Web client programming

JavaScript/AJAX

Web requests with JavaScript/AJAX

- Needed for reverse-engineering homework site
- Web request via jQuery JavaScript library

```
jQuery.ajax({
  'type': 'GET',
  'url': 'http://vulnerable/ajax.php',
  'success': function(data) {
     console.log(data);
  }
});

jQuery.ajax({
  'type': 'POST',
  'url': 'http://vulnerable/ajax.php',
  'data': 'hello world',
  'success': function(data) {
    console.log(data);
  }
});
```

cs410.oregonctf.org example

- Inspect the “Get this user” button in SQL Injection Lesson
- Form subm script (`leForm`)

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- View script tag immediately following `<form>` element

```
▼<script>
        var counter = 0;
        $("#leForm").submit(function(){
            counter = counter + 1;
            $("#submitButton").hide("fast");
            $("#loadingSign").show("slow");
            $("#userContent").text($("#aUserName").val());
            var theName = $("#aUserName").val();
            $("#resultsDiv").hide("slow", function(){
                var ajaxCall = $.ajax({
                    type: "POST",
                    url:
"e881086d4d8eb2604d8093d93ae60986af8119c4f643894775433dbfb6faa594",
                    data: {
                        aUserName: theName
                    },
                    async: false
                });
```

- Note the use of a relative URL. Find base page of frame

```
▼<iframe frameborder="no" class="levelIframe" id="theLesson" src="lessons/
e881086d4d8eb2604d8093d93ae60986af8119c4f643894775433dbfb6faa594.jsp">
```

- Form submission URL

`http://cs410.oregonctf.org/lessons/e881086d4d8eb2604d8093d93ae60986af8119c4f643894775433dbfb6faa594`

- Post parameters

`aUserName : wuchang`

Python Requests

Python Requests

- HTTP for humans
- Programmatically handle HTTP
  - Requests and responses
  - Authentication
  - Headers
  - Forms
  - Cookies
  - Sessions
  - JSON
- Can be used to solve each level
  - Submit solution scripts as part of lab notebook

Setting up

- Install python3, python-pip, virtualenv (`apt-get`)
- Then, set up a local python3 instance in directory `env` for use during the rest of the course

```
mkdir env
virtualenv -p /usr/bin/python3 env
```

- Enter the local python3 environment (always do this)

```
source env/bin/activate
```

- Install requests into environment

```
pip install requests
```

- Install beautifulsoup (bs4) into environment

```
pip install bs4
```

- Run your scripts (either via interactive prompt or as a file)

```
python 01.py
```

Requests and responses

- Methods in Python requests package map to HTTP methods
  - requests.get => GET
  - requests.post => POST
- Simple HTTP request

```
import requests
r = requests.get('http://thefengs.com')
print(r.text)
print(r.status_code)
print(r.headers)
```

Sessions

- Emulate web browser
  - Accumulate cookies
  - Remember header and authentication settings

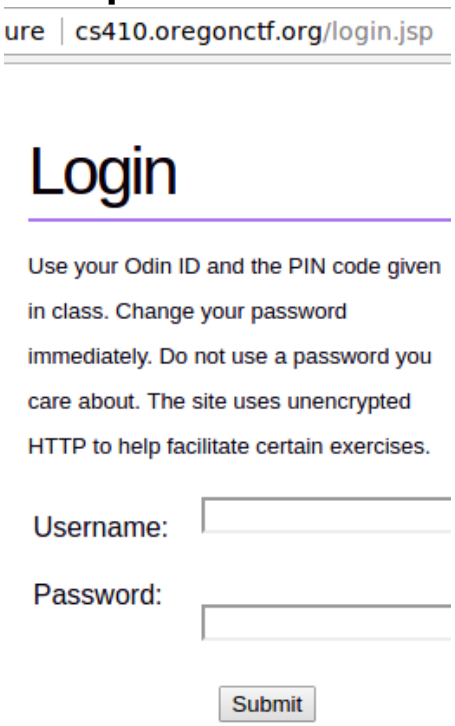
```
import requests
s = requests.Session()
print(s.cookies)
r = s.get('http://facebook.com')
print(s.cookies)
r = s.get('http://google.com')
print(s.cookies)
```

Forms

- Named parameter `data`
- Given as a dictionary
  - An associative array of key:value pairs in python
- Two possible methods: GET, POST
  - Examine form to find URL, method, and field name

cs410.oregonctf.org example

- Login form for homework site
- Inspect “Submit” button, expand form fields




```
loginurl='http://cs410.oregonctf.org/login'
loginpayload={"login":"wuchang","pwd":"cs410510"}
resp=session.post(loginurl,data=loginpayload)
```

Putting it together

- SQL Injection Lesson

```
import requests
session=requests.Session()

loginurl='http://cs410.oregonctf.org/login'
loginpayload={"login":"wuchang","pwd":"cs410510"}
resp=session.post(loginurl,data=loginpayload)

url='http://cs410.oregonctf.org/lessons/e881086d4d8eb2604d8093d
93ae60986af8119c4f643894775433dbfb6faa594'
resp=session.post(url,data={"aUserName":"' OR 1 = 1 #"})

print("Output is: ",resp.text)
```

Basic Authentication

- Named parameter `auth`
- Given as a tuple (an immutable list in python)
  - Denoted by parentheses with values separated by commas

```
import requests
url = 'http://natas0.natas.labs.overthewire.org'
r = requests.get(url)
print(r.status_code)
print(r.headers)
r = requests.get(url,auth=('natas0','natas0'))
print(r.status_code)
print(r.text)
```

Setting request headers

- Named parameter `headers` for both reading HTTP response headers and setting HTTP request headers
- Given as a dictionary
  - An associative array of key:value pairs in python
  - Can set per-request or across a session

```
import requests
myheaders = {'referer':'http://natas5.natas.labs.overthewire.org/'}
url = 'http://natas4.natas.labs.overthewire.org'
r = requests.get(url,auth=('natas4','the_natas4_pass'),headers=myheaders)
print(r.text)
```

```
import requests
s = requests.Session()
s.headers.update({'User-Agent':'Python Requests'})
url = 'http://natas25.natas.labs.overthewire.org/'
r = s.get(url,auth=('natas25', 'the_natas25_pass'))
```

Setting cookies

- Named parameter `cookies` for both reading cookies in response and setting cookies in request
- Give as a dictionary
  - An associative array of key:value pairs in python
  - Encodes `key=value` in `Cookie:` field

```
import requests
url = 'http://natas5.natas.labs.overthewire.org'
mycookies = {'loggedin':'1'}
r = requests.get(url,auth=('natas5','natas5_pass'),cookies=mycookies)
print(r.text)
```

Reading cookies

- Returned in response via a `CookieJar` named `cookies`
- Automatically added to session `CookieJar` if session is used
- Can be indexed similar to a `dict()`

```
import requests
url = 'http://natas21-experimenter.natas.labs.overthewire.org/index.php'
r = requests.get(url)
sessionid = r.cookies['PHPSESSID']
print(sessionid)
```

```
import requests
s = requests.Session()
r = s.get('http://espn.go.com/')
r = s.get('http://facebook.com/')
for cookie in s.cookies:
    print(cookie)
```

URL-encoding

- Python requests automatically URL-encodes payloads for transmission over HTTP

```
import requests
r = requests.get('http://oregonctf.org/x + y/')
print(r.url)
```

HTML parsing

- BeautifulSoup

```
import requests
from bs4 import BeautifulSoup
url = 'http://espn.go.com/'
r = requests.get(url)
soup = BeautifulSoup(r.text,'html.parser')
for link in soup.find_all('a'):
    print(link.get('href'))
```

JSON and REST

- JSON often returned when transmitting web objects
  - Encodes a serialized data structure to and from server
  - Typically translated to/from dictionaries in Python
  - Example sending a JSON object to a REST API call and receiving a JSON response

```
# Set up the order
orders_url="https://api.stockfighter.io/ob/api/venues/NYSE/stock/AAPL
myorder = {
  'account' : 3000001,
  'price' : 4400,
  'qty' : 100,
  'direction' : 'buy',
  'orderType' : 'limit'
}
r = requests.post(orders_url, data=json.dumps(myorder))
r_data = r.json()
print(r_data['id'])
```

Other tools

- Burp Suite (see Kali VM)
- Firefox
  - Edit and Resend feature on Network tab of Developer tools
- Postman
  - Demo
    - Add Postman and Postman Interceptor extensions in Chrome
    - http://cs410.oregonctf.org
    - Launch Postman app and turn on interceptor
    - Submit form
    - Edit and resubmit
    - View request and response

Questions

- https://sayat.me/wu4f