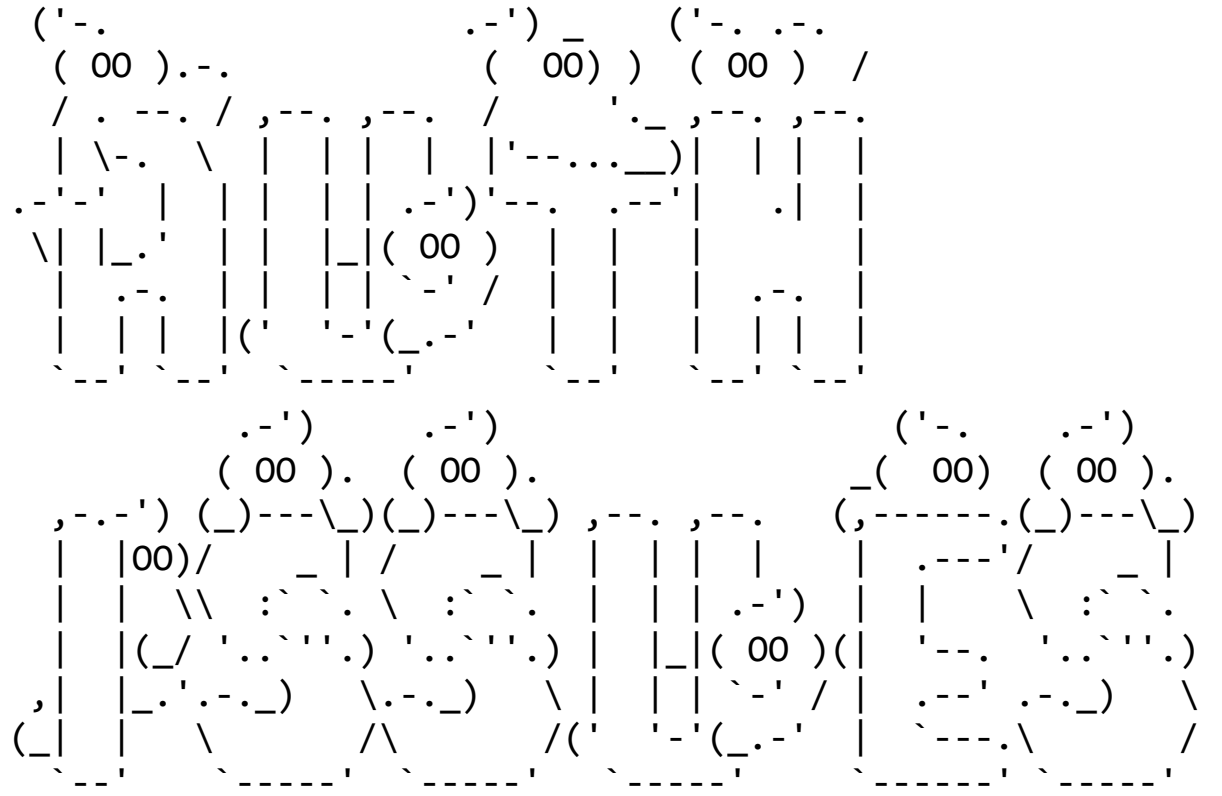


Authentication Overview

- Authentication of users is important for confidentiality
- As websites move from simply displaying information to becoming web applications authentication becomes more and more important
- Authentication systems utilize a lot of technologies/systems

Authentication Walkthrough

- Note: assuming an already registered user
- User enters username and password
- Username and password are sent to the server
- The password is hashed
- The database is checked for a user containing that name and password hash that matches the submitted hash
- If the username and password match a record then a session cookie is sent back and that acts as a form of authentication for future requests
- The login is about issuing a valid session token in the form of a cookie; an ID badge sent with future requests

Can you think of any attacks on this system?

Attacks on Authentication

- Session Fixation
- Improper Session Invalidation
- Timing Attacks
- User Enumeration
  - Timing
  - Error Messages
- Insecure Cookie Settings
- Insufficient Entropy

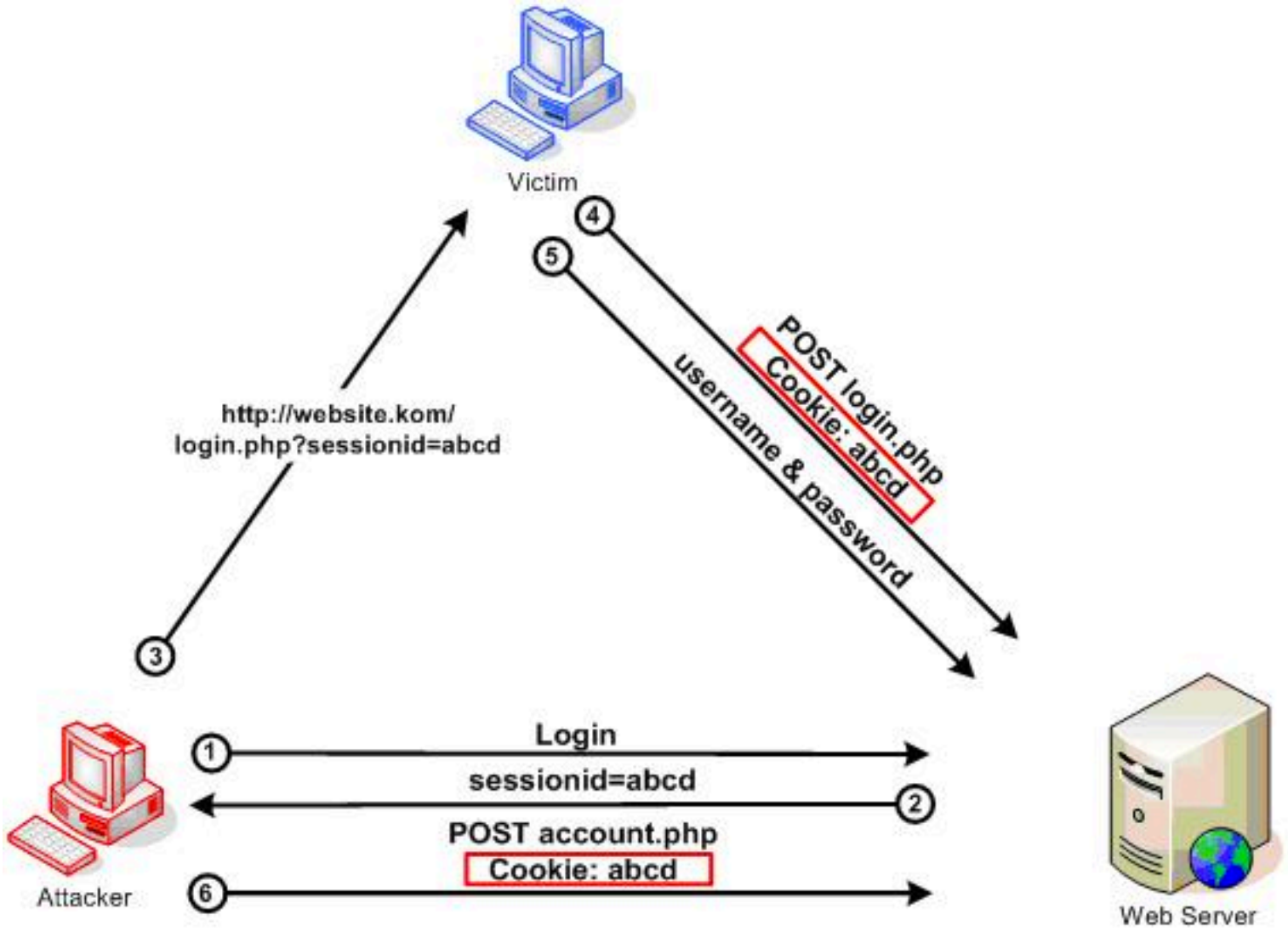
Session Fixation

Session Fixation

- An attack that allows an attacker to hijack a valid session
- Due to a system that, when authenticating a user, uses an existing session token instead of assign a new session ID
- An attacker forces a user to authenticate him/herself with a known session ID
- The known session ID then becomes valid and an attacker can use it to do evil things

Session Fixation

- Several methods execution
  - Session token in the URL argument
    - Attacker tricks victim into clicking on a crafted hyperlink containing the session token
  - Session token in a hidden form field
    - A user is tricked into authenticating using a crafted login form hosted by the attacker containing the session token
  - Session ID in a cookie
    - An XSS attack can be used to set a cookie value in the victims browser to a known value
    - Using <meta http-equiv=Set-Cookie content="sessionid=foo">
    - An attacker with a MITM position can send a Set-Cookie header to the victim, setting their cookies
    - If user generated code can be hosted on the same domain legitimately it can be used to set the session cookie


Victim
4
5
POST login.php
Cookie: abcd
username & password
http://website.kom/
login.php?sessionid=abcd
3
Attacker
1
Login
sessionid=abcd
2
POST account.php
Cookie: abcd
6
Web Server

Testing for Session Fixation

- Login
- Change the session token (keep the same format)
- Login again
- See if a new token is issued

Fixing Session Fixation

- When a user logs in clear old session cookies and always set a new cookie

Improper Session Invalidation

Improper Session Invalidation

- When a user logs out the session should be deleted
- Sometimes it is only deleted client-side
  - Using JavaScript or setting the cookie expiration date to sometime in the past
- An attacker with a stolen session won't receive the client-side delete and can keep using the session
- Greatly increases the value of a stolen session

Testing for Improper Session Invalidation

- Login
- Copy the session token
- Logout
- Put the old session token back
- See if you are logged in

Fixing Improper Session Invalidation

- Sessions must be deleted server side!!
- Clear the session token from the database

Timing Attacks & User Enumeration

Timing Attacks

- Operations take time
  - Comparing two strings
  - Looking up a user, then their password
  - String validation checks
- The time it takes for an operation to complete leaks information about what is happening under the hood
- This can be exploited to find valid users, or even valid passwords

User Enumeration

- Timing attack
  - If the authentication form looks up the user then matches the password hash those two operations occur one after the other
  - That means that an attacker can potentially watch how long a reply takes and figure out if they have found a valid user
  - A request with a valid user will take slightly longer to reply because first the user lookup occurs, then the password check

User Enumeration

- Error messages
  - "please enter a valid user"
  - "the password you entered is incorrect"
  - "login for the user foobar failed"
- These messages can tell you if a user is in the system or not
- A valid username can then be used in a brute forcing or spear phishing attack
  - Can even be used in a fake leak

Testing for User Enumeration

- Timing attacks
  - Try logging in with several usernames (some valid and some invalid) several times
    - Use invalid passwords
  - Watch to see if a reply to a valid user takes longer than an invalid user
- Error messages
  - Try logging in with several usernames (some valid and some invalid) several times
    - Use invalid passwords
  - See if the error messages change

Fixing User Enumeration

- Lookup users in a consistent manner
- Use SQL that checks both the username and password in one statement
- Pad the response times so they take too long to brute force
- Make all error messages consistent
  - "Sorry the username or password you entered is incorrect."

Cookie Settings & Entropy

Cookie Settings

- Name - the cookie name
- Value - the cookie value
- Path - the path the cookie applies to
- Expiration - when the cookie expires
  - Don't set! Otherwise it is written to disk
  - If expiration or Max-Age aren't set it will be deleted when the browser closes
- HttpOnly - whether the cookie is accessible to JS
  - Set to True
- Secure - whether the cookie is sent encrypted
  - Set to True if the site uses SSL/TLS

Cookie Entropy

- Make sure your session tokens use a cryptographically secure random number generator
- If not then they will be predictable and an attacker just has to try a bunch
- Make sure you have ~150 bits of entropy
- Demo time?
  - Burp sequencer