# L03

# HTTP Overview

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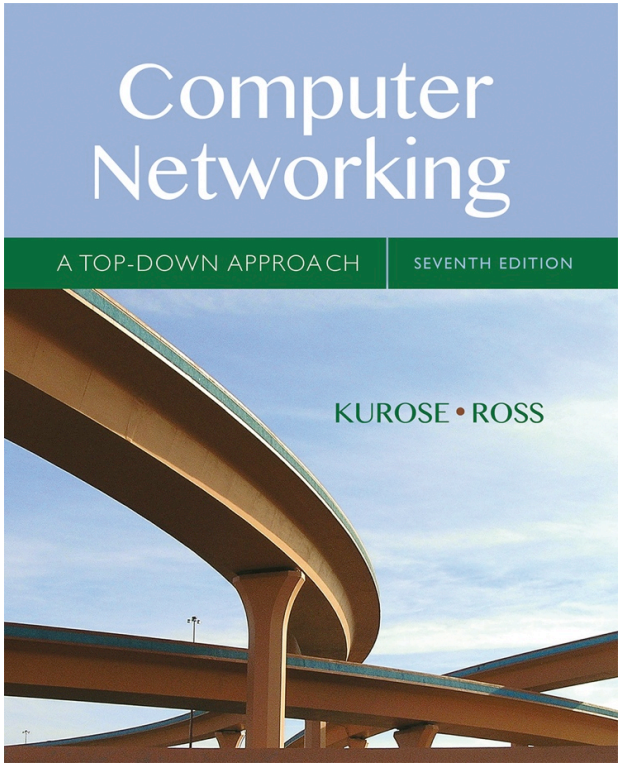
# Resources Acknowledgement

# Chapter 2
# Application Layer




*Computer Networking: A Top Down Approach*

7th edition
Jim Kurose, Keith Ross
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Thanks and enjoy! JFK/KWR

# Resources

- RFC 1935: What is internet
  - https://tools.ietf.org/html/rfc1935
- RFC 2616: HTTP Protocol (v1.1)
  - https://tools.ietf.org/html/rfc2616
- RFC 7540, 7541 (v2)
  - https://tools.ietf.org/html/rfc7540
- http://www.iana.org/assignments/media-types/index.html

# The Web

- Different from other TV, Radio
  - Operates on demand
    - Does not force users to tune in
  - Enables every one to become the producer
  - Channels (URLs) are way too many
  - Search engines enables easy navigation
- RIAs make it exciting
  - Users become engrossed

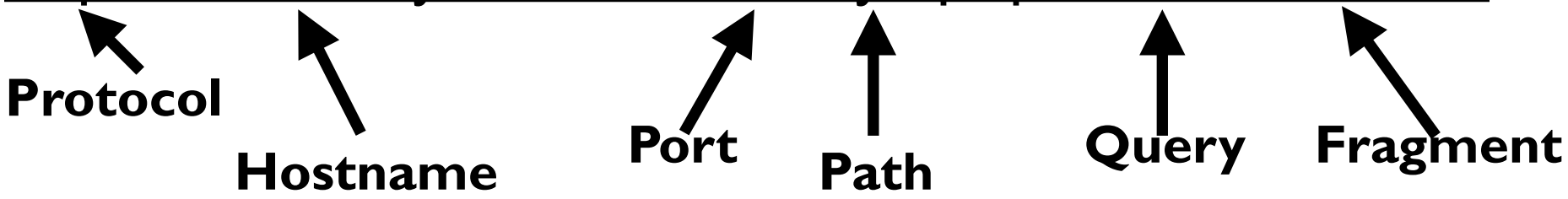
# Overview of Web

- Web Server
  - Apache, Nginx, IIS, Embedded WS
- Web Clients
  - Display: GUI browsers, lynx
  - Fetch: wget, curl
- Communication protocols
  - HTTP, HTTPS
  - Extension of HTTP
    - WebDAV, CardDAV, CalDAV…

# Web and HTTP

- *First, a review…*
- What is a *web page*
  - It consists of *objects*
  - Object can be HTML file, JPEG image, Java applet, audio file,…
- Web page consists of *base HTML-file* which includes *several referenced objects*
- Each object is addressable by a *URL,* e.g.,

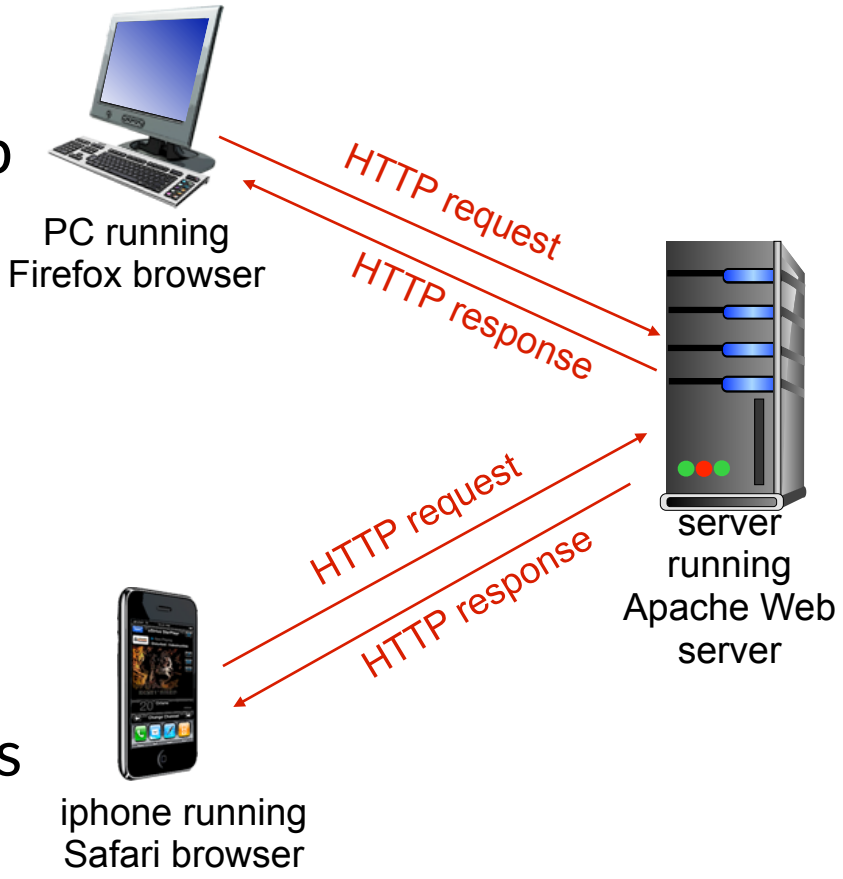
https://www.myweb.com:80/tryit.php?fn=first#Name



# HTTP overview

- HTTP: hypertext transfer protocol

- Web's application layer protocol
- Defines how client requests web page from server
- client/server model
  - *client:* browser that requests, receives, (using HTTP protocol) and "displays" Web objects
  - *server:* Web server sends (using HTTP protocol) objects in response to requests



# HTTP overview (continued)

- *uses TCP:*
- client initiates TCP connection (creates socket) to server, port 80
- server accepts TCP connection from client
- HTTP messages (application-layer protocol messages) exchanged between browser (HTTP client) and Web server (HTTP server)
- TCP connection closed

- *HTTP is "stateless"*
- server maintains no information about past client requests

*aside*

- protocols that maintain "state" are complex!
- past history (state) must be maintained
- if server/client crashes, their views of "state" may be inconsistent, must be reconciled

# Stateless protocol

- Server has no information about previous request
- When client re-requests the web page
    - Few seconds after the previous request
  - Server will send the page again
  - Will not say that page was served just now
- Explain Stateless (in non-technical context)
  - E.g. Re-answering the question again and again

# HTTP Protocol

- First interaction/implementation
  - A subset of intended protocol
  - (unofficially) labeled as HTTP 0.9
- HTTP 0.9
  - Client-server, request-response protocol
  - ASCII protocol, running on TCP/IP
  - Designed to xfer HTML document
  - Connection is closed after each request
  - No meta data (HTTP headers)

# HTTP 1.0

- Key protocol changes
  - Request has multiple header lines
  - Response is prefixed with status line
  - Response has its own header lines
  - Response can be non-HTML
    - A plain text file, image, other contents
  - TCP connection closed after response served
  - Other supports
    - Content encoding, character set, multi-part
    - Authentication, caching, proxy behaviours,
    - Date formats …

# HTTP 1.1

- RFC 2068 - First official standard (Jan 1977)
- RFC 2616 - Current standard (June 1999)
- A lot of performance optimizations
  - Keep alive connections
  - Chunked encoding transfers
  - Byte range requests
  - Additional caching mechanims
  - Request pipelines
  - Language negotiations
  - Caching directives

# HTTP/2

- Goals:
  - Impove transport performance
  - Lower latency and  higher thruput
  - No changes in high level semantics
    - All headers, values, use cases are same
  - Any existing HTTP application should work without modification
  - Any server upgrades should be transparent to majority of users

# HTTP Messages

- Two types
  - Request Message
  - Response Message
- Data is in clear text
  - Readable by humans
- Structure
  - Message line
  - Header lines
  - Empty lines
  - Data

# HTTP Request Message

- two types of HTTP messages: *request, response*
- HTTP request message:
  - ASCII (human-readable format)

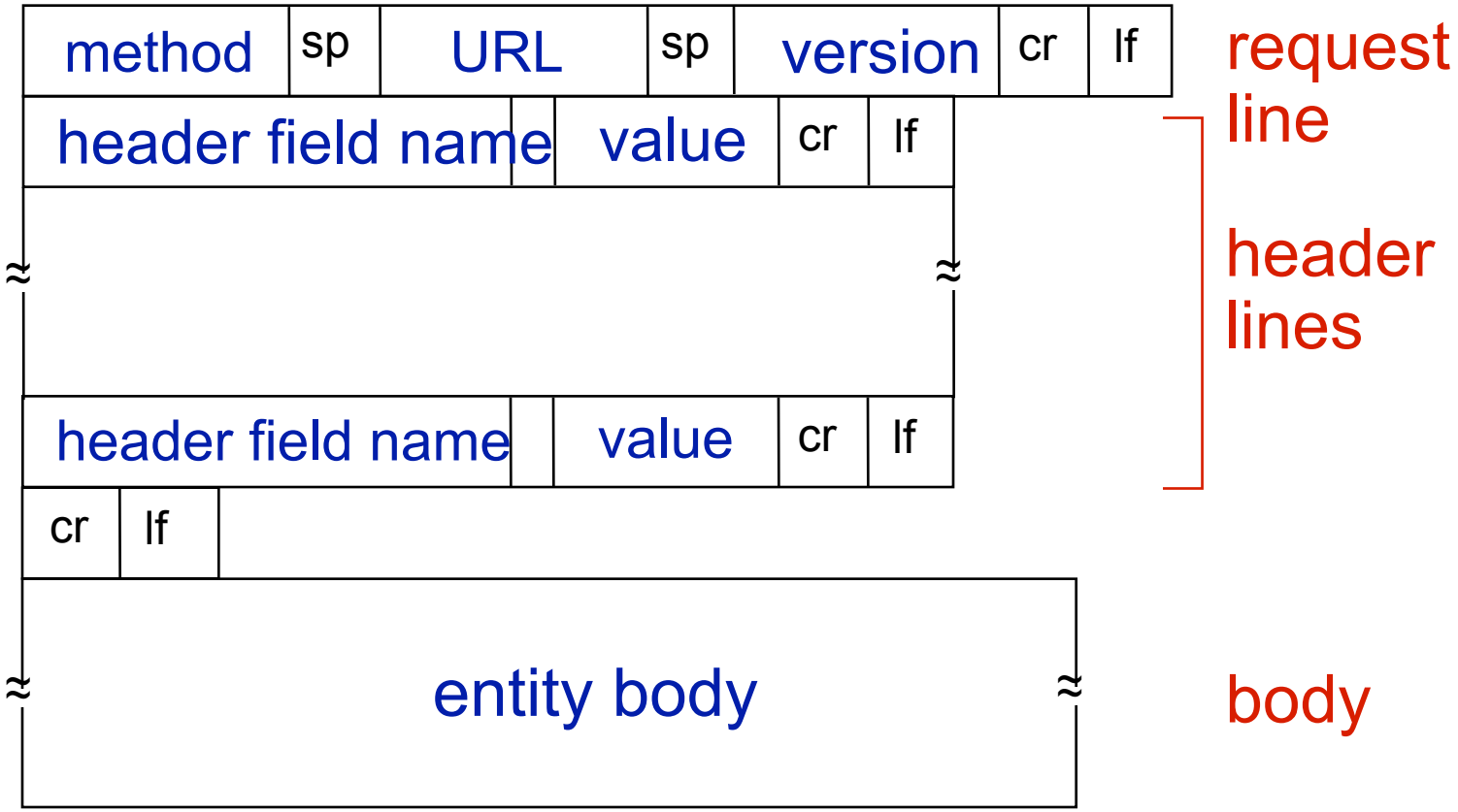
request line (GET, POST, HEAD)

header lines

\r\n at start of line indicates end of header lines

```
GET /workshops/web/welcome.html HTTP/1
Accept: text/html,image/*,*/*\r\n
Accept-Encoding: gzip, deflate\r\n
Accept-Language: en-US,en;q=0.9,hi;q=0
Connection: keep-alive\r\n
Host: rprustagi.com\r\n
Referer: http://rprustagi.com/workshop
   \r\n
Upgrade-Insecure-Requests: 1\r\n
User-Agent: Mozilla/5.0 (Macintosh; In
   OS X 10_14_6)…\r\n
\r\n
```

# HTTP Request Message: General Format



# Uploading Form Input

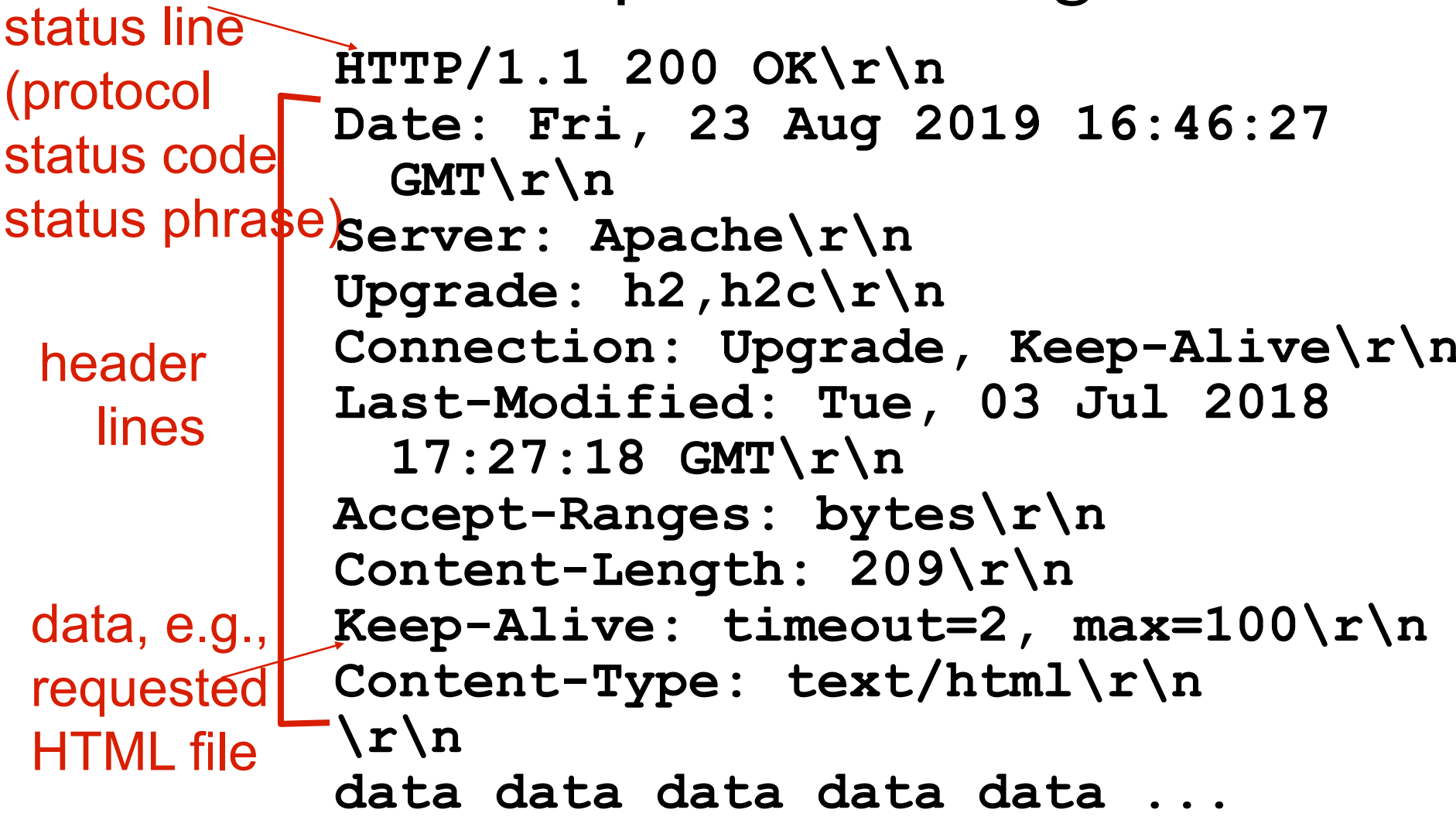
- POST method:
- web page often includes form input
- input is uploaded to server in entity body

- URL method:
- uses GET method
- input is uploaded in URL field of request line:
  - Query String

Example:

- http://rprustagi.com/workshops/web/formsget.html
- http://rprustagi.com/workshops/web/formspost.html
- Use both GET and POST methods and see the difference

# HTTP response message



# MIME Types

- Originally for email
- Specifies the form of content served
  - Form: Type/subtype
    - Examples
      - `text/plain, text/html,`
      - `image/gif, image/jpeg,`
      - `audio/mpeg, video/quicktime,`
      - `application/msword,`
        `application/powerpoint`
- Server gets type from file name suffix
  - pictures.html vs pictures.txt
- Reference: http://www.iana.org/assignments/media-types/index.html

# HTTP Status Code

- `1xx` - Informational
  - Request received, continuing process
- `2xx` - Success
  - Action successful, understood and accepted
- `3xx` - Redirection
  - Further action must be taken to complete 4xx
- `4xx` - Client Error
  - Request contains bad syntax or cannot be filled
- `5xx` - Server Error
  - Server failed to fulfil an apparently valid request

# HTTP response status codes

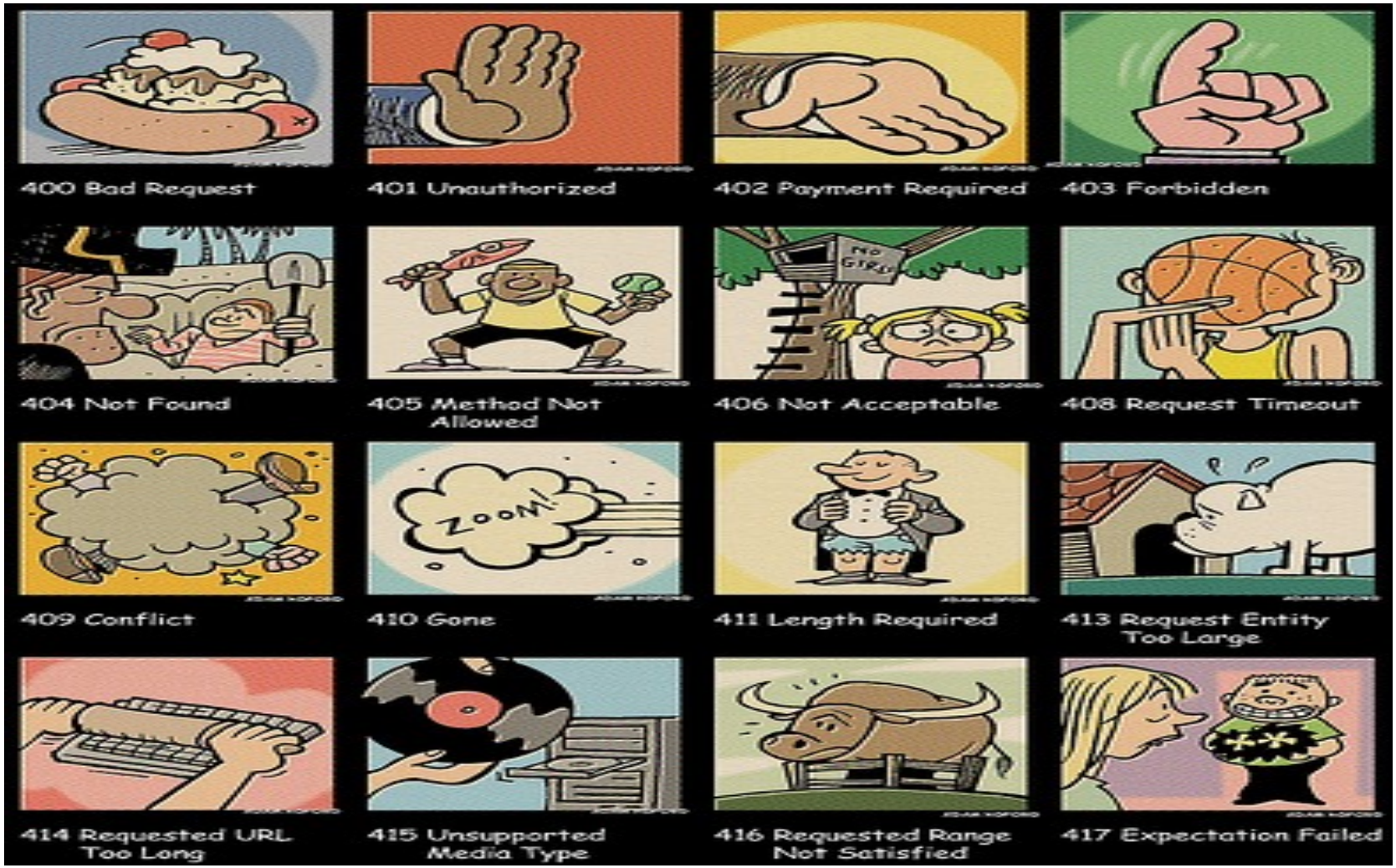
- https://www.w3.org/Protocols/rfc2616/rfc2616-sec10.html
- **200 OK**
  - Request succeeded, requested object later in this msg
- 301 Moved Permanently
  - Requested object moved, new location in this msg
- 400 Bad Request
  - Request msg not understood by server
  - Missing parameters
- 401 Unauthorized
- 403 Forbidden
- 404 Not Found
  - Requested document not found on this server

# HTTP response status codes

- Status codes 5xx
  - (mywww.com is private website, not accessible publicly)
- http://mywww.com/cgi-bin/goodcgi.sh
  - **500 Internal Server Error**
    - http://mywww.com/cgi-bin/badcgi.sh
  - **505 HTTP Version Not Supported**

# 4xx Status codes

https://www.flickr.com/photos/jessefriedman/1435220149/



# HTTP Headers

- `Content-Type: text/html`
- `Content-Length: 209`
- `Accept-Language: en-US`
  - Determines your preference
- `Accept-Encoding: gzip, deflate`
  - Determines compressed download
- `Keep-Alive: timeout=2, max=100`
- `User-Agent:`
  - Determines client type
  - Mobile, web, tablet

# Summary

- HTTP Protocol
  - URL structure
- HTTP headers
  - Request and Response
- HTTP Methods
  - GET, POST
- Status Codes