INT 303 BIG DATA ANALYTICS

Lecture4: Get the Data

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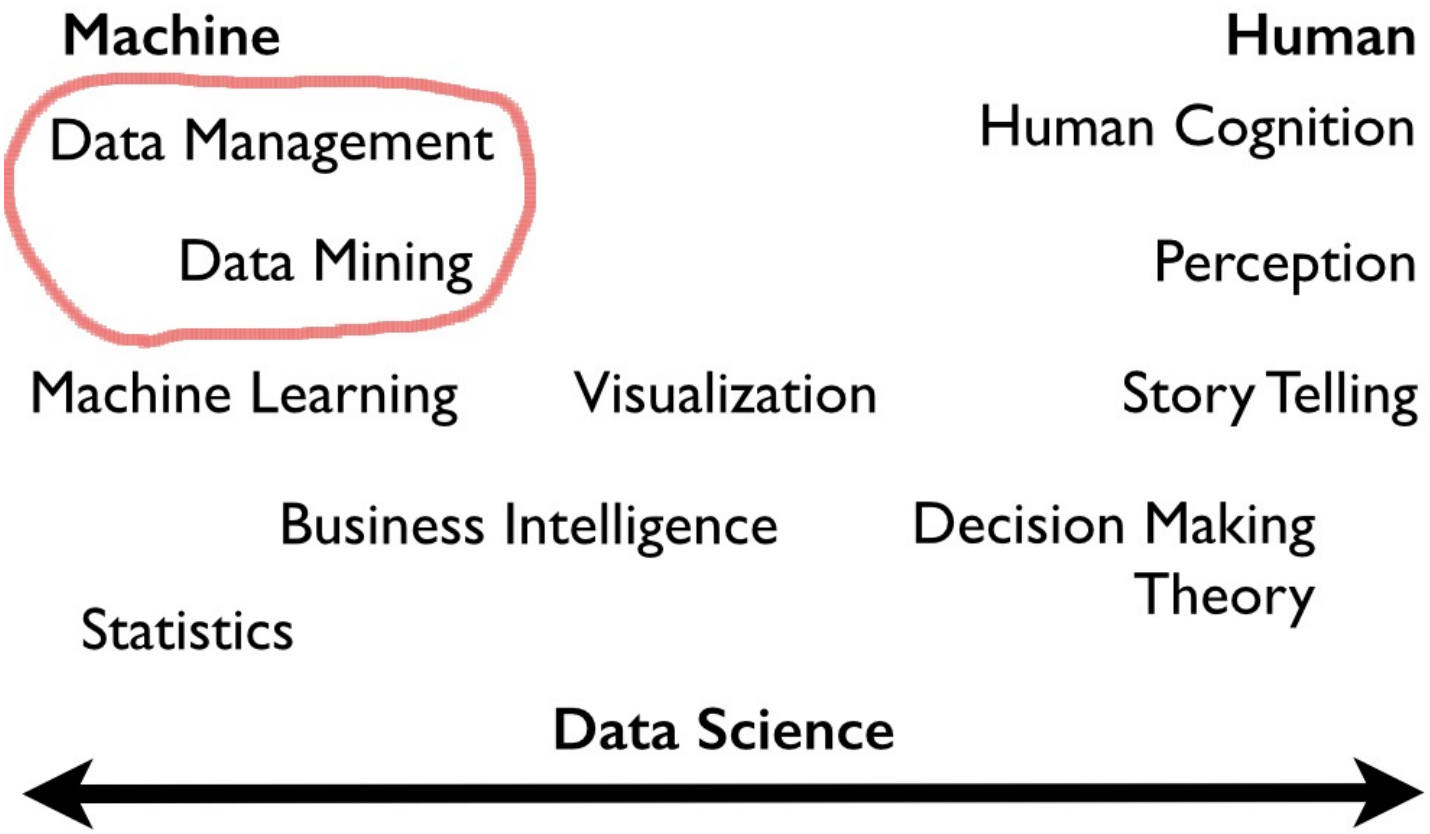
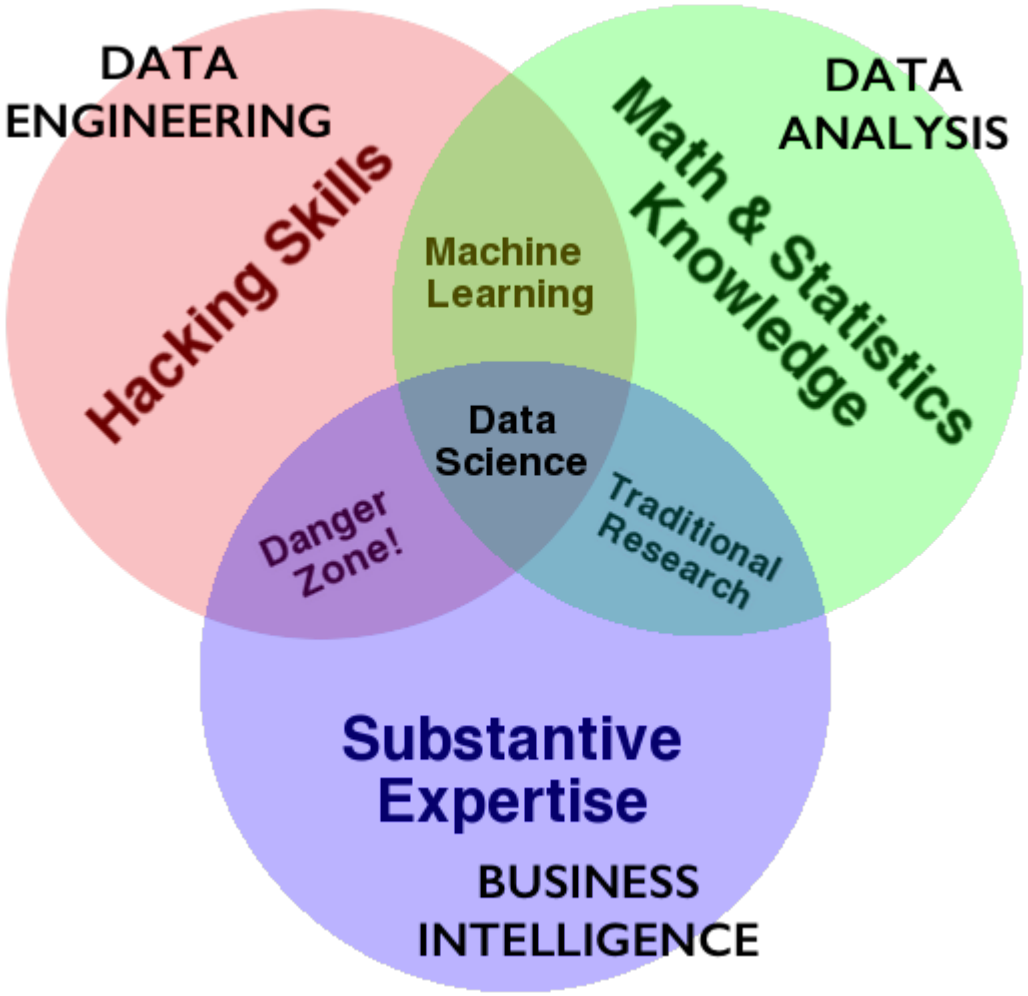
OUTLINE

- What is Web Service?
- Data Scraping
- Gathering data from APIs



Inspired by Daniel Keim, "Visual Analytics: Definition, Process, and Challenges"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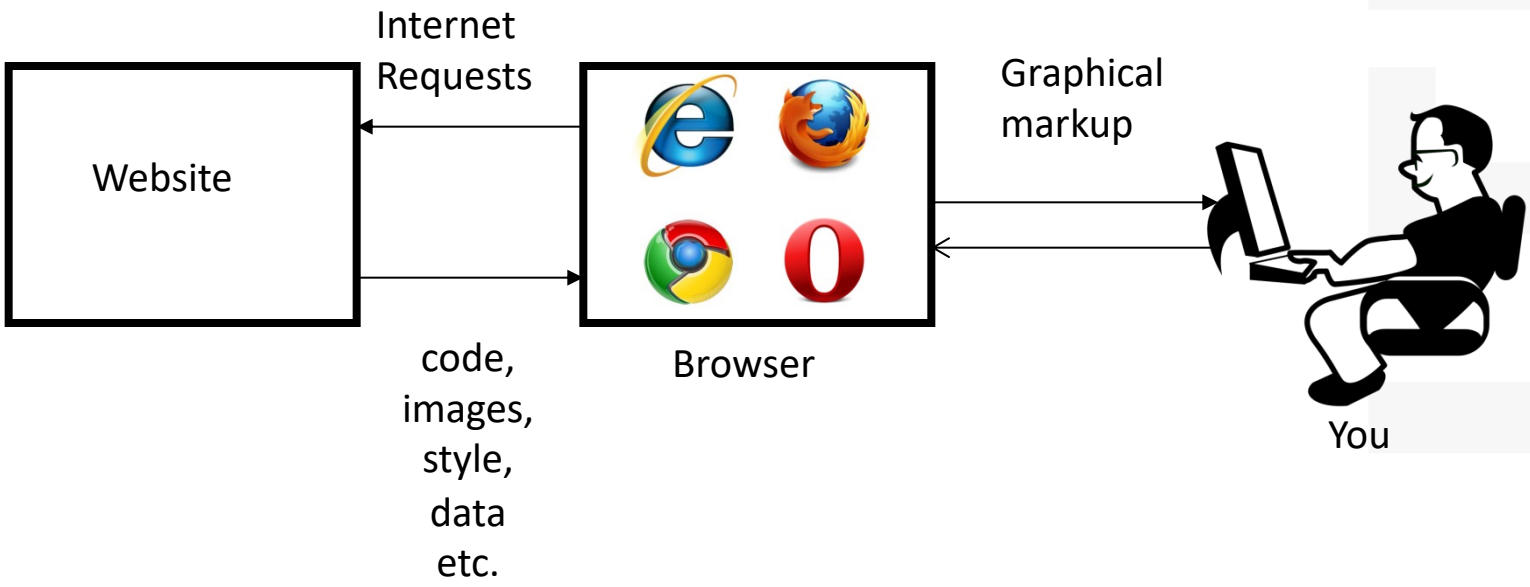
Web Servers

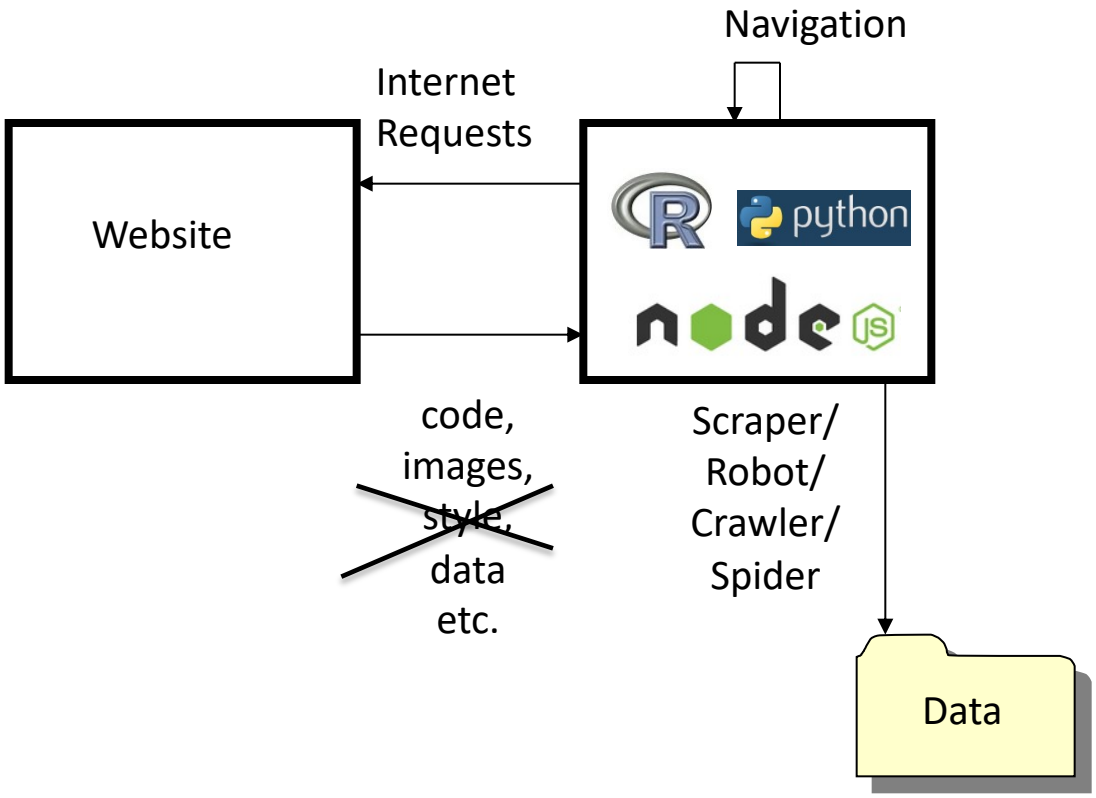
WEB SERVERS

- A server is a long running process (also called daemon) which listens on a pre-specified port
- and responds to a request, which is sent using a protocol called HTTP
- A browser parses the url.

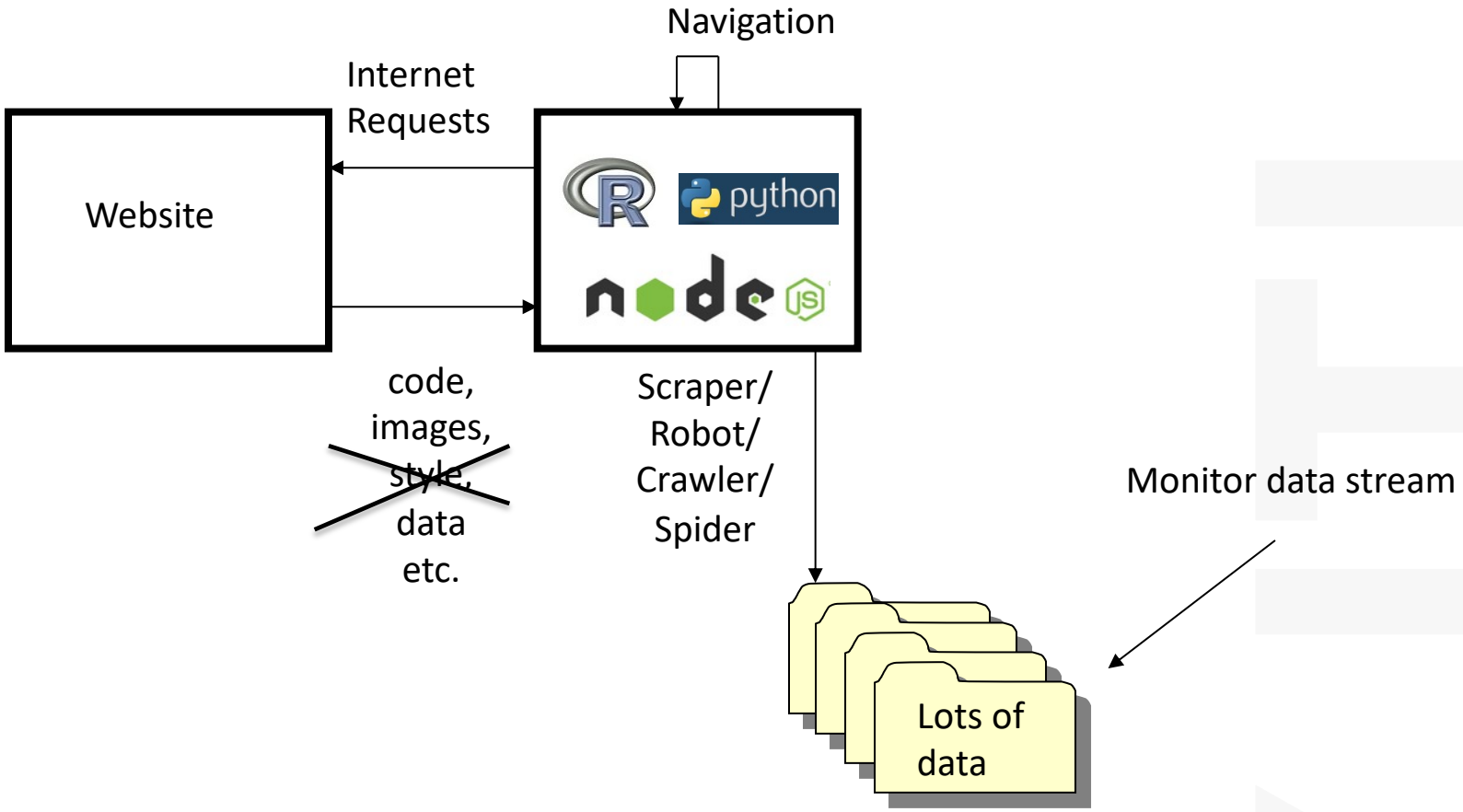
HOW IT WORKS (1)



HOW IT WORKS (1)



HOW IT WORKS (3)



WEB SERVERS

- **Example:**
- Our notebooks also talk to a local web server on our machines: `http://localhost:8888/Documents/cs109/BLA.ipynb#something`
- protocol is http, hostname is localhost, port is 8888
- url is /Documents/cs109/BLA.ipynb
- url fragment is #something
- Request is sent to localhost on port 8888. It says:
- `Request: GET /request-URI HTTP/version`

Example with Response: Google

```
GET / HTTP/1.0
Host: www.google.com

HTTP/1.0 200 OK
Date: Mon, 14 Nov 2016 04:49:02 GMT
Expires: -1
Cache-Control: private, max-age=0
Content-Type: text/html; charset=ISO-8859-1
P3P: CP="This is ..."
Server: gws
X-XSS-Protection: 1; mode=block
X-Frame-Options: SAMEORIGIN
Set-Cookie: NID=90=gb5q7b0...; expires=Tue, 16-May-2017 04:49:02 GMT;
path=/; domain=.google.com; HttpOnly
Accept-Ranges: none
Vary: Accept-Encoding

<!doctype html><html itemscope=""
itemtype="http://schema.org/WebPage" lang="en">
<head><meta content="Search the world's information,
```

HTTP STATUS CODES[1]

200 OK:

Means that the server did whatever the client wanted it to, and all is well.

400: Bad request

The request sent by the client didn't have the correct syntax.

401: Unauthorized

Means that the client is not allowed to access the resource. This may change if the client retries with an authorization header.

403: Forbidden

The client is not allowed to access the resource and authorizaton will not help.

404: Not found

Seen this one before? :) It means that the server has not heard of the resource and has no further clues as to what the client should do about it. In other words: dead link.

500: Internal server error

Something went wrong inside the server.

501: Not implemented

The request method is not supported by the server.

[1]from http://www.garshol.priv.no/download/text/http-tut.htm)

WEB SERVERS

- **Requests:**
- great module built into python for http requests
- `req=requests.get("https://en.wikipedia.org/wiki/Harvard_University")`

- <Response [200]>
- page = req.text
- `'<!DOCTYPE html>\n<html class="client-nojs" lang="en" dir="ltr">\n<head>\n<meta charset="UTF-8"/>\n<title>Harvard University - Wikipedia</title>\n<script>document.documentElement.className=document.documentElement.className.replace( /(^|\\s)client-nojs(\\s|$)/,"$1client-js$2"`
- `);</script>\n<script>(window.RLQ=window.RLQ||[]).push(function(){mw.config.set({`
- `"wgCanonicalNamespace":"","wgCanonicalSpecialPageName":false,"wgNamespaceNumber"`
- `:0,"wgPageName":"Harvard_University","wgTitle":"Harva...'`

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Harvard University

From Wikipedia, the free encyclopedia

Coordinates: 42°22′28″N 71°07′01″W

"Harvard" redirects here. For other uses, see Harvard (disambiguation).

Harvard University is a private Ivy League research university in Cambridge, Massachusetts, established in 1636, whose history, influence, and wealth have made it one of the world's most prestigious universities.[7]

Established originally by the Massachusetts legislature and soon thereafter named for John Harvard (its first benefactor), Harvard is the United States' oldest institution of higher learning,[8] and the Harvard Corporation (formally, the *President and Fellows of Harvard College*) is its first chartered corporation. Although

Harvard University

Latin: *Universitas Harvardiana*

Former names	Harvard College
Motto	*Veritas*[1]
Motto in English	Truth
Type	Private research
Established	1636[2]
Endowment	$34.541 billion (2016)[3]

Python data scraping

PYTHON DATA SCRAPING

- Why scrape the web?
  - companies have not provided APIs
  - automate tasks
  - keep up with sites
  - fun!

CHALLENGES IN WEB SCRAPING

- Which data?
  - It is not always easy to know which site to scrape
  - Which data is relevant, up to date, reliable?
- The internet is dynamic
  - Each web site has a particular structure, which may be changed anytime
- Data is volatile
  - Be aware of changing data patterns over time

LEGAL

- Privacy:
  - Legislation on protection of personal information
  - At this moment we only scrape public sources
- Netiquette (practical):
  - respect the Robots Exclusion Protocol also known as the robots.txt (example)
  - identify yourself (user-agent)
  - do not overload servers, use some idle time between requests, run crawlers at night / morning
  - Inform website owners if feasible

NOTICE

- **copyrights and permission:**
  - be careful and polite
  - give credit
  - care about media law
  - don't be evil (no spam, overloading sites, etc.)

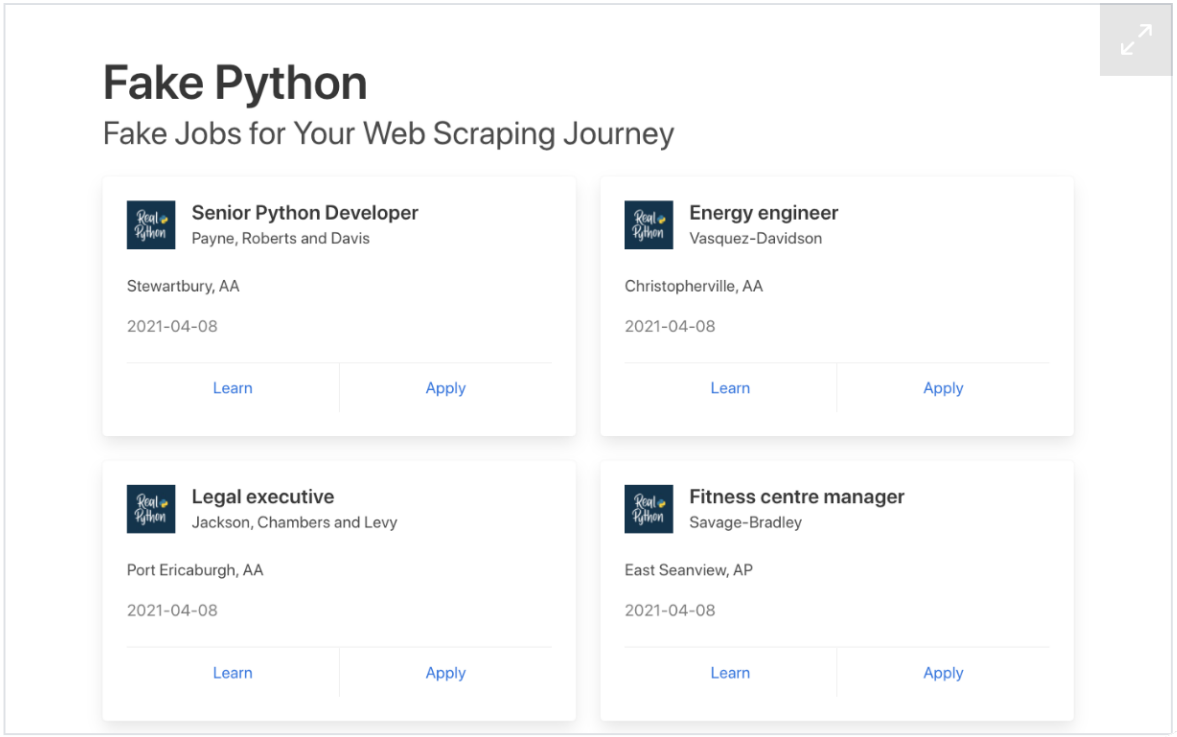
ROBOTS.TXT

- specified by web site owner
- gives instructions to web robots (aka your script)
- is located at the top-level directory of the web server
- e.g.: http://google.com/robots.txt

STEP 1: INSPECT YOUR DATA SOURCE

- Explore the Website

Click through the site and interact with it just like any typical job searcher would. For example, you can scroll through the main page of the website:



https://realpython.github.io/fake-jobs/

DEVELOPER TOOLS

- ctrl/cmd shift- i in chrome
- cmd-option-i in safari
- look for "inspect element"
- locate details of tags

- **Mac:** ⌘ Cmd + Alt + I
- **Windows/Linux:** ^ Ctrl + ⇧ Shift + I

STEP 2: SCRAPE HTML CONTENT FROM A PAGE

Python

```python
import requests

URL = "https://realpython.github.io/fake-jobs/"
page = requests.get(URL)

print(page.text)
```

This code issues an HTTP GET request to the given URL. It retrieves the HTML data that the server sends back and stores that data in a Python object.

You successfully fetched the static site content from the Internet!

STEP 3: PARSE HTML CODE WITH BEAUTIFUL SOUP

Python

```python
import requests
from bs4 import BeautifulSoup

URL = "https://realpython.github.io/fake-jobs/"
page = requests.get(URL)

soup = BeautifulSoup(page.content, "html.parser")
```

FIND ELEMENTS BY ID

The element you're looking for is a `<div>` with an `id` attribute that has the value `"ResultsContainer"`. It has some other attributes as well, but below is the gist of what you're looking for:

HTML

```
<div id="ResultsContainer">
  <!-- all the job listings -->
</div>
```

Beautiful Soup allows you to find that specific HTML element by its ID:

Python

```
results = soup.find(id="ResultsContainer")
```

FINDALL VS. FIND

- will normalize dirty html
- basic usage

```
import bs4
## get bs4 object
soup = bs4.BeautifulSoup(source)
## all a tags
soup.findAll('a')
## first a
soup.find('a')
## get all links in the page
link_list = [l.get('href') for l in soup.findAll('a')]
```

http://books.toscrape.com/index.html

FIND ELEMENTS BY HTML CLASS NAME

- You've seen that every job posting is wrapped in a element with the class card-content.

Python

```
job_elements = results.find_all("div", class_="card-content")
```

Here, you call `.find_all()` on a Beautiful Soup object, which returns an iterable containing all the HTML for all the job listings displayed on that page.

Take a look at all of them:

Python

```
for job_element in job_elements:
    print(job_element, end="\n"*2)
```

FIND ELEMENTS BY HTML CLASS NAME

Python

```python
for job_element in job_elements:
    title_element = job_element.find("h2", class_="title")
    company_element = job_element.find("h3", class_="company")
    location_element = job_element.find("p", class_="location")
    print(title_element)
    print(company_element)
    print(location_element)
    print()
```

HTML

```html
<h2 class="title is-5">Senior Python Developer</h2>
<h3 class="subtitle is-6 company">Payne, Roberts and Davis</h3>
<p class="location">Stewartbury, AA</p>
```

EXTRACT TEXT FROM HTML ELEMENTS

Python

```python
for job_element in job_elements:
    title_element = job_element.find("h2", class_="title")
    company_element = job_element.find("h3", class_="company")
    location_element = job_element.find("p", class_="location")
    print(title_element.text.strip())
    print(company_element.text.strip())
    print(location_element.text.strip())
    print()
```

- You can add .text to a Beautiful Soup object to return only the **text content** of the HTML elements that the object contains.
- you can .strip() the superfluous whitespace.

FIND ELEMENTS BY CLASS NAME AND TEXT CONTENT

HTML

```
<h2 class="title is-5">Senior Python Developer</h2>
<h3 class="subtitle is-6 company">Payne, Roberts and Davis</h3>
<p class="location">Stewartbury, AA</p>
```

You know that job titles in the page are kept within <h2> elements. To filter for only specific jobs, you can use the `string` argument:

Python

```
python_jobs = results.find_all("h2", string="Python")
```

PASS A FUNCTION TO A BEAUTIFUL SOUP METHOD

Python

```
python_jobs = results.find_all(
    "h2", string=lambda text: "python" in text.lower()
)
```

Now you're passing an **anonymous function** to the `string=` argument. The lambda function looks at the text of each <h2> element, converts it to lowercase, and checks whether the substring `"python"` is found anywhere. You can check whether you managed to identify all the Python jobs with this approach:

Python >>>

```
>>> print(len(python_jobs))
10
```

HTML IS A TREE

```
tree = bs4.BeautifulSoup(source)

## get html root node
root_node = tree.html
## get head from root using contents
head = root_node.contents[0]
## get body from root
body = root_node.contents[1]
## could directly access body
tree.body
```

ACCESS PARENT ELEMENTS

With this information in mind, you can now use the elements in `python_jobs` and fetch their great-grandparent elements instead to get access to all the information you want:

Python

```
python_jobs = results.find_all(
    "h2", string=lambda text: "python" in text.lower()
)

python_job_elements = [
    h2_element.parent.parent.parent for h2_element in python_jobs
]
```

EXTRACT ATTRIBUTES FROM HTML ELEMENTS

HTML

```
    <!-- snip -->
    <footer class="card-footer">
        <a href="https://www.realpython.com" target="_blank"
           class="card-footer-item">Learn</a>
        <a href="https://realpython.github.io/fake-jobs/jobs/senior-python-dev
           target="_blank"
           class="card-footer-item">Apply</a>
    </footer>
  </div>
</div>
```

Start by fetching all the <a> elements in a job card. Then, extract the value of their `href` attributes using square-bracket notation:

Python

```
for job_element in python_job_elements:
    # -- snip --
    links = job_element.find_all("a")
    for link in links:
        link_url = link["href"]
        print(f"Apply here: {link_url}\n")
```

PROJECT EXAMPLE

- https://github.com/alirezamika/autoscraper
- https://github.com/scrapy/scrapy
- https://yasoob.me/posts/github-actions-web-scraper-schedule-tutorial/

Gathering data from APIs

API

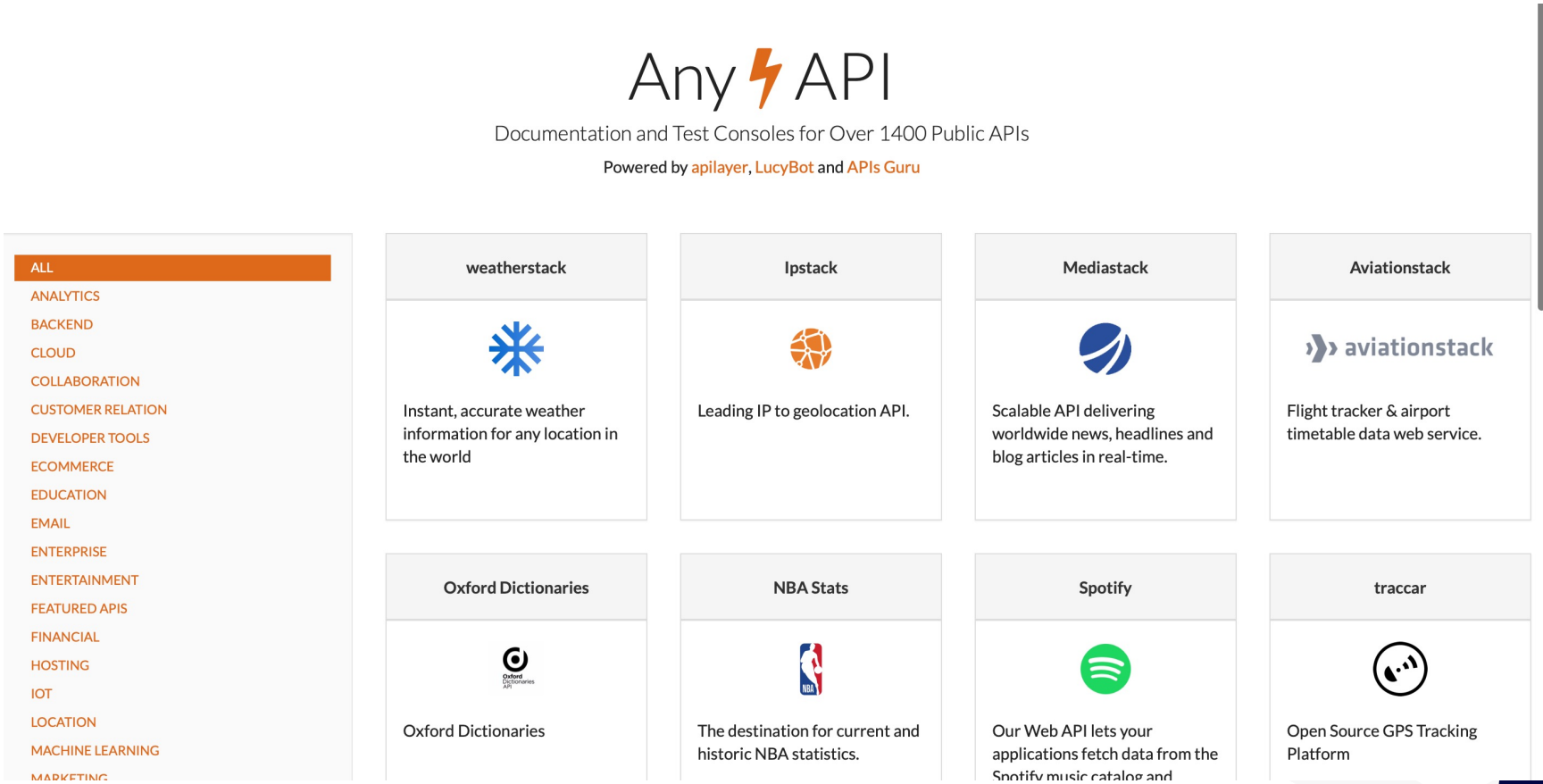
- API = **A**pplication **P**rogram **I**nterface
- Many data sources have API's - largely for talking to other web interfaces

- Consists of a set of methods to search, retrieve, or submit data to, a data source

- Many packages already connect to well-known API's (we'll look at a couple today)

PUBLIC API

https://any-api.com



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