after the session has expired.
• The login page needs to know where to send the user after successful login.
• Input can include a username, password, pre-login cookie, anti-CSRF token, CAPTCHA, and even a second factor such as an RSA token.
Clicked on Login link

HTTP/1.1 302 Found
Location: https://example.com/login/

Redirected to Login

Logged in area

HTTP 302

Get Login Form

Login Form

Get Login Form

Login Form
1. Request to Logged in Page:
GET mail/inbox.php?email_id=11&action=mark_as_read HTTP/1.1

2. 302 Response containing
Set-cookie: go_to=/mail/inbox.php?email_id=11&action=mark_as_read
Location: https://example.com/login.php

3. Request to https://example.com/login.php

4. Response containing Login page:
HTTP/1.1 200 OK
... Other Headers

<html>
... Login Form

5. Request containing credentials:
POST /login.php HTTP/1.1
Host: example.com
Cookie: anonymous_session_id=ff5f109f765de12d3a83ce578e9d44ef; go_to=/mail/inbox.php?email_id=11&action=mark_as_read
username=ben&password=myrealpassword&csrf_token=6108d48838...
Login Redirect

- Pre-Login
- Login Page
- **Login Redirect**
- Logged In
- Log Out

- Upon successful verification of the user's credentials, a redirection response which contains a Set-Cookie header is returned.
  - Usually an HTTP 302 Found response with a Location header.
  - Sometimes a webpage is returned which includes a javascript or meta tag redirect.
- This new cookie is the logged in session cookie.
1. Response from successful login:
HTTP/1.1 302 Found
Set-Cookie: session_id=617372ea63040f780b16dd992122e170; path=/; secure; HttpOnly
Location: https://example.com/mail/inbox.php?email_id=11&action=mark_as_read

2. Request to Location value:
GET /mail/inbox.php?email_id=11&action=mark_as_read HTTP/1.1
Host: example.com
Cookie: session_id=617372ea63040f780b16dd992122e170

3. Response containing logged in page:
HTTP/1.1 200 OK
... Other Headers

<html>
... Logged in Page
Logged In

- Pre-Login
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- **Logged In**
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- Now that the user is logged in, they can take sensitive actions and look at sensitive data.
- The user stays logged in because the browser adds the Cookie header to every request (with the appropriate domain, path, flags, etc.).
- Often users have to fill out long forms that take longer than the inactivity logout period.
- Users may have multiple tabs open which makes it difficult to impose an order on their actions.
REQUEST
POST /payroll/directdeposit.php HTTP/1.1
Host: www.example.com
User-Agent: Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.9.2.16)
Gecko/20110323 Ubuntu/10.04 (lucid) Firefox/3.6.16
Cookie: session_id=617372ea63040f780b16dd992122e170
routing_nbr=111111111&acct_nbr=123412341234&csrf_token=c1446f6da166450281c91108551ae9b6

RESPONSE
HTTP/1.1 200 OK
Pragma: no-cache
Content-Length: 2150
Keep-Alive: timeout=15, max=100
Content-Type: text/html; charset=iso-8859-1

<html>
... web page
Log Out

- How do users log out:
  - They click on the logout link.
  - Their session expires due to inactivity or absolute timeout.
  - They complete an action.
  - They navigate to a non-logged-in section of the site.
- If the user's session didn't expire, they get a response which contains a Set-Cookie header that expires the logged in cookie and then redirects the user.
- Otherwise they get redirected to the login page.
Clicked on Logout Link

Logged out due to inactivity
Attacks!

The fun stuff.
Attack Goals

- Bypass Login
- Login as another user
- Force logged in users to take actions
- Get logged in users' information
- Affect pre-login actions that affect logged in actions

- Get users to login to a known session or account
- Get valid usernames
- Get valid user passwords
- Get valid user email addresses
- Lockout users
Pre-Login

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• SQL Injection - same database
• XSS as a Social Engineering vector
• Carry over attacks:
  o Cookie attacks: XSS, lack of SSL, Header Injection, token prediction
  o Session via URL token (no cookies)
  o CSRF and Clickjacking
• User Enumeration:
  o Password Reset
  o Account Creation
  o Login Form
• Inadequate SSL Coverage
• Combination XSS with CSRF to the logged in section to get sensitive data.
Login Page

- Pre-Login
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- SQL Injection to bypass verification
- XSS as a key logger
- User Enumeration
- Password Bruteforcing
- SQL Injection for password gathering
- Login CSRF
  - Contests
  - Stored data
  - I was framed!
- Inadequate SSL
- Account Lockout
Login Redirect

- Pre-Login
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- Header Injection: Location header
- Session Fixation
- Predictable session token
- Forced redirection
  - Off site (Referer header)
  - CSRF
- Gotta have the SSL
- Javascript or meta tag redirect XSS
Logged In

- Pre-Login
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- XSS framework for full control (BeEF)
- XSS for session token capture
- SQL Injection via CSRF
- CSRF and Clickjacking
- Inadequate SSL coverage
- Authentication bypass
- Disclosure of URL parameters (Referer)
- AJAX hijacking
- Force Logout
Log Out

- Forced redirection
- Header injection: Location
- Session reuse / Inadequate log out
- CSRF logout

- Pre-Login
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Conclusions

• Login and Authentication can't be easily segregated from the applications that use it.
• Pre-Login, subdomains, parent domains, and sister domains all can affect the Login and Authentication functionality.
• Pre-Login must either have no session or be under SSL.
• User enumeration protection applies to the Login page as well as Account Creation and Password Reset.
• XSS and SQL Injection are pretty much Game Over.
• Stopping bruteforcing of passwords is difficult, so make the passwords difficult to bruteforce. Password Rules.
• Javascript redirects can lead to DOM based XSS.
• Update the session cookie during the redirection step.
• Use Cryptography for security related tokens.
Conclusions (cont.)

• Watch what goes into the URL. This can get sent off-site in the Referer HTTP header.
• Force users to use cookies. There's no excuse anymore.
• A framework or systematic approach should be taken for Authentication, HTML output, SQL, and CSRF protection.
• AJAX may require CSRF protection for GET requests, too.
• Expiring a session cookie is not a sufficient logout procedure.
Questions?

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