CS472 WAP

Layers of the Web

Introduction to Web Programming

Layers of Abstraction

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Fairfield, Iowa © 2020

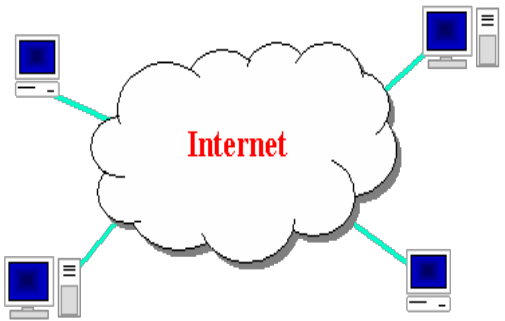
Main Point Preview

- The internet is a global computer network that uses the IP protocol to uniquely identify computers on the network. Through the TCP protocol each IP address can work with multiple services at the same time. One of these services is the HTTP protocol which is used by the World Wide Web to transport HTML pages.

- There are many layers of the Internet. *Familiarity with the deep layers is necessary for optimal understanding and use of the surface layers. TM settles our mind so that it is more connected to the deep layers that are the basis of the more expressed layers.*

The Internet

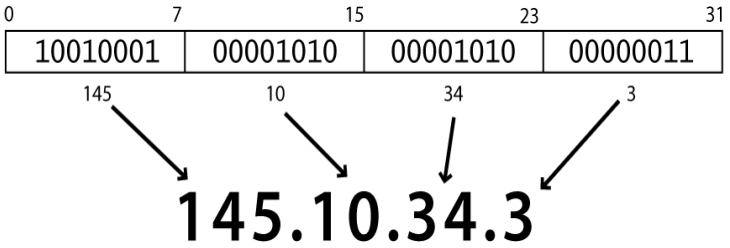
- A connection of computer networks using the Internet Protocol (IP)
- layers of communication protocols:
  IP → TCP/UDP → HTTP/FTP/POP/...



- What's the difference between the Internet and the World Wide Web (WWW)?
  - The Web is the collection of web sites and pages around the world
  - The Internet is larger and also includes other services such as email, chat, online games, etc.

Internet Protocol (IPv4)

- The underlying system of communication for all data sent across the Internet.
  - Each device has a 32-bit IP address written as four 8-bit numbers (0-255)
- There are two types of IP addresses
  - servers often have static IP address
  - Users usually get a dynamic IP address from their ISP
- Find out your local IP address:
  - In a terminal, type: ipconfig (Windows) or ifconfig (Mac/Linux)



- IPv6 addresses are 128-bit IP address written in hexadecimal and separated by colons.
  - An example IPv6 address could be written like this: 3ffe:1900:4545:3:200:f8ff:fe21:67cf

Transmission Control Protocol (TCP)

- Adds multiplexing, guaranteed message delivery on top of IP
  - IP is stateless – no memory of sent messages or success of delivery
  - TCP is stateful – tracks status of messages until determine success of delivery
- Multiplexing: multiple programs using the same IP address
  - port: a number given to each program or service
  - port 80: web browser (port 443 for secure browsing)
  - port 25: sending email
  - port 22: ssh
  - Port 21: File transfer (FTP)
  - port 5190: AOL Instant Messenger
  - more common ports
- Some programs (games, streaming media programs) use simpler UDP protocol instead of TCP

Web Servers and Browsers

- **Web server**: software that listens for web page requests
  - Apache
  - Microsoft Internet Information Server (IIS)
- **Web browser**: fetches/displays documents from web servers
  - Mozilla Firefox
  - Microsoft Internet Explorer (IE)
  - Apple Safari
  - Google Chrome
  - Opera
  - Browser usage statistics

Domain Name System (DNS)

- A set of servers that map written names to IP addresses
  - Example: www.cs.miu.edu → 192.103.45.104

Uniform Resource Locator (URL)

- An identifier for the location of a document on a web site
  - Example URL: http://www.abc.com/info/index.html

    ~~~ ~~~~~~~~~~ ~~~~~~~~~~

    protocol host path

- Upon entering this URL into the browser, it will:
  - Ask the DNS server for the IP address of www.abc.com
  - Connect to that IP address at port 80
  - Ask the server to GET /info/index.html
  - Display the result page on the screen
    ~~~

More Advaced URLs

- **Anchor**: jumps to a given section of a web page
  - http://www.textpad.com/download/index.html#downloads7
  - fetches index.html then jumps down to

- **Port**: for web servers on ports other than the default 80
  - http://www.cs.miu.edu:8080/secret/money.txt

- **Query string**: a set of parameters passed to a web program
  - http://www.google.com/search?q=miserable+failure&start=10
  - parameter q is set to "miserable+failure"
  - parameter start is set to 10

Hypertext Transport Protocol (HTTP)

- The protocol consists of a set of commands that a computer can send to a server to request files
- Example HTTP commands (your browser sends these internally):
  - **GET**: Requests a specific file or resource from the server
  - **POST**: Submits form information to the server (not idempotent)
  - **PUT**: Uploads a file to the server (idempotent)
  - **HEAD**: Requests information about a file from the server, but not the file's entire contents.

HTTP Request / Response

- **Request:**

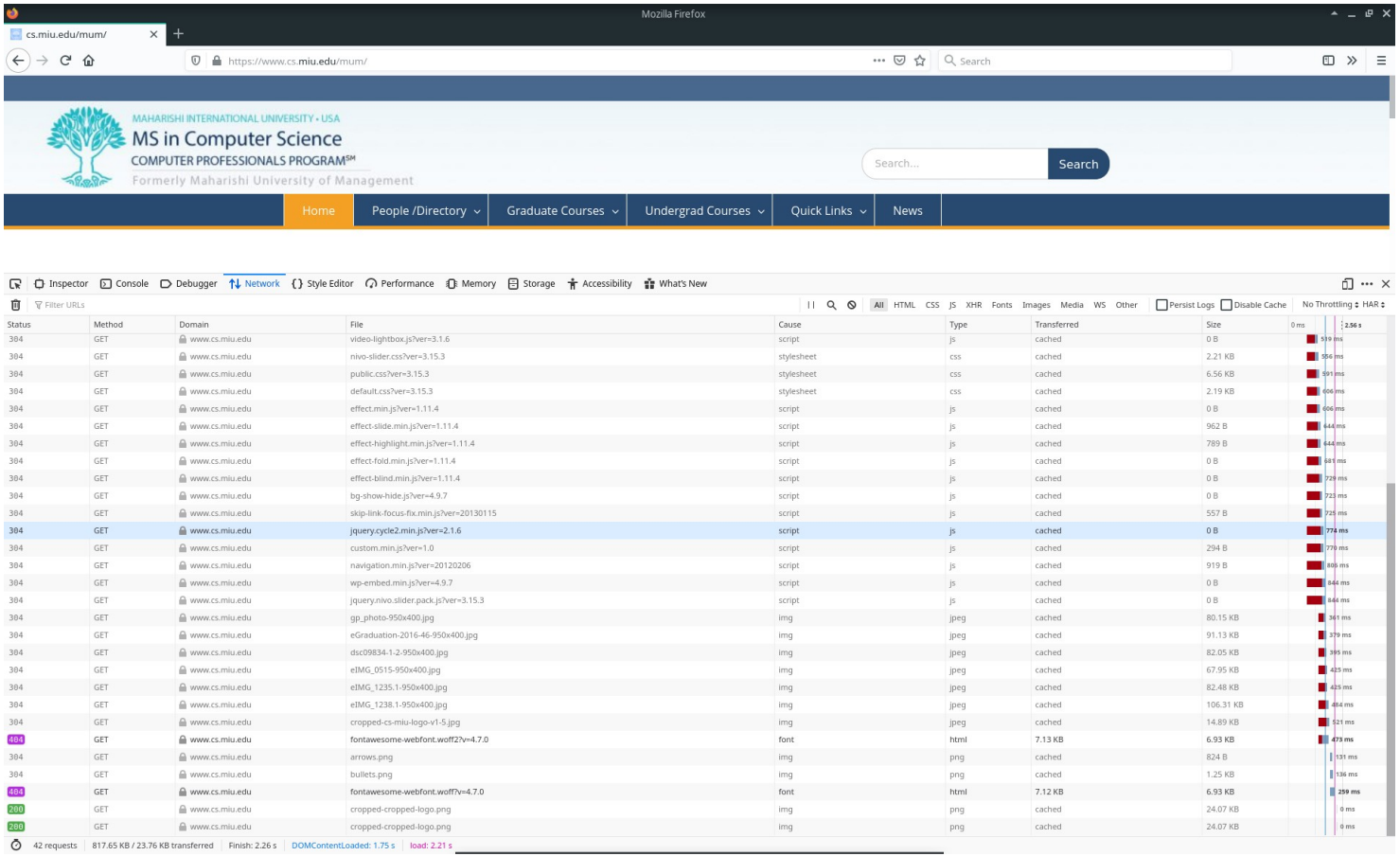
```
GET /index.html HTTP/1.1
HOST: mumstudents.org
```

- **Response:**

```
HTTP/1.1 200 OK
Date: Sun, 31 May 2020 12:10:06 GMT
Server: Apache
Last-Modified: Mon, 03 Oct 2016 15:51:02 GMT
ETag: "3ae-53df7e933e013"
Accept-Ranges: bytes
Content-Length: 942
Vary: Accept-Encoding
Content-Type: text/html

<!DOCTYPE html>
<html>
...
```

Inside Developer Tools



HTTP Status Codes

- When you request a document from a web server, it sends this document back to you, along with a number called HTTP status code.

Number	Meaning
200	OK
301-303	page has moved (permanently or temporarily)
403	you are forbidden to access this page
404	page not found
500	internal server error
complete list	

MIME Types

- A two-part identifier which many web protocols use to categorize each type of data.

MIME Type	File extension(s)	Description
application/octet-stream	.exe	Executable programs
audio/mpeg	.mp3, .mpg	MPEG or MP3 music
image/gif, image/jpeg, image/png	.gif, .jpg, .png	GIF, JPEG, PNG images
text/css	.css	Style sheets
text/html	.html, .htm, .php	Web pages
MIME Type list		

Web Languages / Technologies

- Hypertext Markup Language (HTML): used for writing web pages
- Cascading Style Sheets (CSS): stylistic info for web pages
- JSP/EJB/Spring, Node/Express, Ruby, .Net, PHP Hypertext Processor (PHP) …: dynamically create pages on a web server
- JavaScript,jQuery, React, Angular: interactive and programmable web pages
- Asynchronous JavaScript and XML (Ajax): accessing data for web applications
- Extensible Markup Language (XML): metalanguage for organizing data
- JavaScript Object Notation (JSON): lightweight data-interchange format that is largely replacing XML in modern web apps

How Browsers Display a Page

- User machines have IP address on the Internet
- Server machines have IP address and Domain Name
- Domain names and IP addresses are registered at global DNS Server
- When the user opens a browser window and asks for www.test.com
- First, the browser will check the local DNS (host file) for the IP address of that domain
- If not found, it will connect to ISP and ask it for the DNS
- Once retrieved, the browser will send another request to that server
- Requests are delivered by the IP protocol, collected by the TCP protocol, and processed by HTTP or HTTPS protocol
- The server will send the browser a response with HTML code.
- The browser will interpret the HTML code line by line and start building the web page.
- For every resource not found in the browser cache, the browser will send a new request to the server again asking for that resource and so on.

Main Point

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