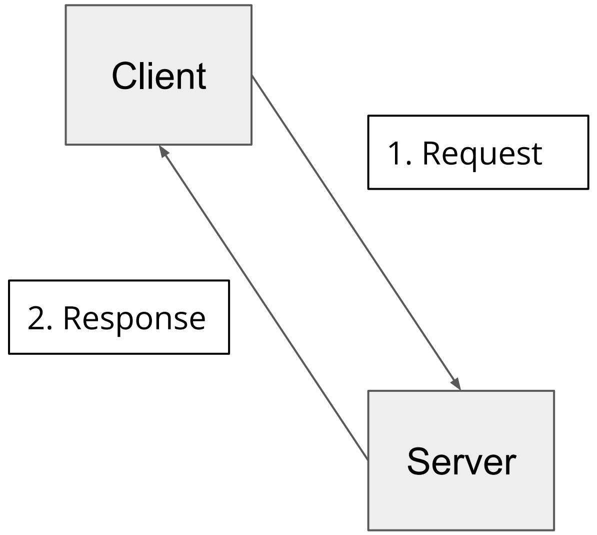
COS 316 Precept #3: What is HTTP?

Overview of HTTP

- **H**yper**T**ext **T**ransfer **P**rotocol
  - Used to distribute *hypertext* over the Internet (i.e., *HT*ML web pages)
  - Relies on a bidirectional stream protocol underneath → ***TCP!***
- Unit of operation: **request+response pairs**
  - Establish a connection from client to server
  - Client: send *HTTP request* to server
  - Server: send HTTP *response* to client
- Stateless protocol
  - No mandatory state maintained beyond a request+response operation
  - Server & client can cooperate to maintain application state, e.g., through *cookies*
- Standardized through a series of *RFC*s → overview of applicable standards



URLs

- Uniform Resource Locator
    - uniquely identifies a given resource on the web
- Syntax:

```
scheme://authority/path?param=val#anchor
```

Scheme:

Specifies *protocol* a client must use to interact with the resource.

E.g., *http* or *ftp*

Path:

Indicates *location* of a resource within the scope of the service.

E.g., */precepts* or */courses/archive/fall19/cos316*

Anchor:

Encode additional information for the client (not sent to server).

E.g., *#section-assignments*

Authority:

Indicates *location* of a given resources in terms of a service, e.g., offered by a server accepting TCP connections. Hostname and port (sometimes omitted).

E.g., *princeton.edu:80* or *google.com*

Parameters:

Encode additional information sent to the server. Behavior depends on the server.

E.g., *?mobile=true&lang=es*

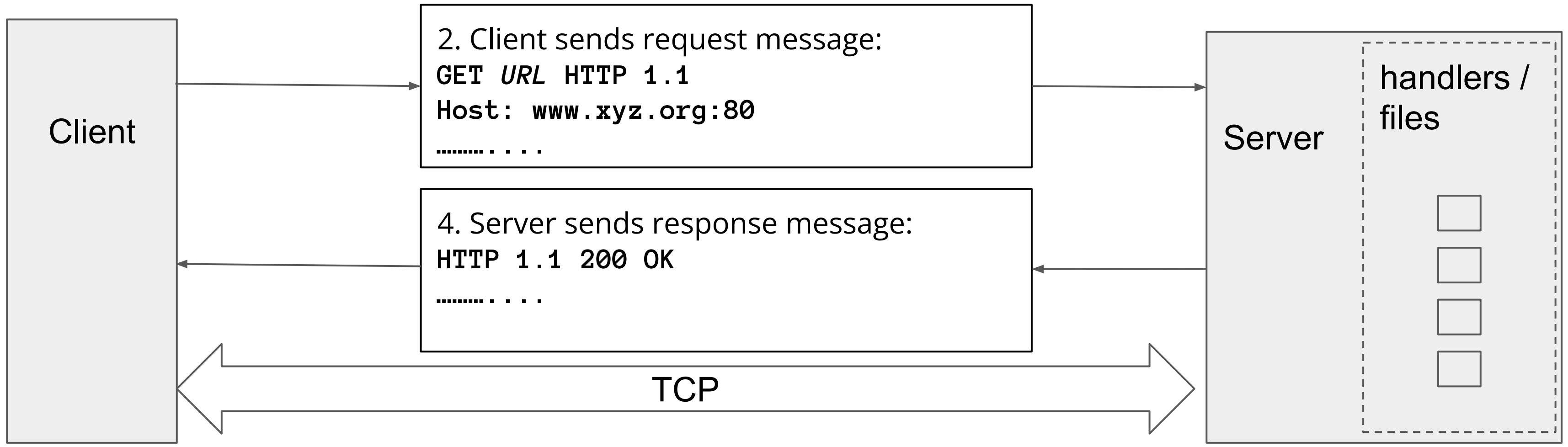
Examples:

```
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 requests URL:
`http://www.xyz.org:80/path/file`

3. Server routes request to the appropriate handler/file



2. Client sends request message:

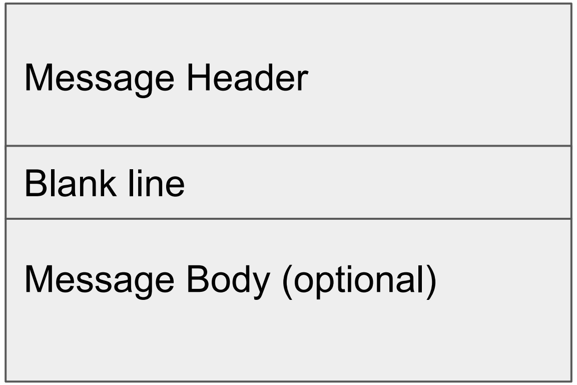
```
GET URL HTTP 1.1
Host: www.xyz.org:80
………....
```

4. Server sends response message:

```
HTTP 1.1 200 OK
………....
```

5. Client processes response

HTTP Request and Response Messages



HTTP Request Message

Request Message Header: ● Request Line ● Request Headers
Blank line
Request Message Body (optional)

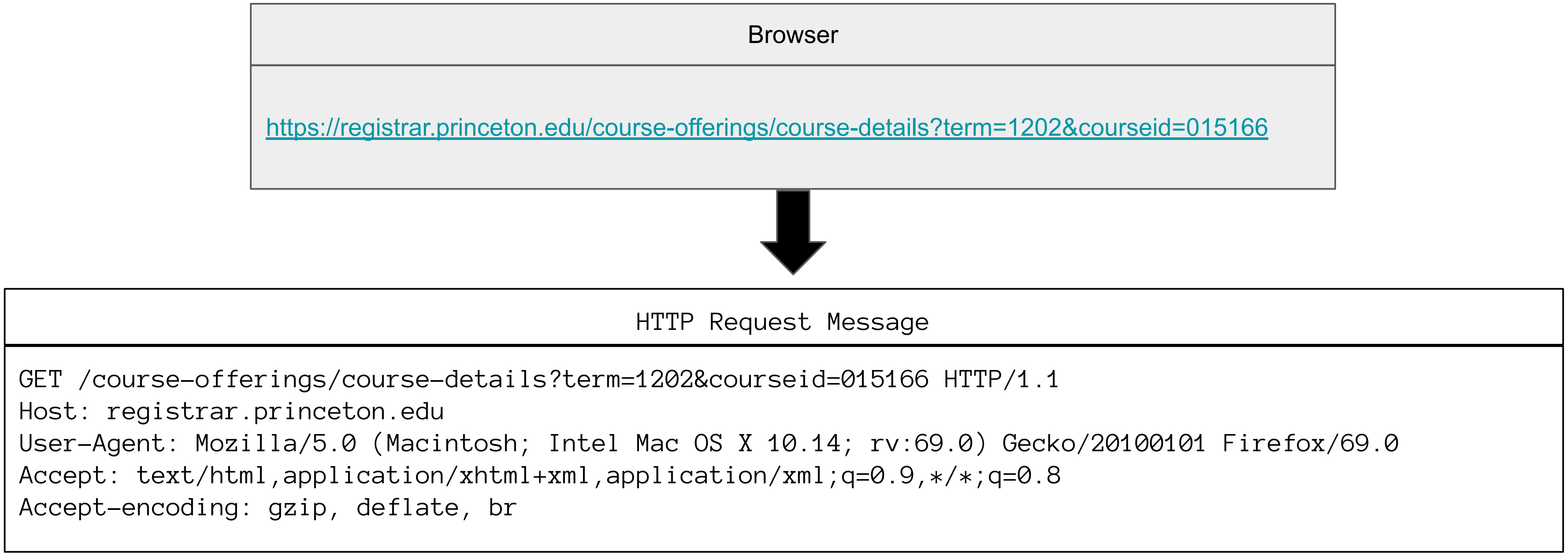
- Request Line
  - **[request-method-name] [request-URI] [HTTP-version]**
  - request-method-name: *HTTP verb*
    - GET, HEAD, POST, etc.
  - request-URI:
    - Name of resource (route) requested
  - HTTP-version:
    - HTTP/1.0, HTTP/1.1 or HTTP/2.0
- Request Header
  - Consists of name:value pairs
  - 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 (*verbs*)

- Common methods
  - GET
    - retrieve a resource from the server
  - HEAD
    - return only the headers of GET response
  - POST
    - create a resource on the server (client sends resource in the request body)
- Case Sensitive

HTTP Request Message


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

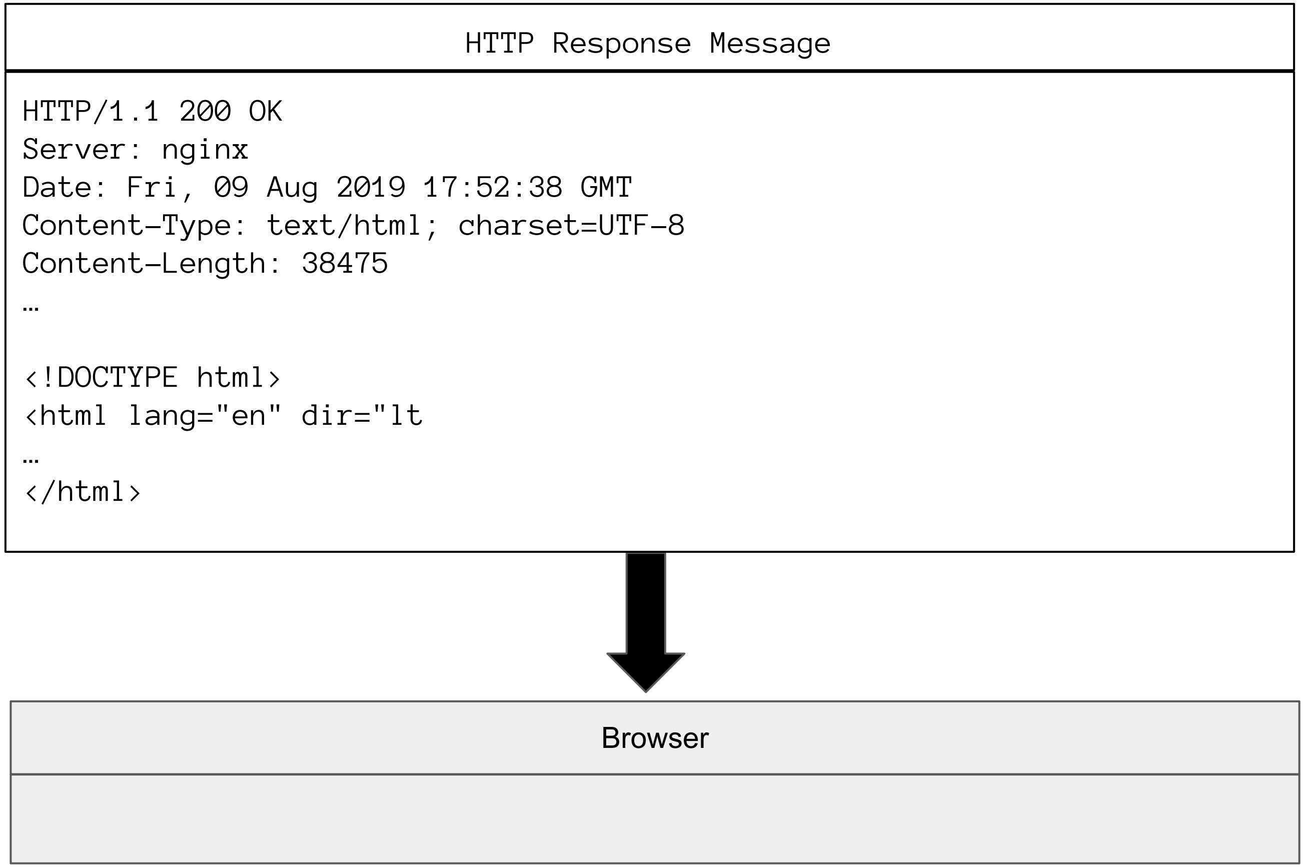
```
GET /course-offerings/course-details?term=1202&courseid=015166 HTTP/1.1
Host: registrar.princeton.edu
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.14; rv:69.0) Gecko/20100101 Firefox/69.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-encoding: gzip, deflate, 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/1.1 200 OK
Server: nginx
Date: Fri, 09 Aug 2019 17:52:38 GMT
Content-Type: text/html; charset=UTF-8
Content-Length: 38475
…

<!DOCTYPE html>
<html lang="en" dir="lt
…
</html>
```

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

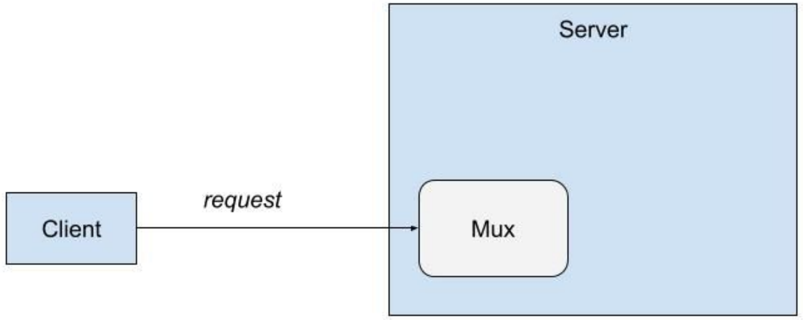
- Browser inspection

- CURL (-v)

Building Simple HTTP Servers in Go

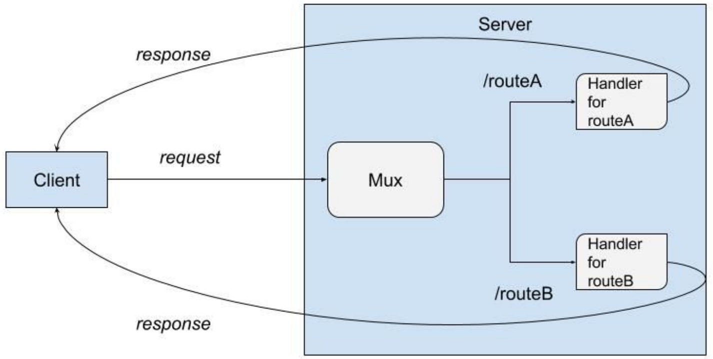
1. Write a simple web server which only listens
2. Extend the web server to serve content
3. What's in an `http.Request`?
4. How do we build a custom Mux?

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?