Website Design

CSc 47300

Week 2

Web Applications; HTTP; Simple Application Server

Web Applications

So, What's This Web Application Thing About Anyway?

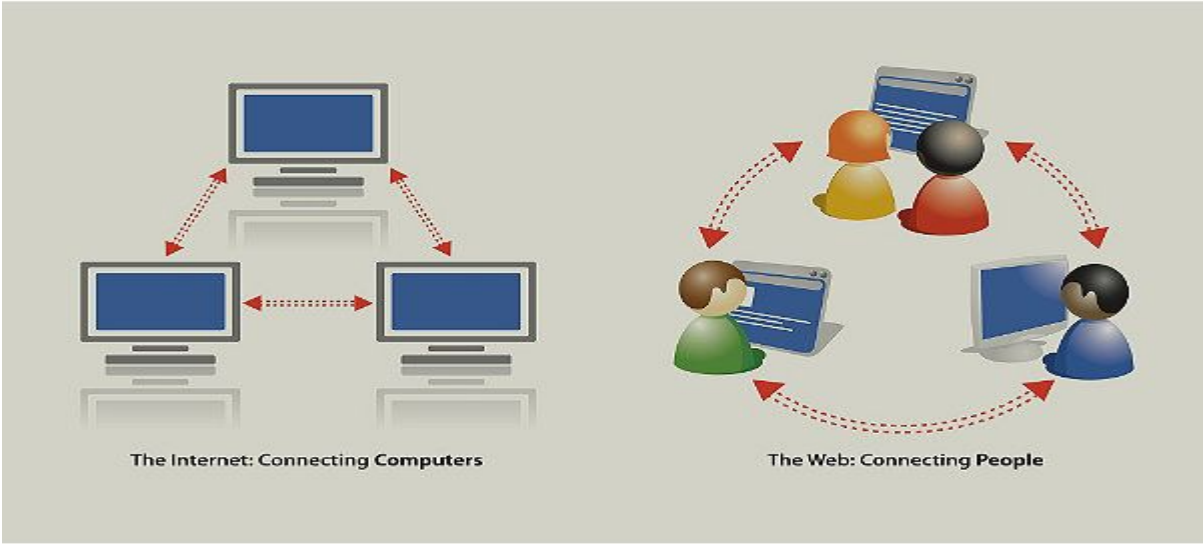
In this set of slides, we'll cover:

- Some definitions
- Simplified explanation of a couple of protocols (TCP, HTTP)
- Client / Server

Definitions

- **The internet** - global system of interconnected computer networks; a network of networks
  - Internet's underlying protocol for communication is **TCP/IP**
  - **TCP/IP** dictates how data should be packetized, addressed, transmitted, routed and received.
- **The web** - a collection of interconnected documents (web pages) and other resources (images, video, ect.), retrievable by url and connected by *hyperlinks*.
  - **HTTP** is the protocol used to allow documents and resources to be requested over a network.

Definitions (cont.)



Other Services

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What are some other services and protocols on the internet?

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- Email (SMTP)
- Chat (XMPP, OSCAR, IRC)
- File Transfer (FTP)
- Voice (SIP, Skype protocol)
- These are all examples of network protocols - ways of communicating over a network

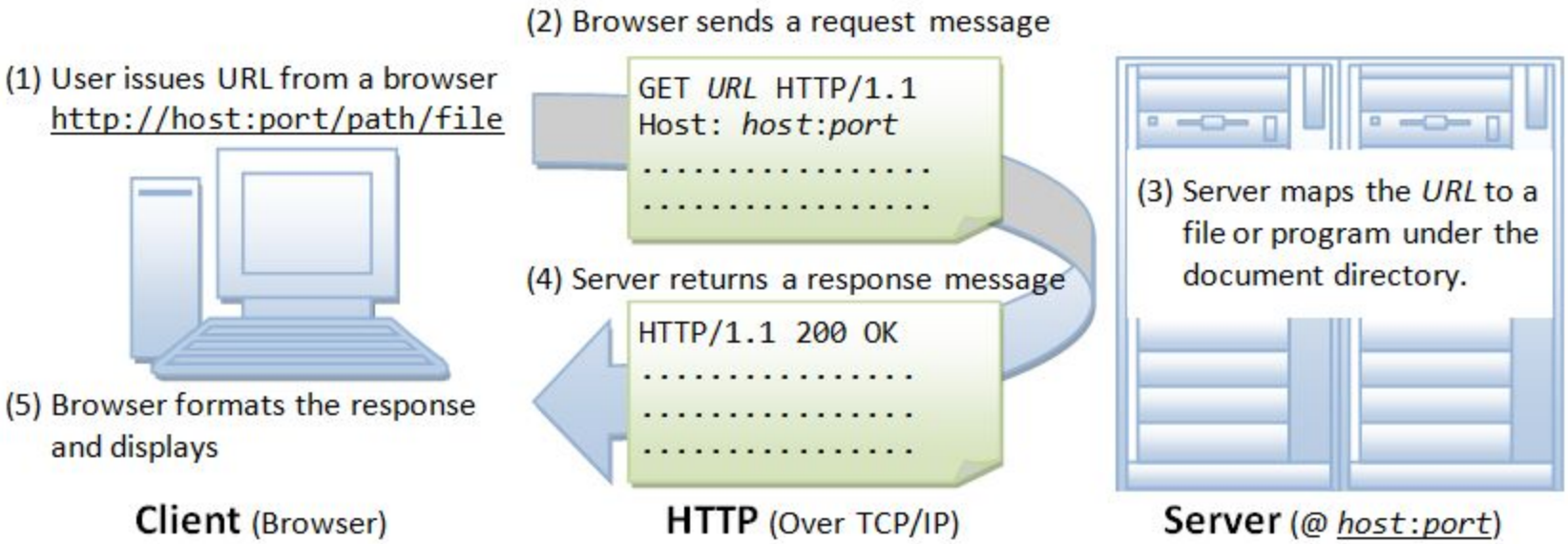
Protocols

Hm. All this talk about protocols but … what exactly is a protocol?

It's a bunch of rules and conventions for communication. Really. That's it.

For computers and communications between them, these rules may define:

- The format for exchanging messages
- A meaning (semantics) and syntax for these messages
- The process for synchronizing the communication


(1) User issues URL from a browser
http://host:port/path/file
(2) Browser sends a request message
GET URL HTTP/1.1
Host: host:port
.....
.....
(3) Server maps the URL to a file or program under the document directory.
(4) Server returns a response message
HTTP/1.1 200 OK
.....
.....
.....
(5) Browser formats the response and displays
Client (Browser)
HTTP (Over TCP/IP)
Server (@ host:port)

TCP/IP is the Underlying Protocol of the Internet

- Don't worry, that's about as in-depth as we'll get on TCP/IP
- However, just know that other application layer protocols are built on top of TCP/IP
- We're mostly interested in the web, and making web applications…
  - So we should take a look at application layer protocols
  - Specifically HTTP

The Web

What was our definition of the web again?

A collection of interconnected documents (web pages) and other resources (images, video, ect.), retrievable by url and connected by *hyperlinks*.

It All Starts With a URL

Each document or resource on the web is retrievable by a name, a URL (Universal Resource Locator).

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What are the parts to a URL?

- Scheme/Protocol - HTTP (Browsers accept schema-less, meaning you don't have to add HTTP/S)
- Domain or Actual IP Address (walmart.com)
- Port (Optional) - 80 (Default if HTTP), 443 (Default if HTTPS)
- Path - walmart.com/m/savings-spotlight
- Query String (Optional) - walmart.com/search/?query=Coffee
- Fragment Identifier (Optional) - github.com/psf/requests#supported-features--bestpractices

```
scheme://domain:port/path?query_string#fragment_identifier
```

Domains and IP Addresses

Each machine connected to the Internet gets a unique IP address.

We can map domains to IP addresses through DNS (Domain Name System)

- Both IP Addresses and domains are acceptable in a URL.
  - Google.com / 172.217.12.174 (IP obtained via `ping`)
- On OSX, Linux, and Windows, there's a file that allows you map names to IP addresses before DNS
  - Typically `/etc/hosts` or `hosts.txt`
- `localhost` maps to 127.0.0.1… which essentially is your computer

HTTP

HTTP

To retrieve documents on the web, we use HTTP (Hyper Text Transfer Protocol).

The computer/application asking for the document is the client or user-agent, and the computer responding to requests for documents is the server.

- The client (or the user-agent) is usually a browser (Chrome, Firefox)
  - There are clients other than browsers (Mobile apps, scripts, etc.)
- Generally, the server is going to be some sort of web server, like Apache or Nginx

HTTP is a request-response protocol, a very basic text-based (at least for version 1.1) communication method between computers:

- The client sends a request for some data. The server responds to the request.

HTTP (cont.)

The interaction between your browser and a web server goes something like this:

1. The browser (client) attempts to connect to the address of the server
2. If the server is listening and reachable, a TCP connection is made between the client and the server on port 80 (HTTP) or 443 (HTTPS)
3. The browser (client) sends a request message
4. On the same connection, the web server gives back a response message

A Request Message

A request consists of:

- Request line … which includes a request method and a path.
  - `GET /search/?query=Coffee`
- Request headers
  - `Host: www.walmart.com`
  - `User-Agent: curl/7.64.1`
- Here's a list of request header fields.

Request Methods

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- **PUT**
  - The `PUT` method replaces all current representations of the target resource with the request payload.
- **DELETE**
  - The `DELETE` method deletes the specified resource.

A Response Message

A response consists of:

- Status-line - which includes a status code and reason
  - `HTTP/2 200`
- Response Header Fields
  - `Content-Type: text/html`

And of course, a list of response header fields.

Status Codes

The status code that a server responds with is a numeric code that indicates the result of the request.

Some typical status codes are:

- 200 OK- request was successful
- 404 Not Found - Resource was not found
- 500 Server Error - Generic server error

Status Codes Continued

There are 5 different classes of status code:

- 1xx - Informational, request received
- 2xx - Success, request was received, understood, and accepted
- 3xx - Redirection, additional action must be taken to complete request
- 4xx - Client Error
- 5xx - Service Error

A Sample Interaction (Request)

```
curl -v -s https://www.google.com 1> /dev/null
```

```
> GET / HTTP/2
> Host: www.google.com
> User-Agent: curl/7.64.1
> Accept: */*
```

A Sample Interaction (Response)

```
curl -v -s https://www.google.com 1> /dev/null
```

```
< HTTP/2 200
< date: Tue, 08 Sep 2020 17:09:31 GMT
< expires: -1
< cache-control: private, max-age=0
< content-type: text/html; charset=ISO-8859-1
```

Tooling

curl

curl is a command line tool to transfer data to and from a server.

- Send a GET request
  - `curl -v -X GET https://www.google.com`
- Send a POST request
  - `curl -v -X POST https://www.google.com`

Chrome

Chrome comes with great tools for development!

1. Go to View → Developer → Developer Tools
2. Click on Network
3. Go to the Page
4. Watch the requests fly by!
5. (Why so many!?)

HTTP/2

HTTP/2 is out and being used.

- HTTP methods, status codes and semantics remain the same!
- However, the focus of the protocol is improved performance:
  - Binary format over plain text
  - Parallel requests can be made over the same connection
  - Server can push required resources to client even before client makes requests!
  - Compresses headers
- Check out the MDN page for the evolution of HTTP

Simple Application Server