Web Programming

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Objectives

- We will cover:
  - The technologies that are at the foundation of web programming...
  - The hypertext transfer protocol (HTTP)
  - The hypertext markup language (HTML)

HTTP and HTML

Tim
Berners-Lee

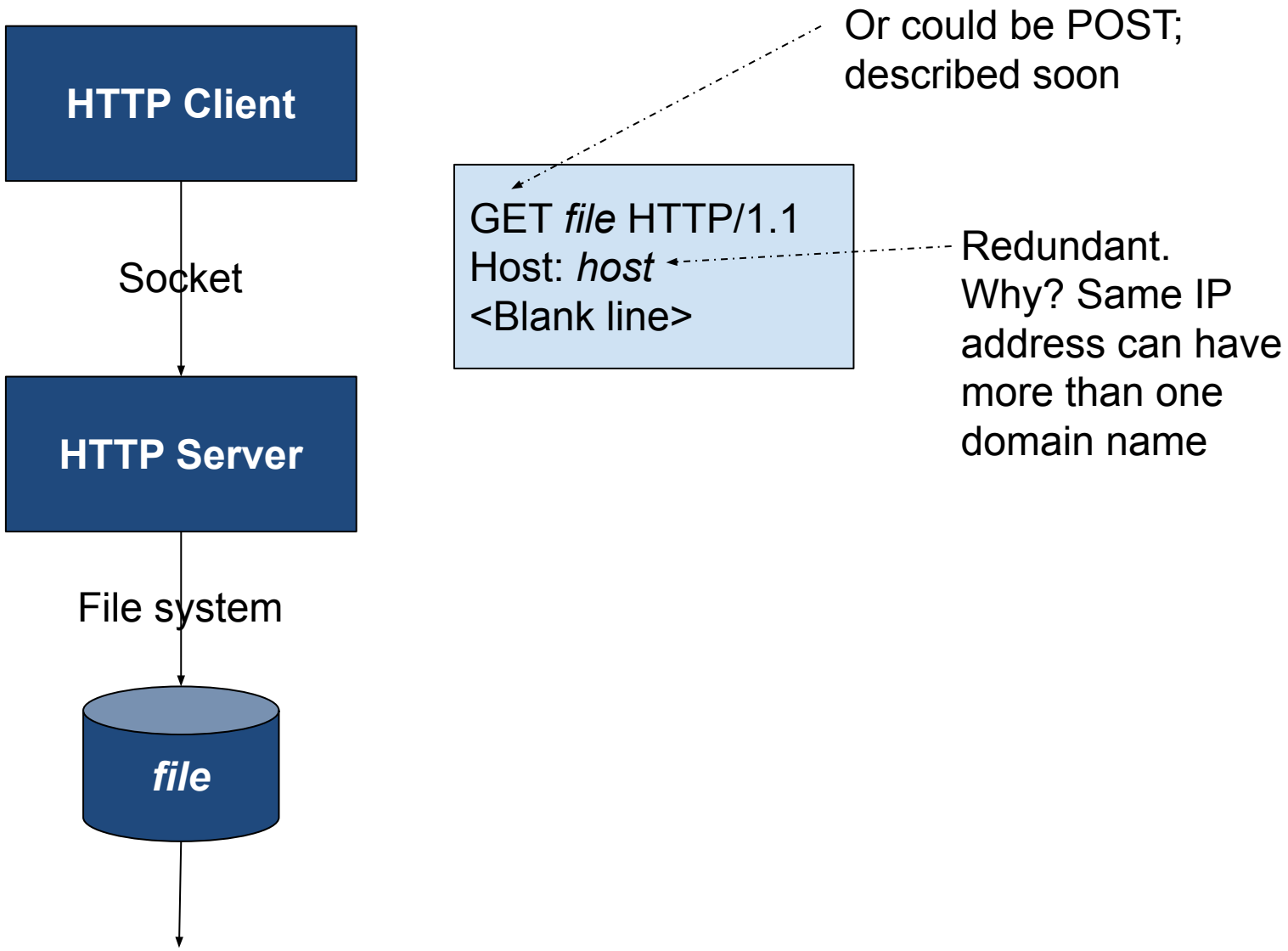
Agenda

- **HTTP**
- URLs
- HTML
- HTML: Links and Forms
- The World Wide Web

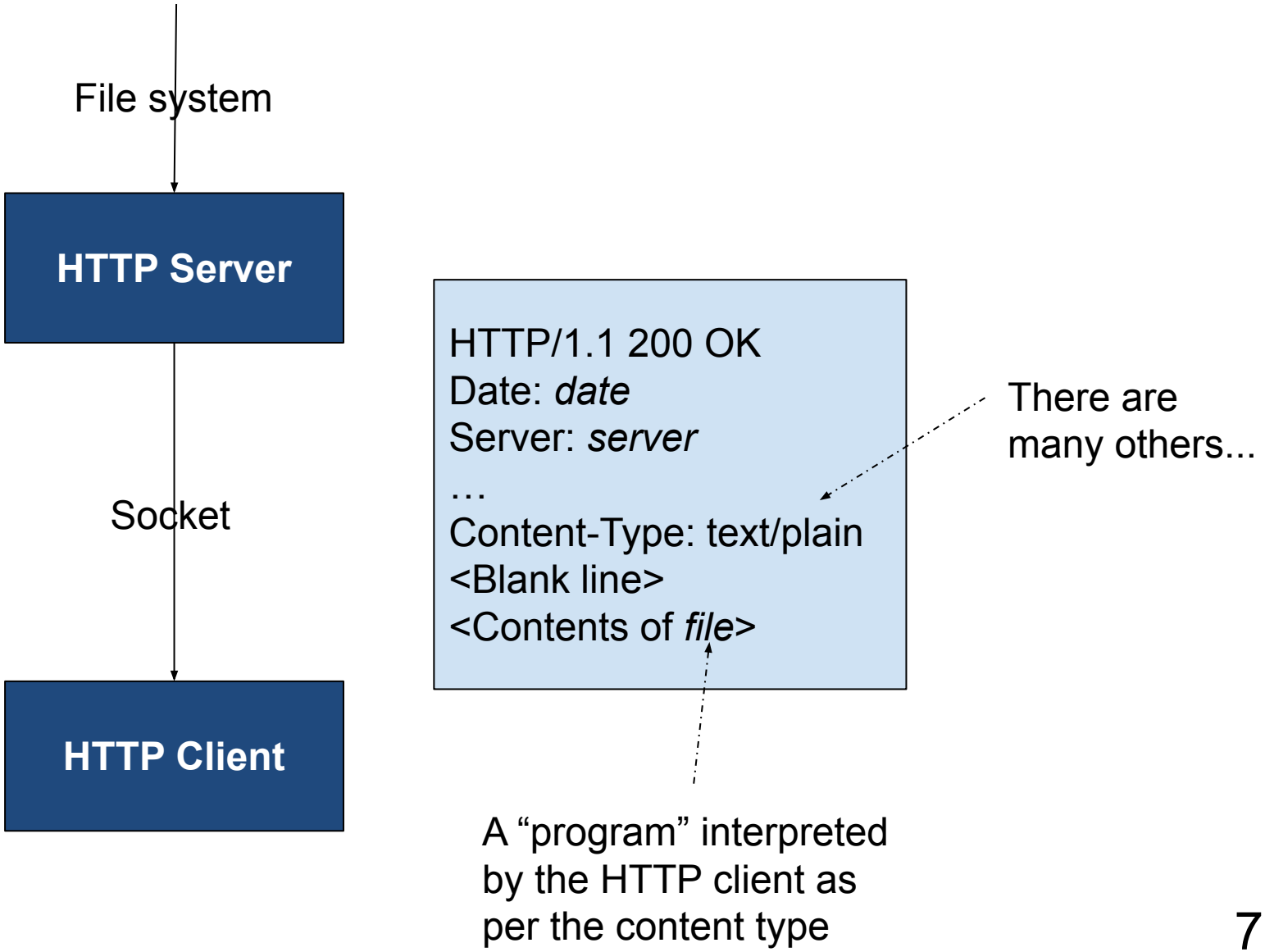
HTTP

- ***Hypertext Transfer Protocol (HTTP)***
  - A client/server protocol
  - HTTP client requests a file
  - HTTP server provides a file

HTTP


HTTP Client
Socket
HTTP Server
File system
file
Or could be POST; described soon
GET *file* HTTP/1.1
Host: *host*
<Blank line>
Redundant. Why? Same IP address can have more than one domain name

HTTP


File system
HTTP Server
Socket
HTTP Client
HTTP/1.1 200 OK
Date: *date*
Server: *server*
…
Content-Type: text/plain
<Blank line>
<Contents of *file*>
There are many others...
A “program” interpreted by the HTTP client as per the content type

HTTP

- **yogi.txt**
  - A simple text file

On **COMPUTER1** (192.168.1.8)

```
$ cat yogi.txt
Baseball is 90% mental and
the other half is physical.
-- Yogi Berra
$
```

HTTP

- **simplehttpserver.py**
  - A simple HTTP server
  - Enhancement of “standard” Python HTTP server
  - Assume that it runs on **COMPUTER1** (192.168.1.8)
  - Assume that it has access to **yogi.txt**

HTTP

On **COMPUTER1** (192.168.1.8)

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/)
...
```

On **COMPUTER2**

```
$ telnet 192.168.1.8 55555
Trying 192.168.1.8...
Connected to 192.168.1.8.
Escape character is '^]'.
GET yogi.txt HTTP/1.1
Host: 192:168:1:8

HTTP/1.0 200 OK
Server: SimpleHTTP/0.6 Python/3.8.10
Date: Sat, 12 Feb 2022 23:14:22 GMT
Content-type: text/plain
Content-Length: 69
Last-Modified: Sat, 12 Feb 2022 23:12:24 GMT

Baseball is 90% mental and
the other half is physical.
-- Yogi Berra
Connection closed by foreign host.
$
```

Note: Content-type is text/plain

HTTP

- See **httpclient1.py**

On **COMPUTER1** (192.168.1.8)

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/) ...
```

On **COMPUTER2**

```
$ python httpclient1.py 192.168.1.8 55555 yogi.txt
HTTP/1.0 200 OK
Server: SimpleHTTP/0.6 Python/3.8.10
Date: Sat, 12 Feb 2022 23:16:27 GMT
Content-type: text/plain
Content-Length: 69
Last-Modified: Sat, 12 Feb 2022 23:12:24 GMT

Baseball is 90% mental and
the other half is physical.
-- Yogi Berra
$
```

Note:
Content-type
is text/plain

Agenda

- HTTP
- **URLs**
- HTML
- HTML: Links and Forms
- The World Wide Web

URLs

- ***Uniform Resource Locator (URL)***

  - `protocol://host:port/file`
    - **`protocol`**
      - We'll use `http` now, `https` later
      - Others: `file`, `ftp`, `mailto`, `file`, ...
      - See http://en.wikipedia.org/wiki/URI_scheme

URLs

- Uniform resource locator (cont.)
  - `protocol://host:port/file`
    - **`host`**
      - IP address or domain name of HTTP server
      - Recall *Network Programming* lecture

URLs

- Uniform resource locator (cont.)
  - `protocol://host:port/file`
    - **`port`**
      - The port at which the HTTP server is listening
      - Recall *Network Programming* lecture
      - For HTTP, default port is 80
      - For HTTPS, default port is 443

URLs

- Uniform resource locator (cont.)
  - `protocol://host:port/`**`file`**
    - **`file`**
      - The path name of the file that the HTTP server should deliver
      - Default path name is specified in HTTP server settings
        - » Often index.html or index.php

URLs

- See **httpclient2.py**

On **COMPUTER1** (192.168.1.8)

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/)
...
```

On **COMPUTER2**

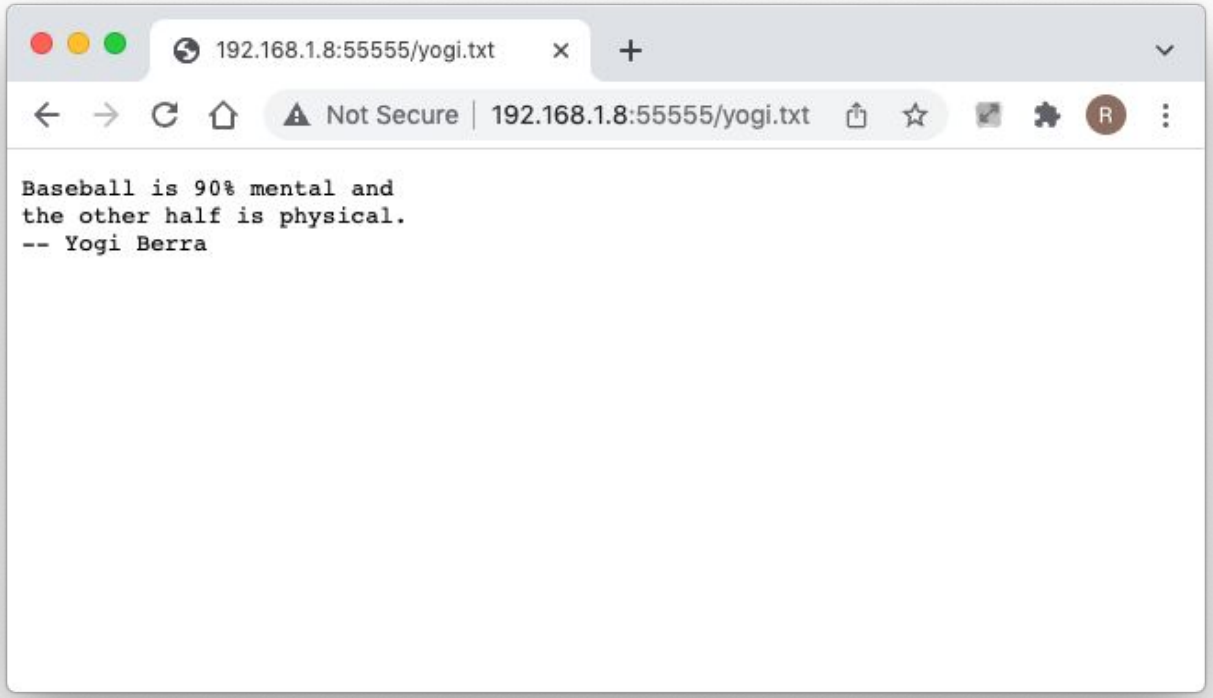
```
$ python httpclient2.py http://192.168.1.8:55555/yogi.txt
Server: SimpleHTTP/0.6 Python/3.11.7
Date: Sun, 25 Feb 2024 03:01:19 GMT
Content-type: text/plain
Content-Length: 69
Last-Modified: Sat, 12 Feb 2022 23:12:24 GMT

Baseball is 90% mental and
the other half is physical.
-- Yogi Berra
$
```

URLs

On **COMPUTER1** (192.168.1.8)

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/)
...
```

On **COMPUTER2**



URLs

- **Review…**

- **Question**: How to issue HTTP request?
- **Answer 1**: Telnet
- **Answer 2**: Your own program
- **Answer 3**: Browser
  - Enter appropriate URL

Agenda

- HTTP
- URLs
- **HTML**
- HTML: Links and Forms
- The World Wide Web

HTML

- Some HTTP content types:
  - **text/plain**, **text/html**, image/gif, image/jpeg, audio/mp4, **application/xml**, **application/json**, …
- Complete list of HTTP content types:
  - http://en.wikipedia.org/wiki/Internet_media_type
- The most popular HTTP content type:
  - **text/html**

HTML

- ***Hypertext Markup Language (HTML)***
  - A language for expressing documents
- HTML document contains…

HTML

- ***Elements***

Example HTML Element	Description
`<strong>some text </strong>`	A normal element Delimited by ***start tag*** and ***end tag***
`<a href="someurl"> some text</a>`	An element with an ***attribute***
`<strong></strong>`	An ***empty element***
`<hr>`	A ***void element*** An element that must be empty and that must consist of a start tag only *
`<hr />`	A ***self-closing tag*** A void element

* Not allowed in some “relatives” of HTML

HTML

- ***Processing Instructions***

Example HTML Element	Description
`<!DOCTYPE html>`	A ***DOCTYPE*** processing instruction First line of document Identifies document as HTML 5
`<!-- comment -->`	A ***comment***

HTML

- See **fund.html**

HTML

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/)
...
```

On **COMPUTER1** (192.168.1.8)

```
$ python httpclient2.py http://192.168.1.8:55555/fund.html
Server: SimpleHTTP/0.6 Python/3.11.7
Date: Sun, 25 Feb 2024 03:01:48 GMT
Content-type: text/html
Content-Length: 3164
Last-Modified: Sat, 25 Sep 2021 01:58:06 GMT

<!DOCTYPE html>

<!-- ============================================================ -->
<!-- fundamentals.html                                            -->
<!-- Author: Bob Dondero                                          -->
<!-- ============================================================ -->

<html>
   <head>
      …
</html>
$
```

On **COMPUTER2**

Note: Content-type is text/html

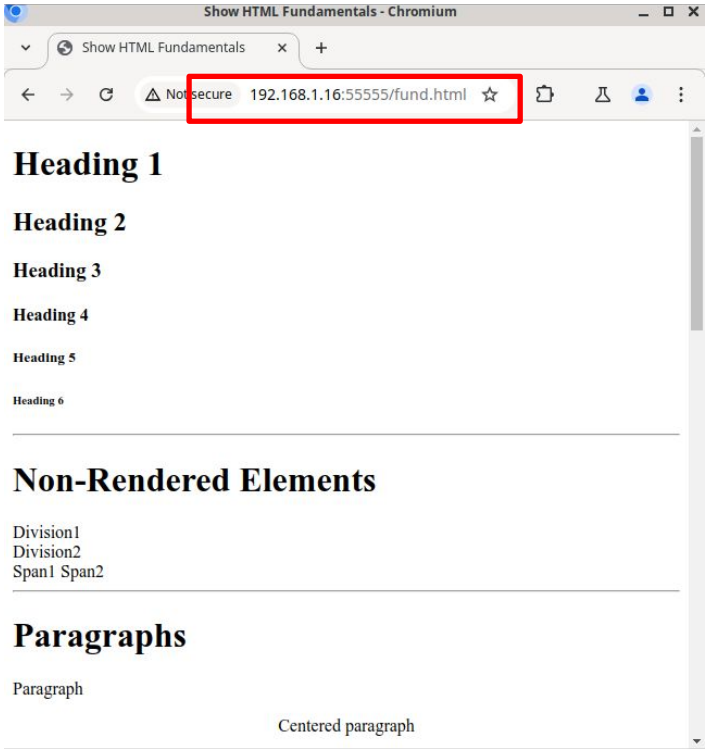
HTML

On **COMPUTER1** (192.168.1.16)

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/) ...
```

On **COMPUTER2**

Interprets document



Continued on next slide

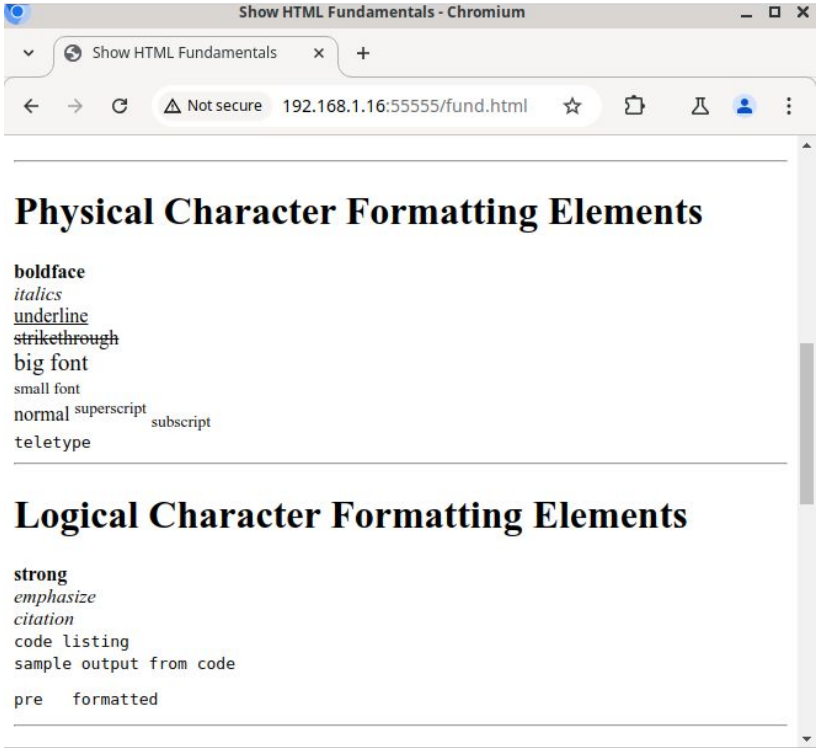
HTML

On **COMPUTER1** (192.168.1.16)

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/) ...
```

On **COMPUTER2**

Interprets document



Continued on next slide

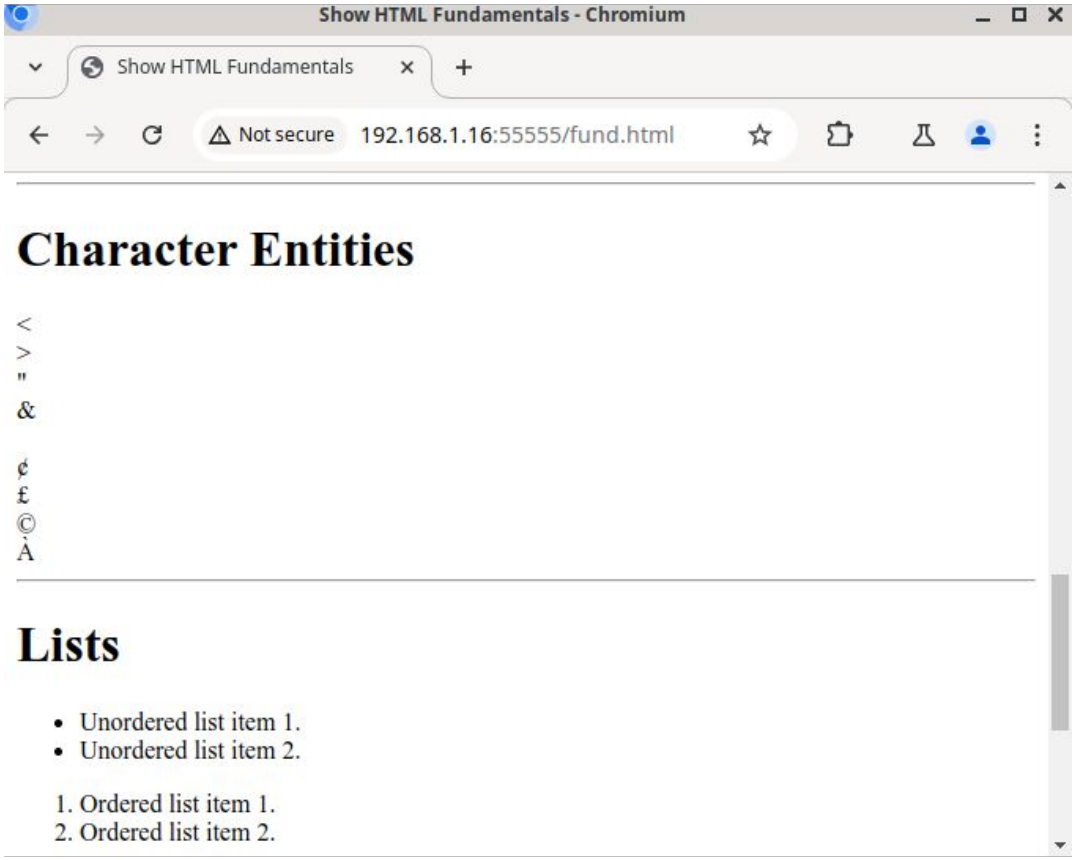
HTML

On **COMPUTER1** (192.168.1.16)

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/) ...
```

On **COMPUTER2**

Interprets document



Continued on next slide

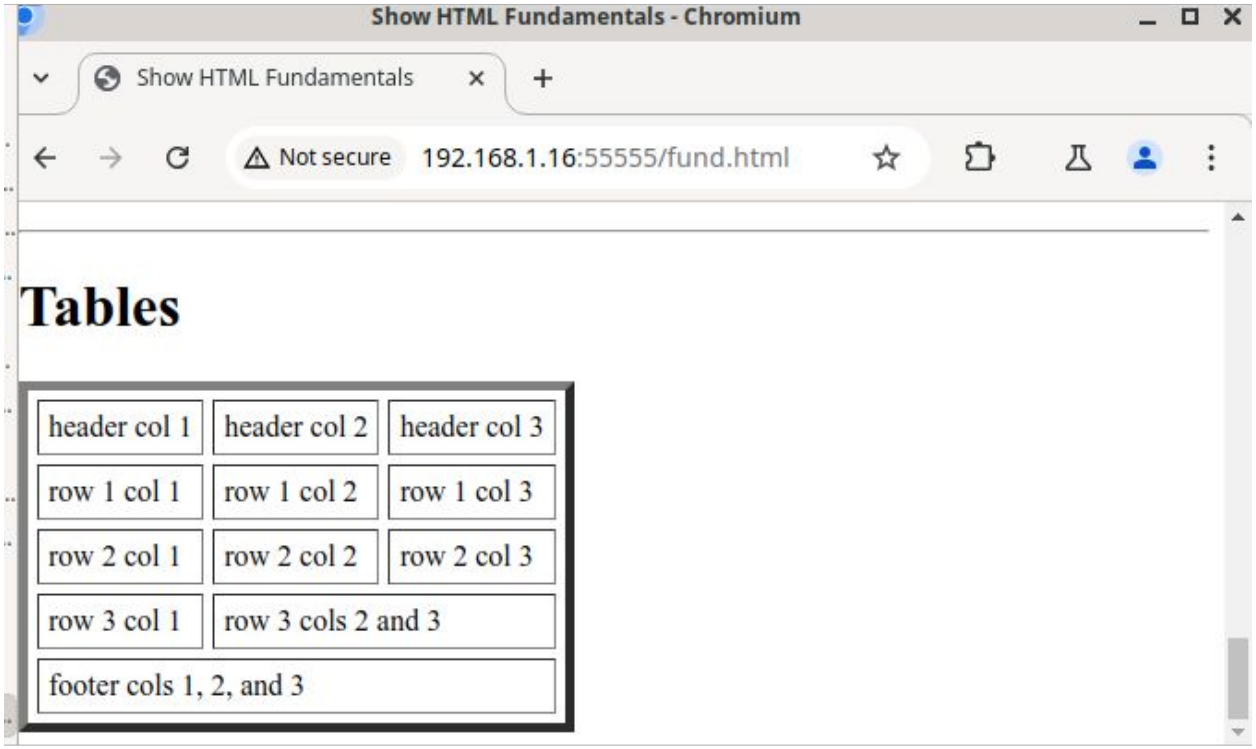
HTML

On **COMPUTER1** (192.168.1.16)

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/) ...
```

On **COMPUTER2**

Interprets document



Agenda

- HTTP
- URLs
- HTML
- **HTML: Links and Forms**
- The World Wide Web

HTML: Links and Forms

- See **links.html**
  - `<a href="someurl">...</a>`
    - Defines a ***page link***
    - User clicks on page link => browser sends request specified by *someurl*

HTML: Links and Forms

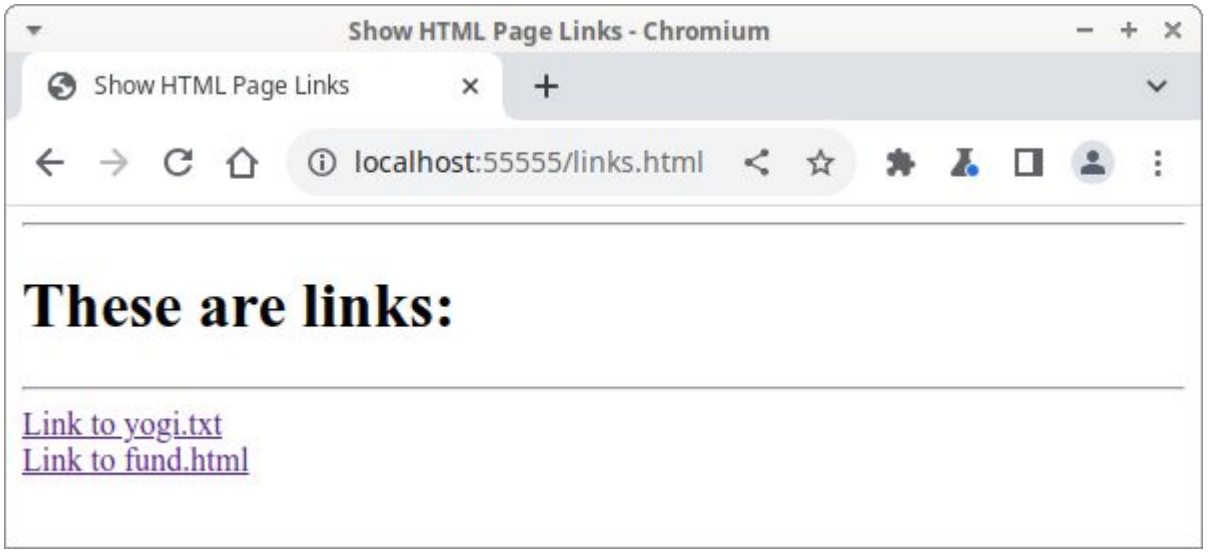
- See **links.html** (cont.)

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/) ...
```

HTML: Links and Forms

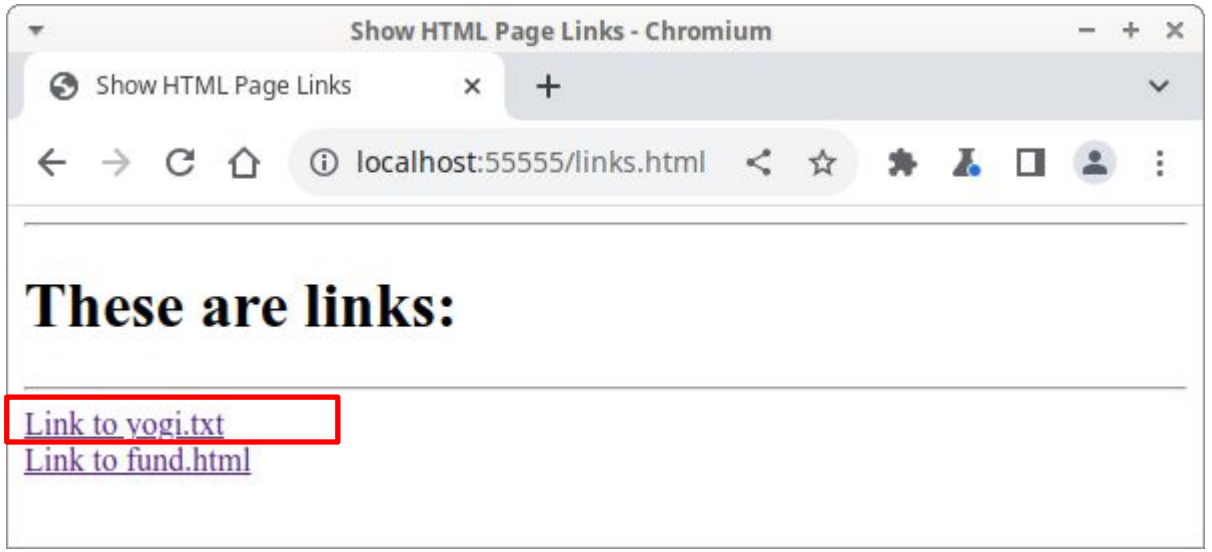
- See **links.html** (cont.)

Use localhost as abbreviation for URL of current computer



HTML: Links and Forms

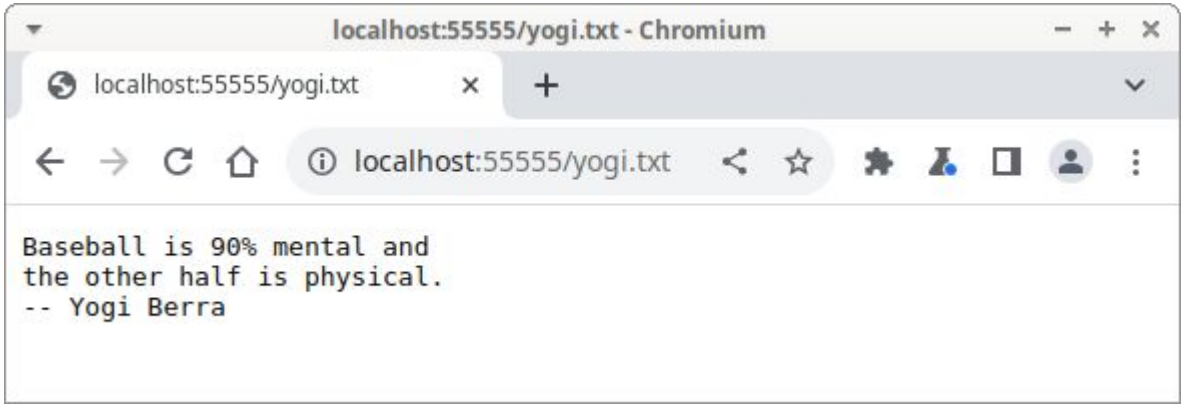
- See **links.html** (cont.)



HTML: Links and Forms

- See **links.html** (cont.)

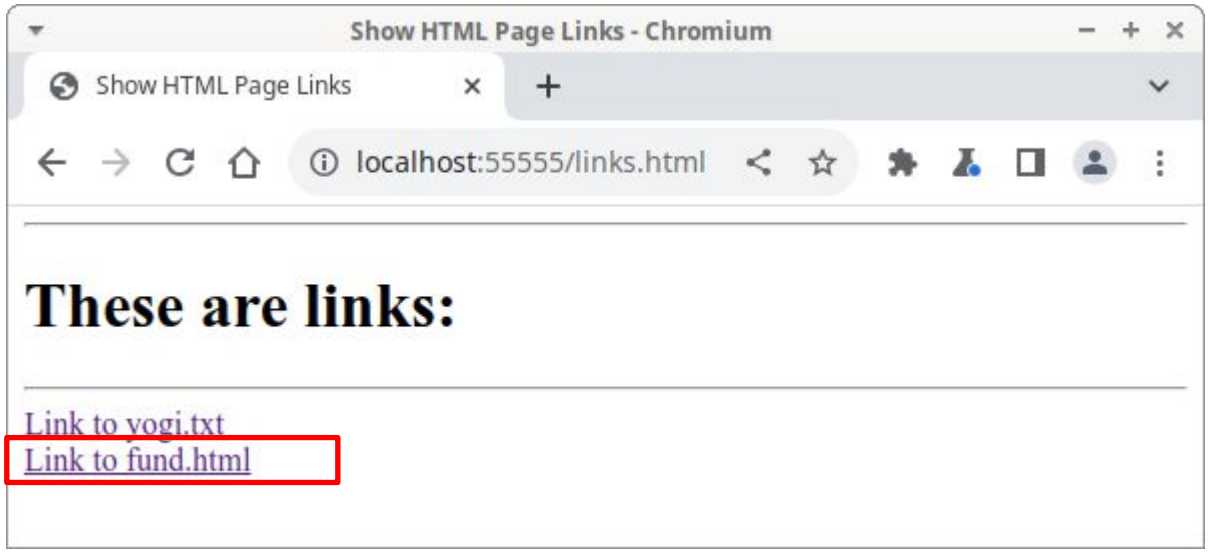
Protocol, host, port are same as the ones used for previous page



Content-type: text/plain
Browser interprets content of response as plain text

HTML: Links and Forms

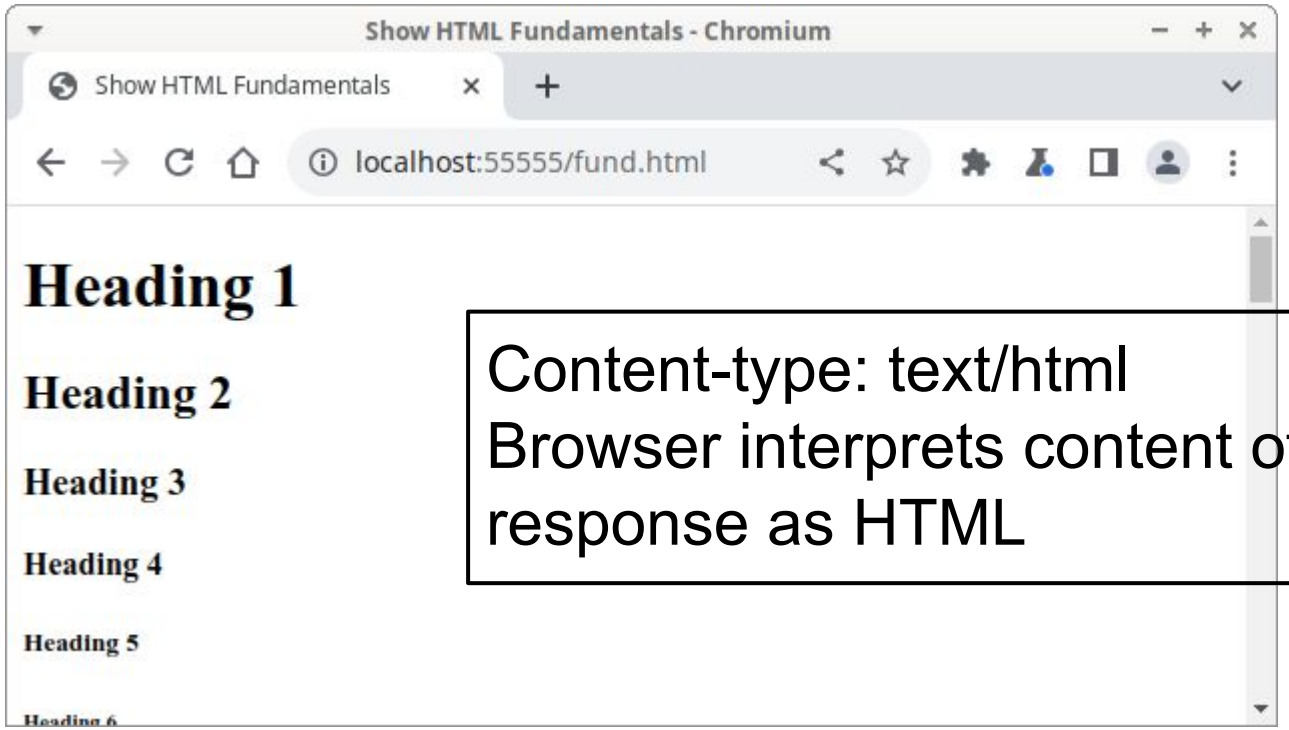
- See **links.html** (cont.)



HTML: Links and Forms

- See **links.html** (cont.)

Protocol, host, port are same as the ones used for previous page



Content-type: text/html
Browser interprets content of response as HTML

HTML: Links and Forms

- See **forms.html**
  - `<form action="someurl">...</form>`
    - Defines a ***form***
    - Browser does not render
  - `<input type="submit" value="label">`
    - Often nested in `form` element
    - Browser renders as button with label *label*
    - User clicks on button => browser sends request specified by *someurl*

HTML: Links and Forms

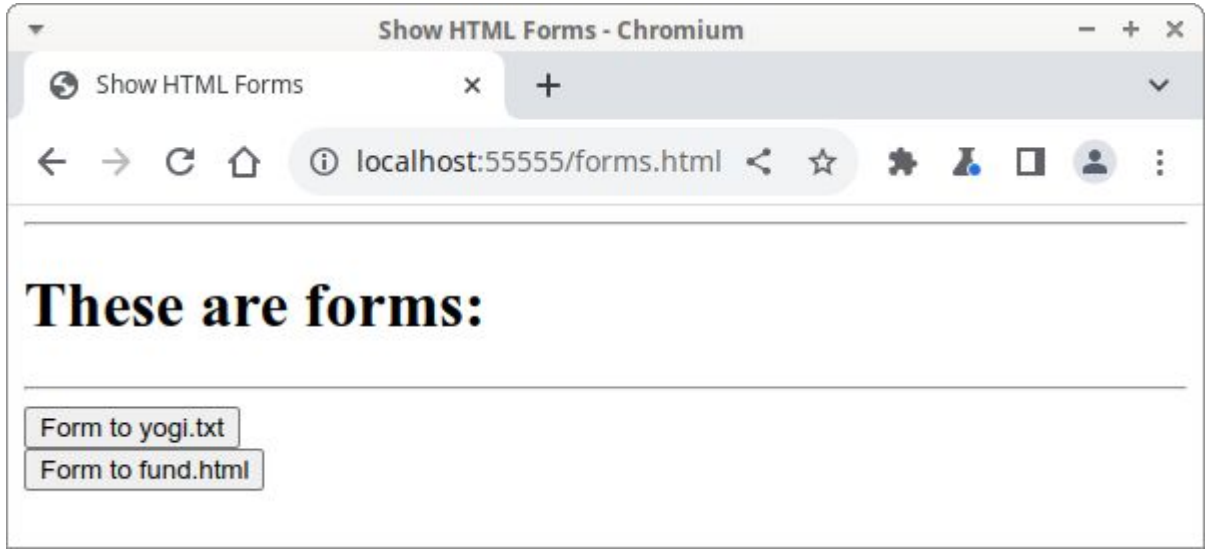
- See **forms.html**

```
$ python simplehttpserver.py 55555
Serving HTTP on 0.0.0.0 port 55555 (http://0.0.0.0:55555/) ...
```

HTML: Links and Forms

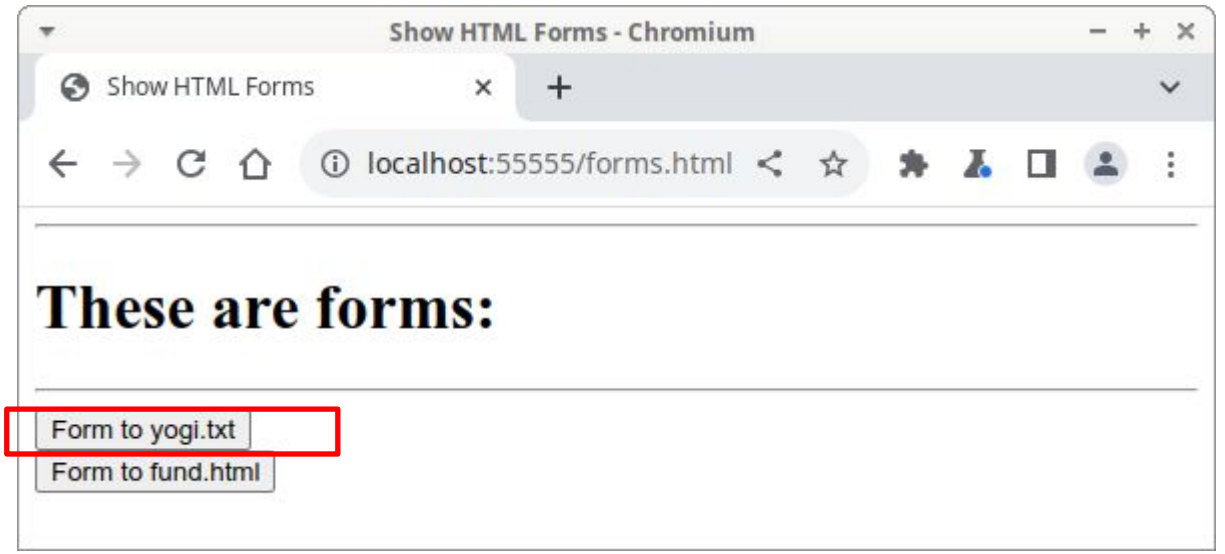
- See **forms.html** (cont.)

Use localhost as abbreviation for URL of current computer



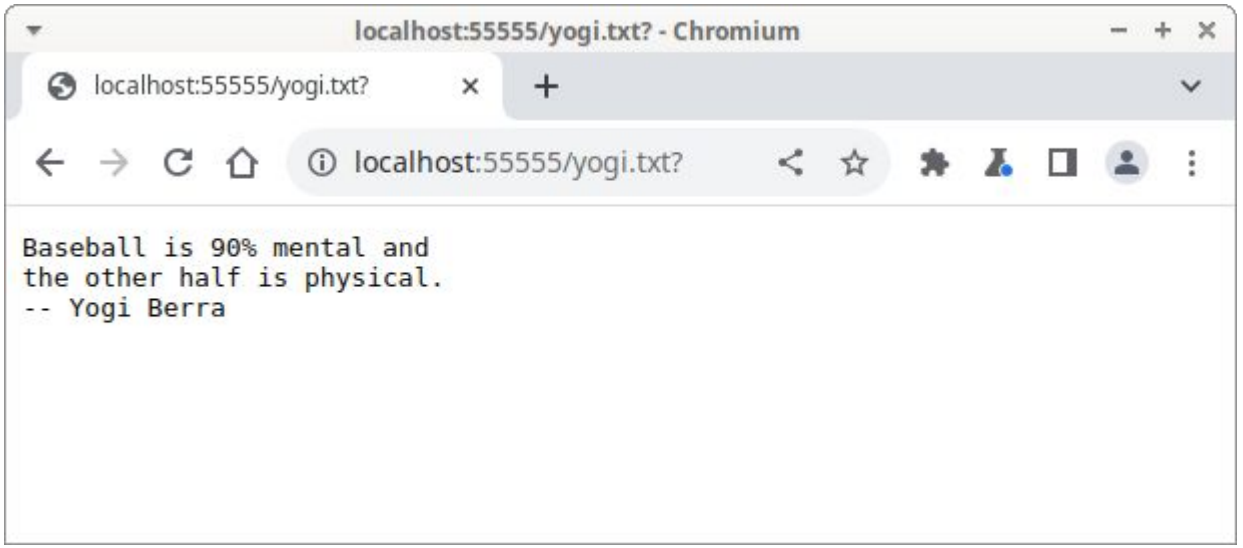
HTML: Links and Forms

- See **forms.html** (cont.)



HTML: Links and Forms

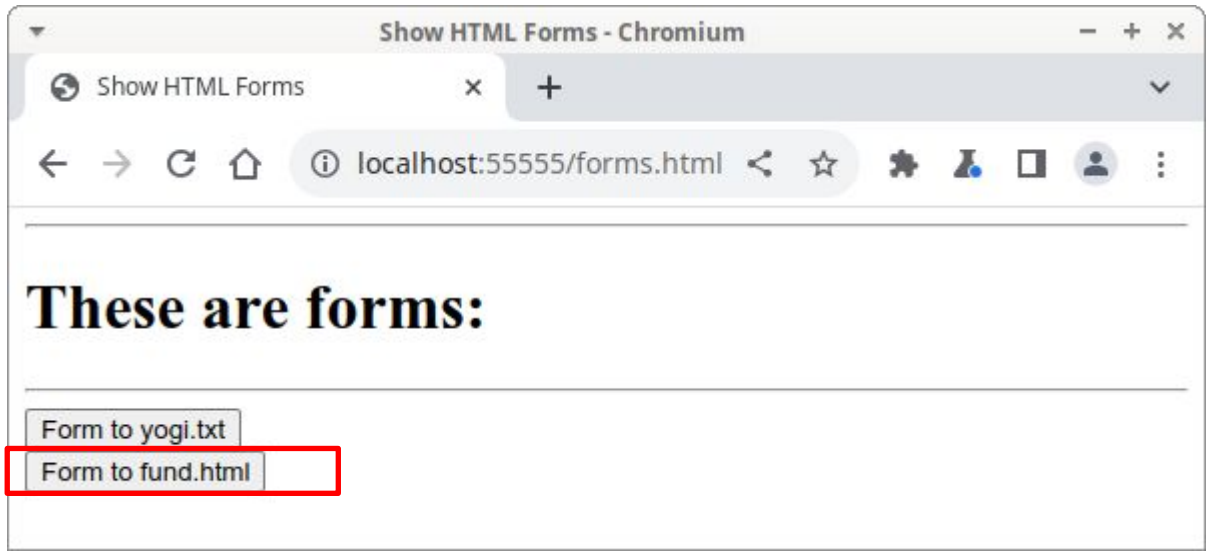
- See **forms.html** (cont.)



Content-type: text/plain
Browser interprets content of response as plain text

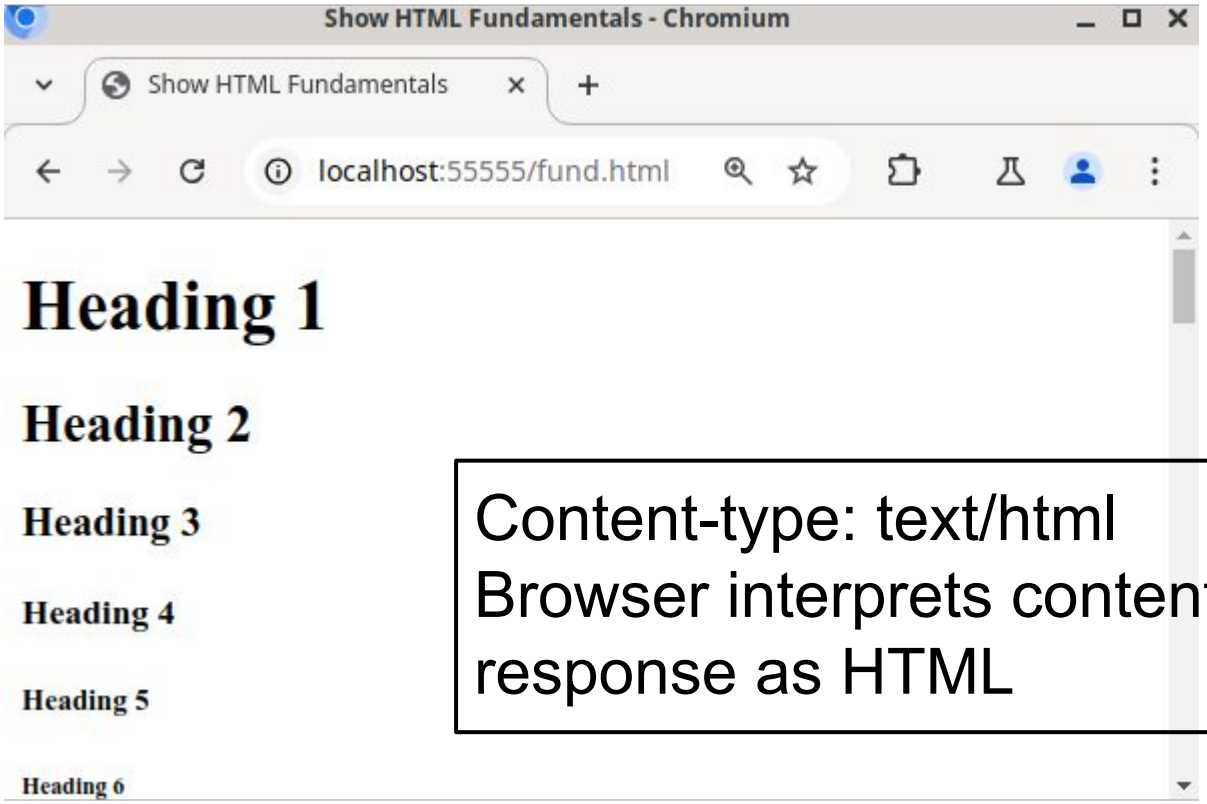
HTML: Links and Forms

- See **forms.html** (cont.)



HTML: Links and Forms

- See **forms.html** (cont.)



Content-type: text/html
Browser interprets content of response as HTML

HTML: Links and Forms

- **Review**…

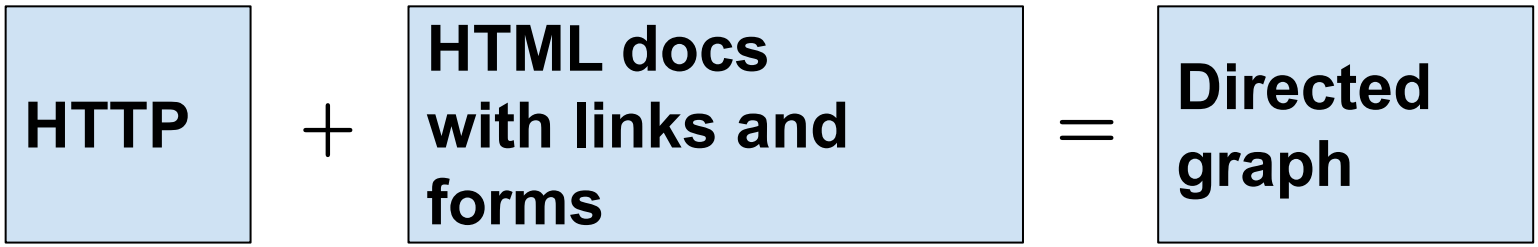
- **Question**: How to issue HTTP request?
- **Answer 1**: Telnet
- **Answer 2**: Your own program
- **Answer 3**: Browser
  - Enter URL
  - Click on HTML page link
  - Click on HTML input element of type submit

Agenda

- HTTP
- URLs
- HTML
- HTML: Links and Forms
- **The World Wide Web**

The World Wide Web

- Note:
  - Link or form in a HTML doc could reference another HTML doc
  - And so…



The World Wide Web

- The ***World Wide Web***
  - A directed graph
    - Nodes: HTML docs
    - Edges: links and forms

Aside: Examining Raw HTML

- To examine raw/uninterpreted HTML doc in browser:
  - Chrome & firefox:
    - Right click → view page source
- Good learning/debugging tool

Summary

- We have covered:
  - The technologies that are at the foundation of web programming...
  - The hypertext transfer protocol (HTTP)
  - The hypertext markup language (HTML)
- See also:
  - **Appendix 1**: Popular HTTP Servers & Browsers
  - **Appendix 2**: HTML History

Appendix 1: Popular HTTP Servers & Browsers

Popular HTTP Servers & Browsers

- As reported by https://news.netcraft.com/ for May 2024

HTTP Server	Market Share
Nginx	22%
Apache HTTP Server	20%
Cloudflare	11%
OpenResty	10%

Popular HTTP Servers & Browsers

- As reported by https://www.w3schools.com/browsers/ for June 2024

Browser	Market Share
Google Chrome	**78%**
Microsoft Edge	11%
Mozilla Firefox	5%
Apple Safari	4%
Opera	2%

Popular HTTP Servers & Browsers

- As reported by https://www.w3schools.com/browsers/ for **Nov 2002**

Browser	Market Share
Microsoft Internet Explorer	**83%**
Netscape	8%
AOL	5%

Popular HTTP Servers & Browsers

- Browser notes:
  - Substantial incompatibilities among browsers
    - Lesser problem now
    - But often must design apps for use with all (current and old) browsers!!!

Appendix 2: HTML History

HTML History

- ***Structured Generalized Markup Language (SGML)***
  - A language for expressing documents
- SGML document
  - Contains unadorned text and ***markup***

HTML History

- ***SGML markup***
  - `<tag>...</tag>`
  - `<tag attribute="value" …>...</tag>`
  - `<tag />`
- Tags and attributes can be anything you want!

HTML History

- ***Document type definition (DTD)***
  - A specification of allowable tags and attributes (and much more)
- Typically:
  - SGML user group (e.g., pharm industry, drug regulatory agencies) composes DTD
  - SGML users (e.g., pharm companies) compose documents that conform to the DTD
- First line of SGML doc specifies DTD

HTML History

- HTML
  - 1990
  - Intended to be an application of SGML, but…
  - At the time no clear parsing guidelines were established, so…
  - Many HTML documents are not valid SGML documents

HTML History

- HTML 2.0
  - 1995
  - First version to be standardized
  - First line of document:
    - `<!DOCTYPE html PUBLIC "-//IETF//DTD HTML 2.0//EN">`

HTML History

- HTML 3.2
  - 1997
  - More of an SGML application, but...
  - Burdened by need for backward compatibility
    - Still had many legacy features that differ from SGML's requirements
  - First line of document:
    - `<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 3.2 Final//EN">`

HTML History

- HTML 4.0
  - 1997
  - Two versions:
    - Strict: deprecated elements are forbidden
    - Transitional: deprecated elements are allowed
  - With strict DTD, an SGML application
    - Conforms to ISO 8879 – SGML

HTML History

- First line of document:
  - `<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01//EN" "http://www.w3.org/TR/html4/strict.dtd">`
  - `<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html4/loose.dtd">`

HTML History

- HTML 5
  - 2014
  - Abandons any attempt to define HTML as SGML application
  - Explicitly defines its own syntax rules
  - More closely match existing implementations and documents
  - First line of document:
    - `<!DOCTYPE html>`

HTML History

- We'll use HTML 5
  - But we'll keep it simple
    - This course is not about HTML