LECTURE 34

REQUESTING URLS IN PYTHON

MCS 260 Fall 2021

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REMINDERS

- Homework 12 will be posted tomorrow
- Read Project 4 description
- Project 4 proposals due by Nov 17
  - But please give yourself more work time by doing it sooner if possible
- Project 4 is due on Fri Dec 3 at 6:00pm Central
- No office hours or synchronous lecture Friday
  - I'll post a lecture video and slide set

INTERNET LAYER CAKE

Application	Retrieve http://example.com/
Transport	Transmit GET / to 93.184.216.34
Network	Deliver this packet to 93.184.216.34
Link	Send this ethernet frame to the router
Physical	Change voltages on these wires...

TODAY

We'll discuss making **Application-level network requests in Python**.

We focus specifically on retrieving data (documents, etc.) from a Uniform Resource Locator or URL.

The `urllib` module in Python supports this. It is primarily focused on HTTP, HTTPS, and local files.

HTTP REQUEST TYPES

HTTP allows many types of requests. For example:

- **GET** — Ask for the resource. Most common.
- **POST** — Submit data to the resource.
- **PUT** — Submit data that should replace the resource.

Today we'll only use GET.

HTTP RESPONSE

Response consists of a numeric **status code**, some **headers** (`key: value` pairs, one per line), then a **payload**.

E.g. GET a web page, the HTML will be in the payload.

There are lots of codes; first digit gives category:

- 2xx — success
- 3xx — what you want is somewhere else
- 4xx — error (server thinks it's your fault)
- 5xx — error (server's fault)

PARTS OF A HTTP RESPONSE

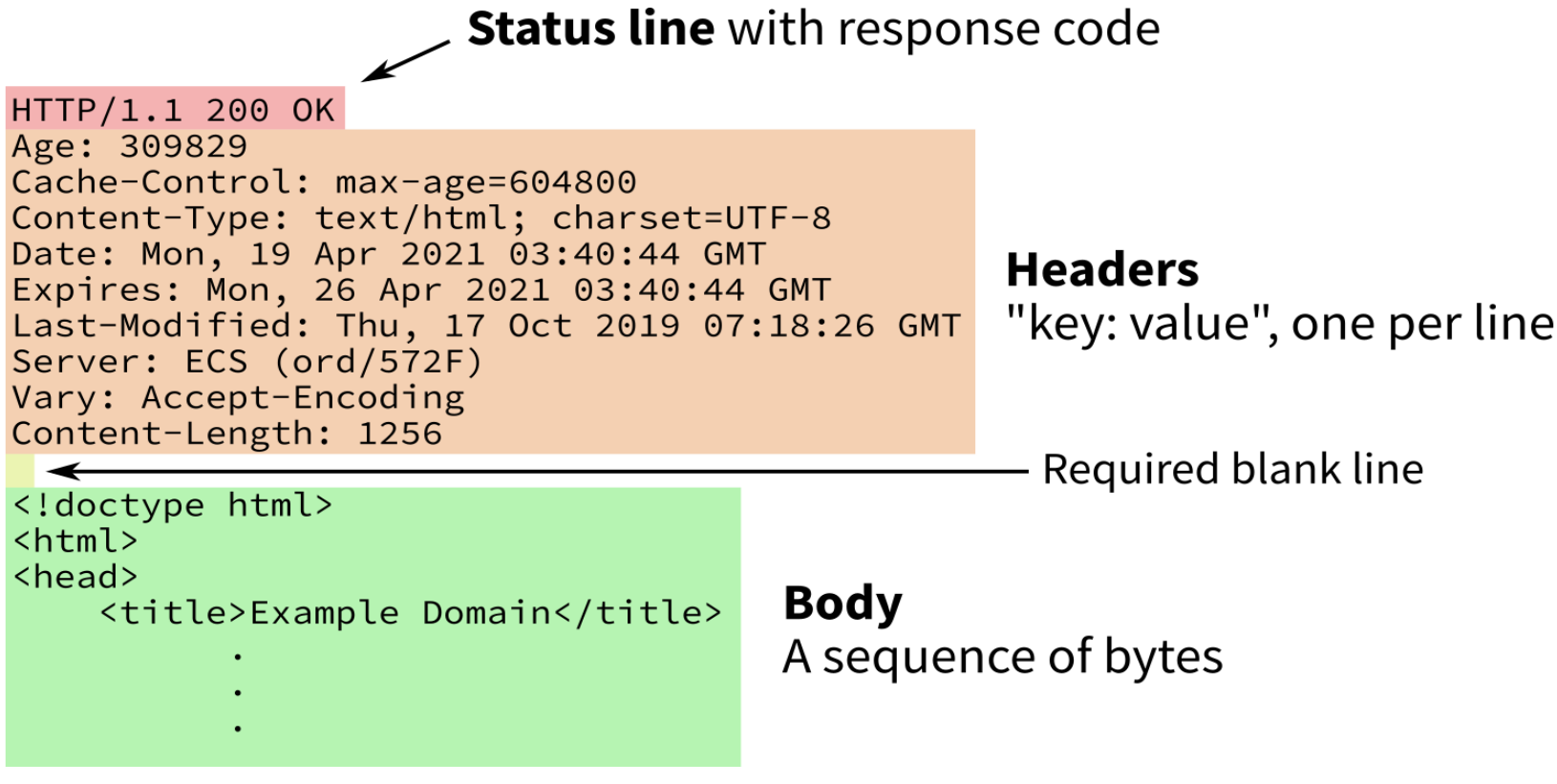
Response to GET `http://example.com/`

```
HTTP/1.1 200 OK
Age: 309829
Cache-Control: max-age=604800
Content-Type: text/html; charset=UTF-8
Date: Mon, 19 Apr 2021 03:40:44 GMT
Expires: Mon, 26 Apr 2021 03:40:44 GMT
Last-Modified: Thu, 17 Oct 2019 07:18:26 GMT
Server: ECS (ord/572F)
Vary: Accept-Encoding
Content-Length: 1256

<!doctype html>
<html>
<head>
    <title>Example Domain</title>
          .
          .
          .
```

PARTS OF A HTTP RESPONSE

Response to GET `http://example.com/`



BASIC URLLIB USAGE

Import `urllib.request` to get the most convenient functions for loading URLs.

Call `urllib.request.urlopen(url)` to open the URL `url` using GET. It returns a response object.

Response objects behave like read-only files, and should be closed with `.close()`.

If a 4xx or 5xx response is received, or if contacting the host fails, a `urllib.error.URLError` exception is raised.

RESPONSE OBJECTS

A HTTP response object `res` has:

- `res.status` — the status code
- `res.geturl()` — returns the final URL (maybe not the one requested, if redirection used)
- `res.read()` — returns the payload as a `bytes` object
- `res.headers` — dict-like object storing the HTTP headers (not HTML header!)
- `res.headers.get_content_charset()` — Return payload encoding, if known

BYTES AND STRINGS

Often the payload is meant to be a string, but you will always receive it as bytes.

To recover that string from the `bytes` object returned by `res.read()`, you need to call the `.decode(...)` method, e.g.

```
enc = res.headers.get_content_charset()  # probably "UTF-8"
response_string = res.read().decode(enc) # bytes -> str
```

APIS

An **application programming interface** or **API** is a structured way for computer programs to talk to each other.

APIs often use the network, and often use HTTP.

Some are available freely to anyone.

USING AN API

`urllib.request.urlopen` is a great way to fetch data from HTTP APIs.

Example for today: A free dice rolling JSON API* by Steve Brazier at `roll.diceapi.com`.

Examples:

- `http://roll.diceapi.com/json/d6` — roll one six-sided die
- `http://roll.diceapi.com/json/3d6` — roll three six-sided dice
- `http://roll.diceapi.com/json/4d12` — roll four twelve-sided dice

* This API could disappear at any moment. It worked on November 9, 2021.

URL PARAMETERS

HTTP GET requests can send an associative array of parameters. For example, to send the dictionary `{"name":"David","apple":"McIntosh"}` to `http://example.com/` the URL would be

```
http://example.com/?name=David&apple=McIntosh
```

The parameter list begins with `?` and has `&` between name=value pairs. It gets tricky when values or names have spaces, but `urllib.parse.urlencode` can convert a dictionary to a suitable string.

CAT FACTS

The domain `cat-fact.herokuapp.com` hosts an API* created by CS undergrad student Alex Wohlbruck for retrieving facts about cats (and other animals). E.g.

- `https://cat-fact.herokuapp.com/facts/random?amount=2` — two random facts about cats
- `https://cat-fact.herokuapp.com/facts/random?animal_type=dog&amount=1` — one random fact about dogs

* This API could disappear at any moment. It worked on November 10, 2020.

REFERENCES

- The urllib documentation is quite nice, especially the examples in each section, e.g.
  - Examples of using urllib.request
- A big list of free/open APIs, mostly JSON-based

REVISION HISTORY

- 2021-11-10 Initial publication