# CSE 333

## Lecture 23 -- HTTP

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## Administrivia

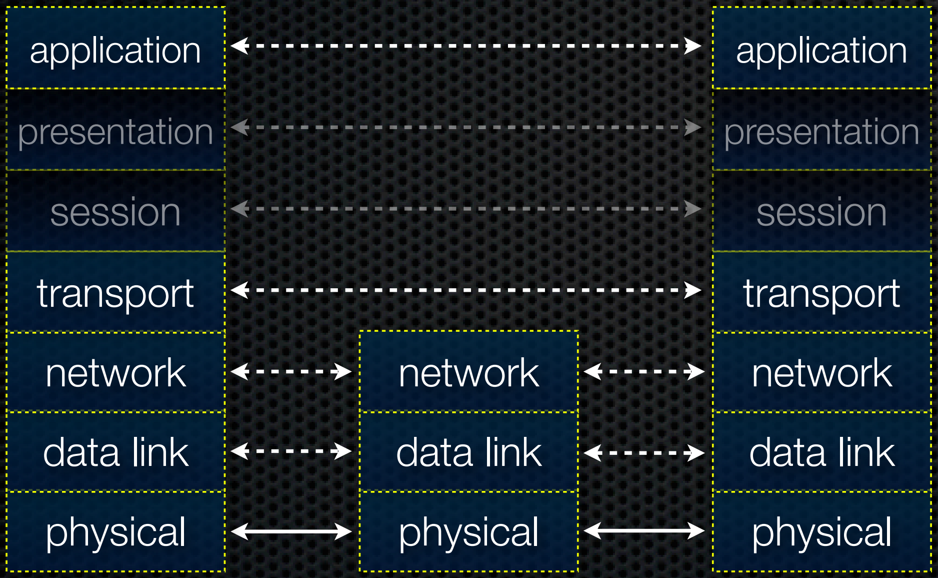
HW4 due in a week!

- get a good run at it over the weekend
- part C is much less structured than earlier homeworks

Monday is a holiday

- no lecture
- but, you owe Colin your hw4 feature proposal on Monday

# Remember this...

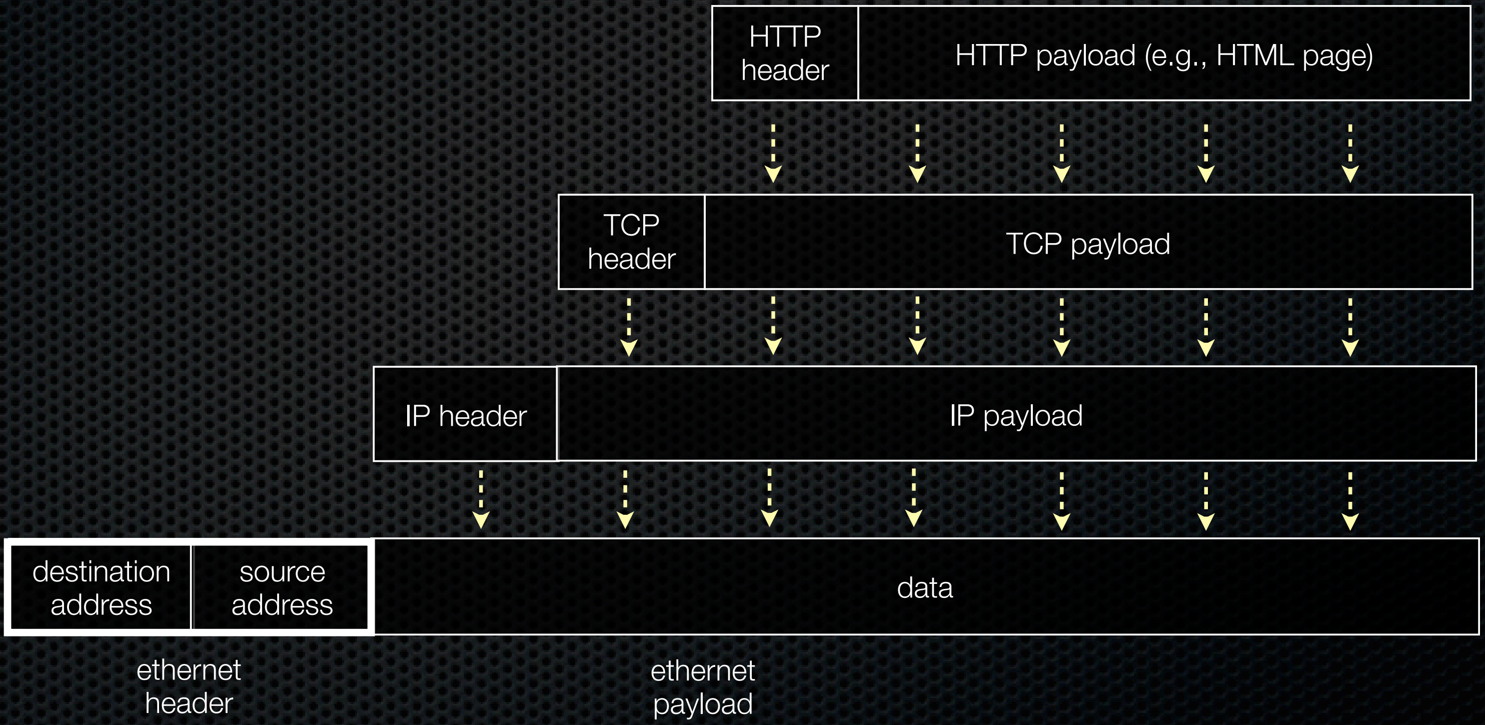


Application protocols

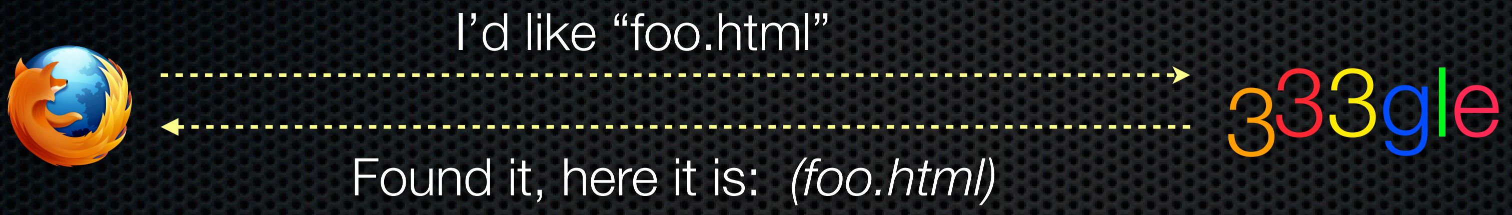
- the format and meaning of messages between application entities
- e.g., HTTP is an application level protocol that dictates how web browsers and web servers communicate
  - HTTP is implemented on top of TCP streams

## And this...

Packet encapsulation -- same as before!



# Let's dive down into HTTP



A client establishes one or more TCP connections to a server

- the client sends a request for a web object over a connection, and the server replies with the object's contents
- we have to figure out how let the client and server communicate their intentions to each other clearly
- we have to define a ***protocol***

## HTTP is a “protocol”

**Protocol:** the rules governing the exchange of messages, and the format of those messages, in a computing system

- what messages can a client exchange with a server?
  - what do the messages mean?
  - what are legal replies to a message?
  - what is the syntax of a message?
- what sequence of messages is legal?
  - how are errors conveyed?

A protocol is (roughly) the network equivalent of an API

## HTTP

**H**yper**t**ext **t**ransport **p**rotocol

- a request / response protocol
- a client (web browser) sends a request to a web server
  - the server processes the request, sends a response
- typically, a request asks the server to retrieve a resource
  - a resource is an object or document, named by a URI
- a response indicates whether the server succeeded
  - and, if so, it provides the content of the requested response

## An HTTP request

```
[METHOD] [request-uri] HTTP/[version]\r\n
[fieldname1]: [fieldvalue1]\r\n
[fieldname2]: [fieldvalue2]\r\n
[...]
[fieldnameN]: [fieldvalueN]\r\n
\r\n
[request body, if any]
```

*let's use "nc" to see a real request*

## HTTP methods

There are three commonly used HTTP methods

- **GET**: "please send me the named document"
- **POST**: "I'd like to submit data to you, such as form content"
- **HEAD**: "send me the headers for the named object, but not the object. (I'd like to see if my cached copy is still valid.)"

There are several rarely used methods:

- PUT, DELETE, TRACE, OPTIONS, CONNECT, PATCH, ...
  - TRACE: "if there are any proxies or caches in between me and the server, please speak up!"

## HTTP versions

Most browsers and servers speak HTTP/1.1

- "version 1.1 of the HTTP protocol"
  - http://www.w3.org/Protocols/rfc2616/rfc2616.html
- introduced around 1996 to fix shortcomings of HTTP/1.0
  - better performance, richer caching features, better support for multi-homed servers, and much more
  - more complicated to implement than HTTP/1.0

## Client headers

The client can provide zero or more request “headers”

- they provide information to the server, or modify how the server should process the request

You’ll encounter many in practice

- Host: the DNS name of the server [why?]
- User-Agent: an identifying string naming the browser [why?]
- Accept: the content types the client prefers or can accept
- Cookie: an HTTP cookie previously set by the server

## Example...

```
GET /foo/bar.html HTTP/1.1
Host: futureproof.cs.washington.edu:5555
User-Agent: Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_6_7; en-us)
AppleWebKit/533.21.1 (KHTML, like Gecko) Version/5.0.5 Safari/
533.21.1
Accept: application/xml,application/xhtml+xml,text/html;q=0.9,text/
plain;q=0.8,image/png,*/*;q=0.5
Accept-Language: en-us
Accept-Encoding: gzip, deflate
Cookie: __utma=59807807.1547453334.1214335349.1301330421.1301339949.
30; __utmz=59807807.1300728257.27.14.utmcsr=google|utmccn=(organic)|
utmcmd=organic|utmctr=csgordon@u.washington.edu;
__utma=80390417.1521666831.1201286098.1302710464.1302717901.34;
__utmz=80390417.1301950604.31.15.utmcsr=cs.washington.edu|utmccn=
(referral)|utmcmd=referral|utmcct=/education/courses/cse333/11sp/;
__qca=P0-1872143622-1294952393928
Connection: keep-alive
```

# An HTTP response

```
HTTP/[version] [status code] [reason]\r\n
[fieldname1]: [fieldvalue1]\r\n
[fieldname2]: [fieldvalue2]\r\n
[...]
[fieldnameN]: [fieldvalueN]\r\n
\r\n
[response body, if any]
```

*let's use "telnet" to see a real response*

## Status codes, reason phrase

Code:  a computer-readable outcome of the request

- three digit integer; first digit identifies the response category
  - 1xx:  some kind of informational message
  - 2xx:  success of some kind
  - 3xx:  redirects the client to a different URL
  - 4xx:  the client's request contained some error
  - 5xx:  the server experienced an error

Reason phrase:  human-readable explanation

- e.g., "OK"  or "Moved Temporarily"

## Common status lines

HTTP/1.1 200 OK

- the request succeeded, the requested object is sent

HTTP/1.1 404 Not Found

- the requested object was not found

HTTP/1.1 301 Moved Permanently

- the object exists, but its name has changed
- the new URL is given in the “Location:” header

HTTP/1.1 500 Server Error

- the server had some kind of unexpected error

## Server headers

The server can provide zero or more request “headers”

- they provide information to the client, or modify how the client should process the response

You’ll encounter many in practice

- **Server**: a string identifying the server software
- **Content-Type:** the type of the requested object
- **Content-Length:** size of requested object [why?]
- **Last-Modified:** a date indicating the last time the request object was modified [why?]

## Example

```
HTTP/1.1 200 OK
Date: Fri, 27 May 2011 17:05:53 GMT
Server: Apache/2.2.19 (Fedora)
Last-Modified: Fri, 27 May 2011 17:04:51 GMT
ETag: "2740640-52-4a444ef9392c0"
Accept-Ranges: bytes
Content-Length: 82
Content-Type: text/html
Content-Language: en
X-Pad: avoid browser bug

<html><body>
<font color="chartreuse" size="18pt">Awesome!!</font>
</body></html>
```

## Cool HTTP/1.1 features

"Chunked Transfer-Encoding"

- a server might not know how big a response object is
  - e.g., you're dynamically generating the content in response to a query or other user input
- how do you send Content-Length?
  - could wait until you've finished generating the response, but that's not great in terms of **latency**
  - instead, want to start sending response right away
- chunked message body: response is series of chunks
  - try with http://www.cs.washington.edu/

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## Cool HTTP/1.1 features

### Persistent connections

- establishing a TCP connection is costly
  - multiple network "round trips" just to set up the TCP connection
  - TCP has a feature called "slow start"; slowly grows the rate at which a TCP connection transmits to avoid overwhelming networks
- a web page consists of multiple objects, and a client probably visits several pages on the same server
  - bad idea: separate TCP connection for each object
  - better idea: single TCP connection, multiple requests
  - *try it on www.cs.washington.edu*

See you on Wednesday!