Web Scraping Workshop

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OVERVIEW

FOR THE UNINITIATED

What is Web Scraping?

Web crawling is the process of systematically browsing the World Wide Web, typically for the purpose of Web indexing.

Web scraping is the process of automatically mining data or collecting information from the World Wide Web. It might require some crawling to access information hidden behind links on a page.

Web scraping a web page involves **downloading** the page (which a browser does when you view it) and then **extracting** the content from it.

Why Web Scrape?

CDS:

- Web sites generally have the most up-to-date data
- Allows more flexibility in creating custom data sets
- More powerful than using APIs

Industry:

- Market Price Monitoring
- Competitor Price Monitoring
- Product Trend Monitoring
- Market Trend Analysis
- Consumer Sentiment Monitoring
- News and Content Monitoring
- Real-time Analytics

WEB SCRAPING

WITH PYTHON

Getting Started in Python

The following libraries are the de-facto standard when it comes to web scraping in Python. You will need to install them:

- `requests` - making HTTP requests in Python.
  - `$ pip install requests`

- `beautifulsoup4` - pulling data out of HTML and XML files.
  - `$ pip install beautifulsoup4`
  - `$ pip install lxml`

HTTP in a Nutshell

HTTP (HyperText Transfer Protocol) is the standard protocol used to structure the exchange of resources over the web.

Resources on the web are typically hosted on a **server**. A client (e.g. web browser) can perform a specific action on a resource by sending an HTTP **request**. There are a number of actions that a client can perform on a resource. For example, to read a resource it sends a GET request, to send a resource it sends a POST request, etc.

When a server receives a request from a client, it sends back information in the form of an HTTP **response**. The response contains not only the requested information, but additional metadata like a status code as well.

Requests Library - Sending Requests

The `requests` library allows you to **send HTTP requests** extremely easily with quality-of-life features like keep-alive & connection pooling, sessions with cookie persistence, and more.

- GET requests
  - `r = requests.get('https://www.google.com')`
  - `r = requests.get('https://www.amazon.com/s', params={'k': 'shoes'})`
- POST requests
  - `r = requests.post('https://example.com/', data = {'key':'value'})`

- Also supports PUT, DELETE, HEAD, and OPTIONS requests.

Requests Library - Adding Headers

HTTP **headers** are typically sent along with an HTTP request or a response to pass additional information between the client and the server.

Our plain request doesn't contain any headers, so sites can easily figure out that it is being sent by a bot and not by a potential consumer. Thus, the server might be configured to send a response that doesn't actually contain any data.

We can get around this by sending packets that specify a **user agent** in the header to fool the server into thinking that the request was sent by a web browser:

```
r = requests.get('https://www.amazon.com', headers={'User-Agent': 'Mozilla/5.0'})
```

Requests Library - Response Objects

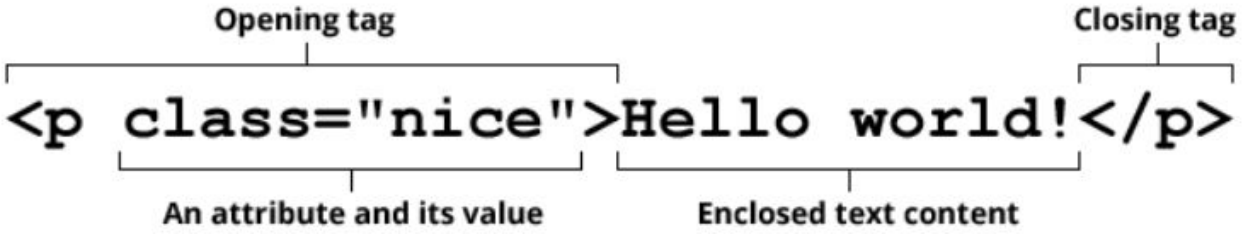
The request methods all return a Response object, which contains all the information about the response sent by the server.

- Response Code
  - `print(r.status_code)`
    `>>> 200`
- URL
  - `print(r.url)`
    `>>> https://www.amazon.com/s?k=shoes`
- HTML content
  - `print(r.text)`
    `>>> <!DOCTYPE html> <!--[if lt IE 7]> <html lang="en-us" class="a-no- ...`

HTML In a Nutshell

HTML (HyperText Markup Language) is a descriptive language that specifies web page structure.

An HTML document is structured by nested **elements**, which are surrounded by matching opening and closing **tags**. Tags can be extended with **attributes**, which provide additional information affecting how the browser interprets the element.



BeautifulSoup Library - HTML Parsing

The `BeautifulSoup` library allows you to **extract data from HTML** (or XML) content. It does this by constructing a parse tree from the nested elements of the document and providing a plethora of ways to query objects in the tree.

The parse tree is constructed when we create a BeautifulSoup object. The first argument contains the HTML and the second argument specifies the parser:

- `soup = BeautifulSoup(r.text, 'html.parser')`
- `soup = BeautifulSoup(r.text, 'lxml')`

Note: I suggest using the lxml parser because it is much faster.

BeautifulSoup Library - Searching for Tags

`BeautifulSoup` makes it very easy to extract specific tags from the parse tree using the `find()` and `find_all()` methods. These methods respectively find the first tag or a list of all tags in the HTML parse tree that match the query you provide.

- Search by tag type
  - `tags = soup.find('body') # finds the first <body> tag`
- Search by id or CSS class attributes
  - `tags = soup.find_all(id='bar', class_='icon')`
- Search using a filter function
  - `tags = soup.find(lambda t: t.has_attr('href') and not t.has_attr('img'))`
- Search the nested structure of the document
  - `nested_tags = soup.find('div', id='preview').find_all('a')`

BeautifulSoup Library - Tag Objects

A Tag object corresponds to a tag in the original HTML document. The `find()` and `find_all()` methods return a Tag object or a list of Tag objects respectively.

The attributes of the tag can be retrieved using dictionary syntax. The text enclosed by the tag can be retrieved using the `.text` or `.string` attributes.

```
soup = BeautifulSoup('<div><p align="left">Ho ho ho</p><p>Yo</p></div>', 'lxml')
tag = soup.find('div').find('p') # returns the first <p> tag in the first <div> tag
print(tag['align']) # prints the value associated with the 'align' key
>>> left
print(tag.text) # prints text enclosed by tag
>>> Ho ho ho
```

Inspecting Web Pages

We've just learned how to extract data from HTML content, but how do we know which elements we actually want to extract?

The answer is by **inspection** of the actual page.

- Windows: Ctrl + Shift + C
- Mac: ⌘ + Shift + C

It is helpful to first write the returned page to a file to inspect the HTML:

```
with open('page.html', mode='wb') as f:
    f.write(r.content)
```

INTERACTIVE DEMO

Demo Project - Scraping Reddit Comments

We’re going to be scraping Reddit - everybody’s favorite potty pastime.

Specifically, we will be building a dataset of the most popular comments of the most popular posts of all-time. This dataset probably doesn’t exist already, especially because the top posts and comments become outdated all the time. So we turn to web scraping.

1. Downloading the Top Posts Page

The first thing we need to do if we want to scrape the top comments of the top posts on Reddit is to **download the page containing the top posts of all time**. This page we want in particular is https://old.reddit.com/r/all/top/?t=all.

We can request the page like so. Note the parameters and the user agent.

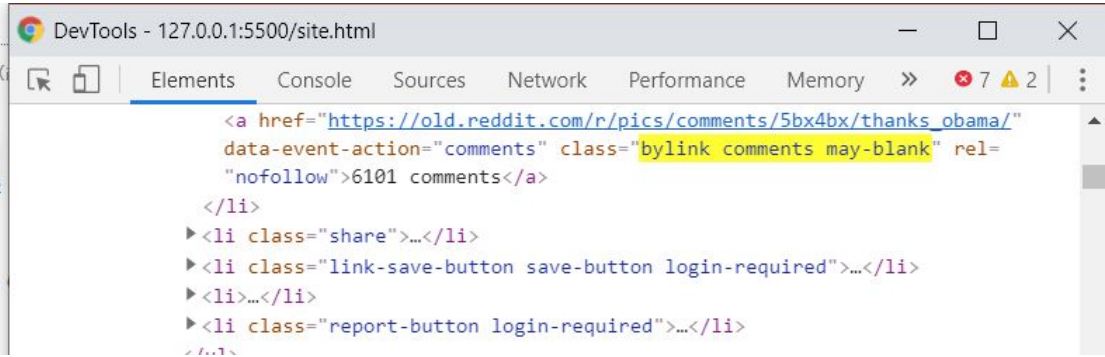
```
base_url   = 'https://old.reddit.com/r/all/top/'
parameters = {'t': 'all'} # this is to sort by top of all time (check API)
user_agent = {'User-Agent': 'Mozilla/5.0'}

r = requests.get(base_url, params=parameters, headers=user_agent)
```

2. Inspecting the Top Posts Page

Next, we need to collect a **list of links to the comments section** of every post on the page. To find the specific HTML tags those links correspond to, we can visually inspect the HTML of the page we were returned.

```
with open('page.html', mode='wb') as f:
    f.write(r.content)
```



3. Extracting Links to Comment Sections

Now that we've found a search parameter for the HTML elements we are trying to extract, we can easily collect those elements using `BeautifulSoup`.

```
soup = BeautifulSoup(r.text, 'lxml')
link_tags = soup.find_all('a', class_='bylink comments may-blank')
```

The returned list contains tag elements, not the actual links. To extract these links, we need to extract the value of the "href" attribute for each tag.

```
links = [tag['href'] for tag in link_tags]
```

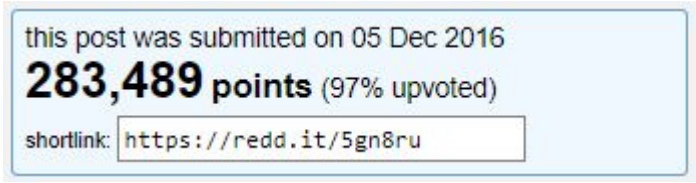
4. Feature Selection

For each comment section link in our list, we want to extract every single comment with some associated data about that comment. Deciding what data might or might not be useful for our dataset is called **feature selection** and is a crucial step in producing good results.

For each comment, we will collect the following associated data:

- Original post score
- Original post link
- Comment string
- Commenter name
- Comment score

5. Extracting Original Post Score



For each link to a post in our list of links, we need to extract the score of the original post. Like before, we can request the page of one link and write it to a file to visually inspect the HTML.

```
r = requests.get(links[0], params={'sort': 'top'}, headers=user_agent)
with open('link.html', mode='wb') as f:
    f.write(r.content)
```

Find some set of attributes (possibly nested) that uniquely correspond with the original post's score.

```
score_str = soup.find('div', class_='linkinfo').find('span', class_='number').text
op_score = int(score_str.replace(',', '')) # because `Tag.text` is a string
```

6. Inspecting the Comment Section

Extracting the post score was relatively easy. Extracting each comment together with its metadata is a little more difficult and requires some more creativity.

We can parse down specifically to the comment section of the HTML like so:

```
comment_section = soup.find('div', class_='commentarea')
```

At this point it seems like visually inspecting the HTML could be helpful again.

```
with open('comment_section.html', mode='w') as f:
    f.write(str(comment_section)) # Note we use mode 'w' for writing a str
```

Find some set of attributes (i.e. tag, id, class, or some combination of the three) that uniquely correspond with the container around each comment.

7. Extracting Comment Containers

Every comment is enclosed in a “div” element with the class attribute “entry unvoted”. However, there are other “div” elements with that same class attribute.

The “div” elements that corresponded to comments exclusively contain a child “span” element with the class attribute “score unvoted”, since that element actually corresponds to the comment score. The “div” element that contains this “span” element also contains the other data we want to extract from each comment, so we want to find and store all of these “div” elements specifically.

We can use the information above to search for the tags using a filter function:

```
comment_filter = lambda t: t.find('span', class_='score unvoted') is not None
comments = soup.find_all(comment_filter, attrs={'class': 'entry unvoted'})
```

8. Extracting Comment Data

Now that we have a list of every comment container in the comment section, we can simply extract the relevant data for each comment by finding the tags that they correspond to. We can do this for each comment by iterating over the list.

Find some set of attributes (i.e. tag, id, class, or some combination of the three) that uniquely correspond with the commenter name, comment text, and comment score in each comment container.

```
for container in comments:
    commenter_tag = container.find(class_='author')
    commenter = commenter_tag.text if commenter_tag is not None else '[deleted]'
    comment   = container.find('div', class_='usertext-body').text
    score     = container.find(class_='score unvoted')['title'])
```

9. Saving the Scraped Data

Once we've scraped all the relevant data, we need to be sure to save it.

One way to save our data is to store it in a `pandas` Dataframe object. Then, we can simply write that Dataframe object to a CSV, JSON, etc. after collecting the data.

```
# Define dataframe
features = ['post score', 'post link', 'score', 'commenter', 'comment']
data = pd.DataFrame(columns=features)

# Data collection code
...

# Write dataframe to csv
data.to_csv('reddit_comments.csv', index=False)
```

Resulting Dataset

We just finished building a simple, custom dataset of the top comments on the top posts of Reddit! We can inspect our dataset using `pandas` Dataframe methods.

```
data.sort_values(by='score', ascending=False).head(8)
```

	post score	post link	score	commenter	comment
1142	207262	https://old.reddit.com/r/pics/comments/co6h3d/...	37882	DullSharp	Croc Blocked
3420	174526	https://old.reddit.com/r/pics/comments/c7yzex/...	30642	andoring	They should photoshop him into every big life ...
3233	170201	https://old.reddit.com/r/news/comments/cohqmr/...	28671	thedrewsef	He killed himself while on suicide watch wtf e...
1163	207262	https://old.reddit.com/r/pics/comments/co6h3d/...	28246	ManyVoices	"Please stop. Please."
1913	201194	https://old.reddit.com/r/aww/comments/cmrkpt/t...	27909	XxpogxzogxX	Well …he did sit.
3039	181063	https://old.reddit.com/r/aww/comments/ckbolc/t...	27586	Immabok	He could possibly be the oldest cat in the world
3260	170201	https://old.reddit.com/r/news/comments/cohqmr/...	27386	PantsuitEmporium	How convenient for those who were involved wit...
573	223257	https://old.reddit.com/r/news/comments/dfn3yi/...	26687	Zeichner	It's absolutely amazing how Blizzard itself bl...

ETHICS

NO ONE MAN SHOULD HAVE ALL THAT POWER

Denial of Service Attacks

As a human browsing the web, you can only send so many requests to a server at a time. But with a web crawler, you can easily execute thousands of requests in just a few seconds. If the server receives more requests than it can handle, it could become overloaded and **stop fulfilling legitimate requests** altogether. This is called a Denial of Service (DoS) attack.

You should be smart about how often you send a request. For example, you should only **send one request per page** and save it locally if you need to use it again. If you are sending many requests, **send them slowly** instead of all at once.

Some websites will even throttle or block your IP address altogether if they detect an unusually high amount of requests.

Robots Exclusion Standard

The robots exclusion standard is a web standard used by websites to communicate to web crawlers which pages it can and cannot request. It is primarily used to manage crawler traffic by whitelisting and blacklisting certain parts of the site.

It can be found by simply appending “robots.txt” to the base URL of any website (e.g. https://www.reddit.com/robots.txt, https://www.amazon.com/robots.txt, etc.)

This is just a standard, meaning it is not explicitly enforced. But as a programmer utilizing a site’s resources at their expense, you should respect this standard.

If you really need to access a blacklisted part of a website, your web crawler should emulate a human by **throttling the rate of requests** to prevent getting blocked.