Web Services

Introduction to Computer Systems
13th Lecture, Dec. 12, 2019

All I want to say is on this PPT.

- So basically I'm going to translate the PPT. (*To avoid awkward silences*)
- Questions are welcomed.

Outline

- **Web history**
- Web and HTTP
- Webserver

Web History

- Not included in tests.
- Omitted.

Outline

- Web history
- **Web and HTTP**
- Webserver

World Wide Web

- **What is World Wide Web?**
  - Basically a directed graph.
    - Vertices: Webpages.
    - Edges: Hyperlinks.
  - Not to be confused with an internet or the Internet.
    - An internet: a network of networks.
    - The Internet: the unique global IP internet.
- **How to use it?**
  - Browsers.
    - Modern browsers are basically just JavaScript interpreters.
  - Mobile Apps.
    - Many mobile apps are virtually just browsers(*which is written by Google instead of app publishers, AND is less powerful than official Google Chrome*).
    - If you are unable to use much of the app offline, it's a browser.

Hypertext Transfer Protocol

- **A standard to transfer webpages.**
  - C/S Model
  - Client send requests. Server give responses.
- **Common request methods: `GET` and `POST`.**

HTTP Request : GET

- Used to get data from server.
- Request headers: key-value pairs.
- Keys are bolded.
- GET only has headers.

```
GET /auth/users/sign_in HTTP/1.1
Host: autolab.pku.edu.cn
Connection: keep-alive
Cache-Control: max-age=0
DNT: 1
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64)
AppleWebKit/537.36 (KHTML, like Gecko) Chrome/80.0.3983.2
Safari/537.36
Accept:text/html,application/xhtml+xml,application/xml;q=0.9
,image/webp,image/apng,*/*;q=0.8,application/signed-
exchange;v=b3;q=0.9
Accept-Encoding: gzip, deflate
Accept-Language: en-US,en;q=0.9,zh-CN;q=0.8,zh;q=0.7,zh-
TW;q=0.6
Cookie: browser.timezone=Asia/Shanghai;
UM_distinctid=<omitted>; _autolab3_session=<omitted>
If-None-Match: W/"4f3775d3dc4e2d6db953535ce16a329b"
```

HTTP Response : GET

```
HTTP/1.1 200 OK
Server: nginx/1.14.0 (Ubuntu)
Date: Wed, 11 Dec 2019 06:40:09 GMT
Content-Type: text/html; charset=utf-8
Transfer-Encoding: chunked
Connection: keep-alive
X-Frame-Options: ALLOWALL
X-XSS-Protection: 1; mode=block
X-Content-Type-Options: nosniff
X-Download-Options: noopen
X-Permitted-Cross-Domain-Policies: none
Referrer-Policy: strict-origin-when-cross-origin
ETag: W/"d4089f853be42d345bbf853bbea14b4f"
Cache-Control: max-age=0, private, must-revalidate
Set-Cookie: _autolab3_session=<omitted>; path=/; HttpOnly
X-Request-Id: 615c4bc6-3f07-464e-91c1-6995ff6a9e41
X-Runtime: 0.025821
Content-Encoding: gzip

a1a
<compressed data>
```

- Response headers: key-value pairs.
- Keys are bolded.
- Response has contents.

HTTP Request : POST

```
POST /auth/users/sign_in HTTP/1.1
Host: autolab.pku.edu.cn
Connection: keep-alive
Content-Length: 241
Cache-Control: max-age=0
Origin: http://autolab.pku.edu.cn
Upgrade-Insecure-Requests: 1
DNT: 1
Content-Type: application/x-www-form-urlencoded
User-Agent: <omitted>
Accept: <omitted>
Referer: http://autolab.pku.edu.cn/auth/users/sign_in
Accept-Encoding: gzip, deflate
Accept-Language: <omitted>
Cookie:<omitted>

utf8=%E2%9C%93&authenticity_token=3o6JvQwBzwMerx8mJaNRntT9XoV0Lp3UFD045ohTC6BdDRRUUgrqKLjfhxlp4lBCUSbxbTtQxlHx2oIdI3WDlA%3D%3D&user%5Bemail%5D=1800013061%40pku.edu.cn&user%5Bpassword%5D=<omitted>&user%5Bremember_me%5D=1&commit=Sign+in
```

- Used to send data to server.
- POST has contents.

HTTP Request : POST (cont'd)

```
utf8=%E2%9C%93&authenticity_token=3o6JvQwBzwMerx8mJaNRntT9Xo
V0Lp3UFD045ohTC6BdDRRUUgrqKLjfhxlp4lBCUSbxbTtQxlHx2oIdI3WDlA
%3D%3D&user%5Bemail%5D=1800013061%40pku.edu.cn&user%5Bpasswo
rd%5D=<omitted>&user%5Bremember_me%5D=0&commit=Sign+in
```

- POST contents are URL encoded.
- Decoded contents: (also key-value pairs)

utf8: ✓
authenticity_token:
3o6JvQwBzwMerx8mJaNRntT9XoV0Lp3UFD045ohTC6BdDRRUUgrqKLjfhxlp
4lBCUSbxbTtQxlHx2oIdI3WDlA==
user[email]: 1800013061@pku.edu.cn
user[password]: <of-course-omitted>
user[remember_me]: 1
commit: Sign in

HTTP Response : POST

```
HTTP/1.1 302 Moved Temporarily
Server: nginx/1.14.0 (Ubuntu)
Date: Wed, 11 Dec 2019 07:09:17 GMT
Content-Type: text/html; charset=utf-8
Location: http://autolab.pku.edu.cn/
Transfer-Encoding: chunked
Connection: keep-alive
X-Frame-Options: ALLOWALL
X-XSS-Protection: 1; mode=bloc
X-Content-Type-Options: nosnif
X-Download-Options: noopen
X-Permitted-Cross-Domain-Polic
Referrer-Policy: strict-origin
Cache-Control: no-cache
Set-Cookie: _autolab3_session=<omitted>; path=/; HttpOnly
X-Request-Id: 58580bac-7cd2-4c6c-acd4-e978372286d5
X-Runtime: 0.117232
```

- Redirected to `http://autolab.pku.edu.cn/`
- This particular response has no contents, but `POST` response can have contents.
- For example if you entered wrong credentials it will respond `200 OK` with contents saying invalid password.

HTTPS

- HTTPS stands for Hypertext Transfer Protocol Secure.
- Basically HTTP with TLS.
- Use port 443.
- Nearly all webpages now use HTTPS to transfer data.
- Why HTTPS?
  - Modern webpages are mostly webapps that interact with users instead of static pages.
  - Servers need to discriminate one user from another. Thus user credentials are transferred through network.
  - HTTP transfer those credentials in cleartext, which can be easily intercepted.
- HTTPS encrypts HTTP requests and responses(including headers and contents). And use certificates to ensure server identity.

Hypertext Markup Language

- Webpages are basically written in HTML.
  - And CSS and JavaScript.
    - But they are not included in tests.
- So, webpages are written in HTML.
- HTML is basically text with a bunch of tags.
  - A tag is name and attributes enclosed in angle brackets.
    - *What if I want to literally show* `<tag>` *in a webpage?*
      - Escape < with `<` > with `>`
        - *Then what if I want to literally show* `<` *?*
          - Escape `&` with `&`

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- Web history
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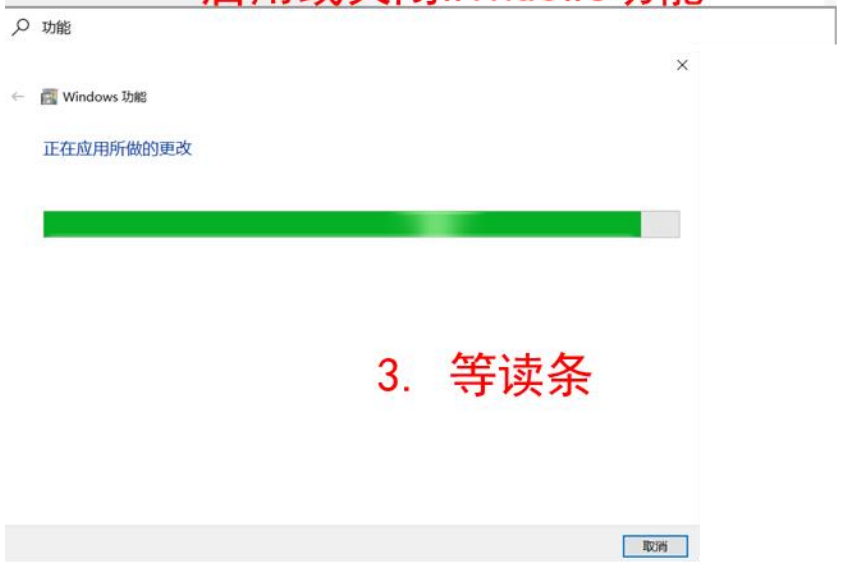
- **Webserver**

Commonly used webservers

- Apache
- Nginx
- Node.js
- Microsoft IIS
- etc.

How to build a webserver on your PC

1. ⊞+S
启用或关闭Windows功能



3. 等读条

2. 找到Internet Information Services
点前面的小框，点确定

4. 成功！在浏览器输入localhost查看效果吧！

Build a webserver on your PC

- **The root directory is `C:\inetpub\wwwroot`**
- **Download some templates and start playing!**
  - You may need to configure IIS to block incoming connections if you want to experiment with vulnerable webapps or handwritten webapps.
- **Is it of practical use?**
  - Not really.
  - PC don't usually have stable IP address, so it cannot be used as a real webserver(unless you use dynamic DNS).
  - But you still can do *something*.