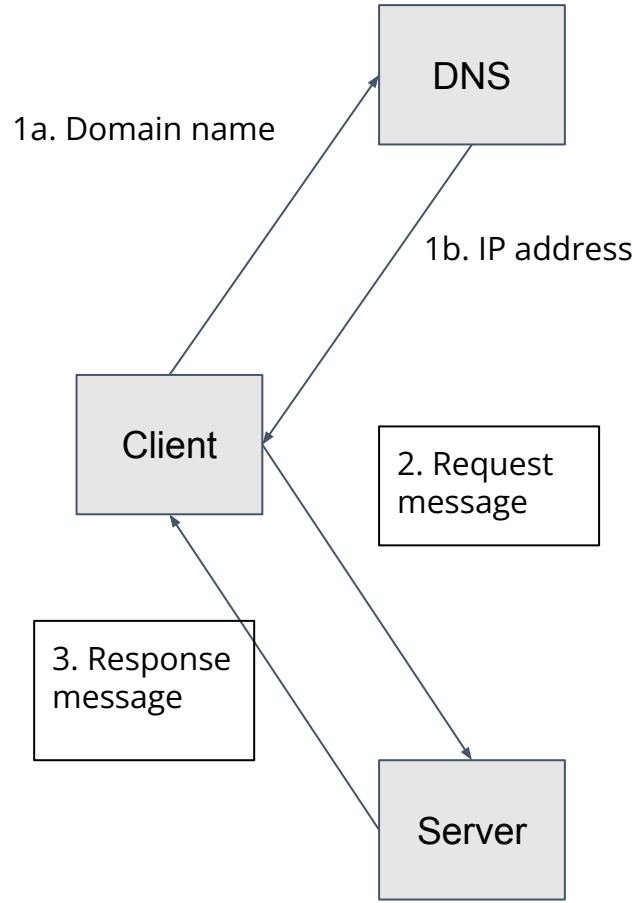
COS 316 Precept #3: What is HTTP?

HTTP Overview

- **H**yper-**T**ext **T**ransfer **P**rotocol over bidirectional byte stream (e.g., TCP)
- Interaction
  1. Client looks up IP of server (DNS)
  2. Client sends request to server
  3. Server responds with data or error
- Requests/responses are encoded in text
- Stateless
  - HTTP maintains no info about past client requests
  - HTTP *cookies* allow server to identify client and associate requests into a client session



HTTP 2 Standard

- https://httpwg.org/specs/rfc9113.html

URLs

- Uniform Resource Locator
  - uniquely identifies a resource
- Syntax
  - protocol://host:port/path
- Protocol:
  - Application-level protocol used by the client and server, e.g., HTTP, FTP, and telnet
- Host:
  - DNS domain name (e.g., www.xys.org) or IP address (e.g., 192.128.1.2) of the server
- Port:
  - Port number server is listening for incoming requests from the clients

Examples

http://www.ietf.org/rfc/rfc959.txt

http://xyz.org:8081/route/subroute

http://www.ietf.org/rfc/rfc959.txt

mailto:ak18@cs.princeton.edu

ftp://tug.ctan.org/pub

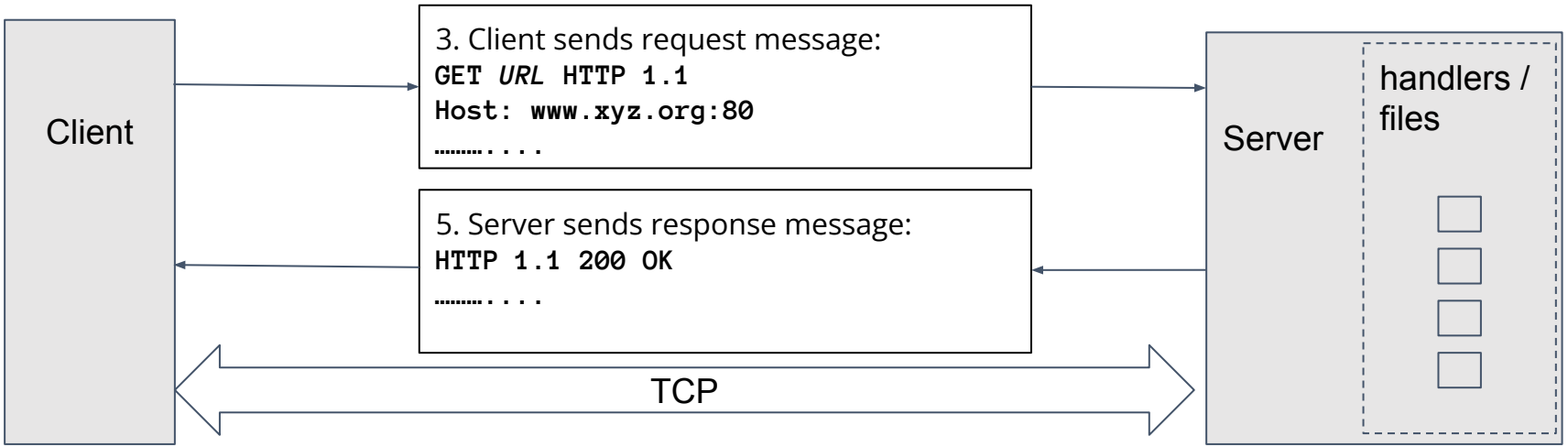
rtsp://192.168.0.164/axis-media/media.amp

HTTP Example

1. Client issues URL:
`http://www.xyz.org:80/path/file`

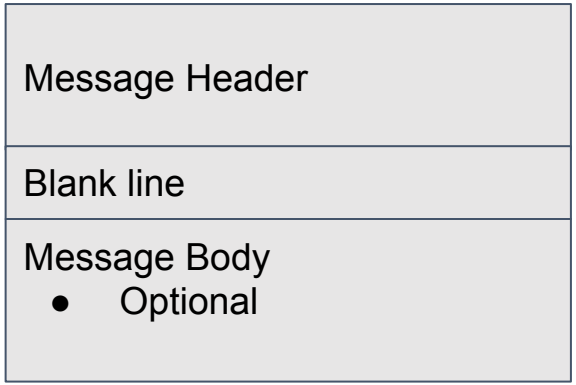
2. Domain resolved to IP address:
`http://10.11.16.10:80/path/file`

4. Server routes request to the appropriate handler/file



6. Client processes response

HTTP Request and Response Messages



HTTP Request Message

Request Message Header: ● Request Line ● Request Headers
Blank line
Request Message Body ● Optional

- Request Line
  - request-method-name request-URI HTTP-version
  - request-method-name:
    - GET, HEAD, POST, etc.
  - request-URI:
    - Name of resource (route) requested
  - HTTP-version:
    - HTTP/1.0, HTTP/1.1 or HTTP/2.0
- Request Header
  - Consists of name:value pairs
  - Multiple values, separated by commas
  - request-header-name: request-header-value1, request-header-value2, ...
- Examples
  - Host: www.xyz.com
  - Connection: Keep-Alive
  - Accept: image/gif, image/jpeg, */*
  - Accept-Language: us-en, fr, cn

HTTP Request Methods

- Common methods
  - GET
    - get web resource from server
  - HEAD
    - return only the headers of GET response
  - POST
    - send data to the server (forms, etc.)
- Case Sensitive

HTTP Request Message

Browser

https://registrar.princeton.edu/course-offerings/course-details?term=1202&courseid=015166

HTTP Request Message

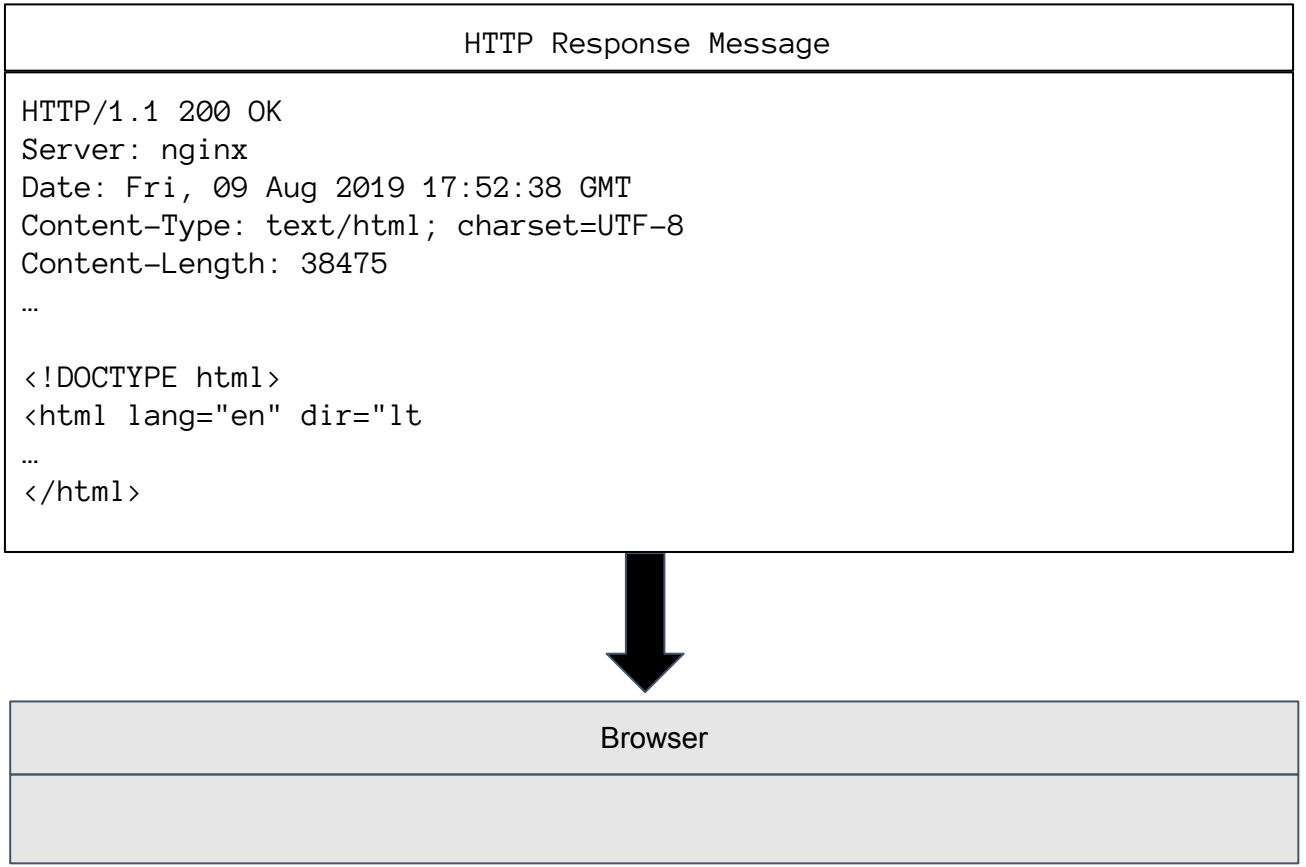
```
GET /course-offerings/course-details?term=1202&courseid=015166 HTTP/1.1
Host: registrar.princeton.edu
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.14; rv:69.0) Gecko/20100101 Firefox/69.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-encoding: gzip, deflate, br
```

HTTP Response Message

Response Message Header: ● Status Line ● Response Headers
Blank line
Request Message Body ● Optional

- Status Line
  - HTTP-version status-code reason-phrase
    - HTTP-version: HTTP version used in this session e.g., HTTP/1.0,HTTP/1.1,HTTP2.0
    - status-code: 3-digit response code
    - reason-phrase: short explanation for status code
    - Common status-code and reason-phrases are
      - "200 OK"
      - "404 Not Found"
    - Examples
      - HTTP/1.1 200 OK
      - HTTP/1.0 404 Not Found
- Response Headers
  - Multiple values, separated by commas
    - response-header-name: response-header-value1, response-header-value2, ...
  - Examples
    - Content-Type: text/html
    - Content-Length: 35
    - Keep-Alive: timeout=15, max=10
- Response Message Body
  - Data requested, e.g., HTML+CSS+JavaScript

HTTP Response Message



HTTP/2

- Features
  - is binary, instead of textual
  - is fully multiplexed, instead of ordered and blocking
  - can therefore use one connection for parallelism
  - uses header compression to reduce overhead
  - allows servers to “push” responses proactively into client caches
- IETF Standard
  - https://httpwg.org/specs/rfc7540.html
- More on HTTP later in semester

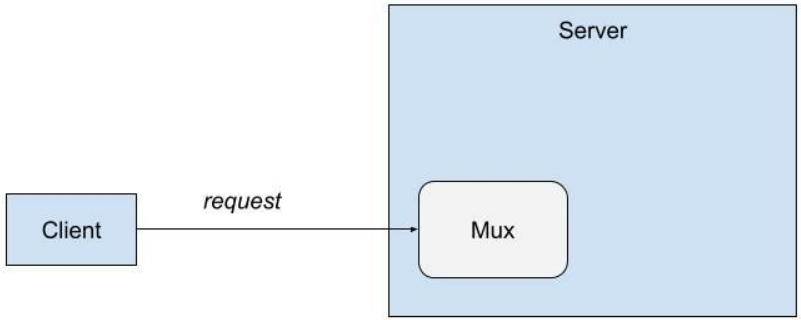
Exercises

- Browser inspection
- CURL

Building Simple HTTP Servers in Go

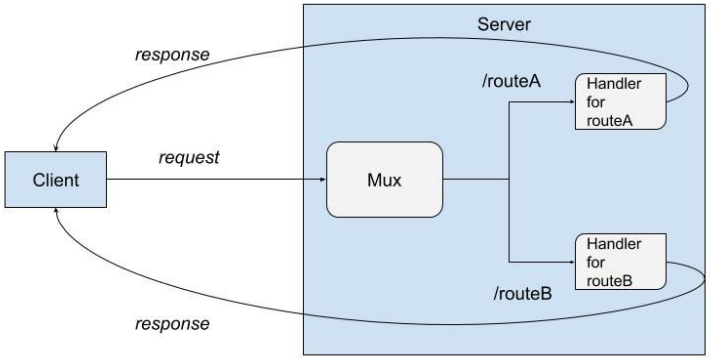
1. Write a simple web server which only listens
2. Extend the web server to serve content
3. What's in an `http.Request`?
4. How do we build a custom Mux?

1. Write a simple web server which only listens



func ListenAndServe(addr string, handler Handler) error

2. Extend the web server to serve content



func HandleFunc(pattern string, handler func(ResponseWriter, *Request))

3. What's in an `http.Request`?

https://pkg.go.dev/net/http#Request

4. How do we build a custom Mux?

Server Code - Relies on router to configure the http routes

```
package main
import (
    "fmt"
    "log"
    "net/http"
    "os"
)
func main() {
    // get port number from command line
    if len(os.Args) != 2 {
       log.Fatal("Usage: ./simple [server port]")
    }
    server_port := os.Args[1]
    fmt.Println("Setting up server to listen on", server_port)
    configure_routes()
    err := http.ListenAndServe("localhost:"+server_port, nil)
    if err != nil {
       log.Fatal("Failed to setup http server")
    }
}
```

```
package main

import (
    "fmt"
    "net/http"
)

func simpleHandleFunc(w http.ResponseWriter, req *http.Request) {
    fmt.Println("Triggered simpleHandleFunc")

    fmt.Printf("Request url: %v\n", req.URL)
}

func configure_routes() {
    // for each route pattern, register the handler
    http.HandleFunc("/routeA", simpleHandleFunc)
}
```

Router code - sets up the http routes for the server