Intro to Web Scraping

February 13, 2019 GW Libraries
Slides: go.gwu.edu/scraping
Handout: go.gwu.edu/scrapinghandout

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Install the Scraper Chrome extension: bit.ly/chrome-scraper
Download and install Tabula: tabula.technology

Objectives

- What is web scraping and what is it good for?
- Technical and ethical considerations
- Using Scraper on a web page (hands-on)
- Using Tabula on PDF pages
- Discussion of using Python for web scraping

Install the Scraper Chrome extension: bit.ly/chrome-scraper

What is web scraping?

Extracting data from a web page, using cut-and-paste, code, or another tool that parses the HTML.

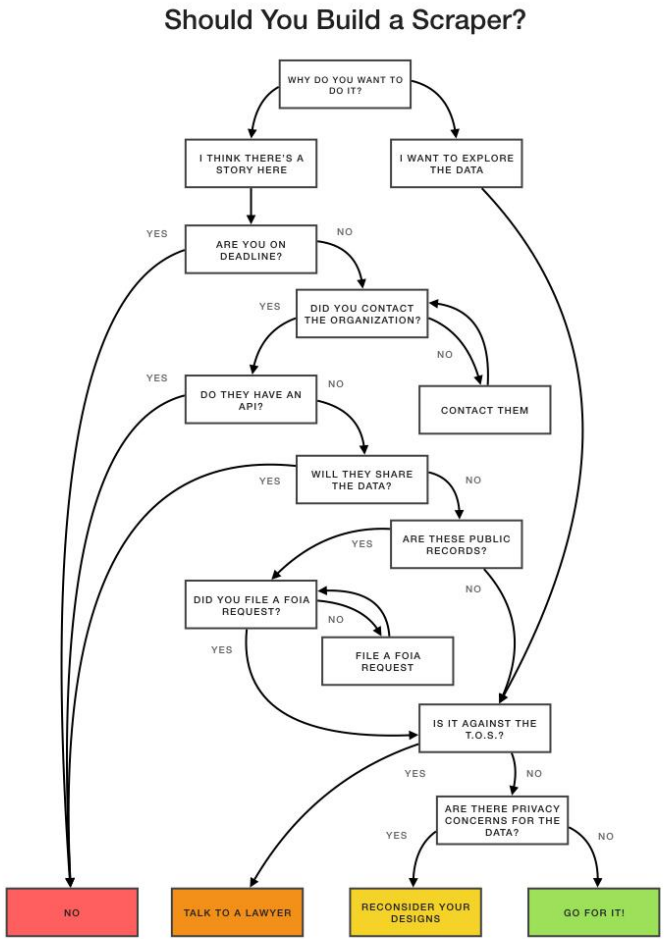
Examples of research

[scraping campsite location data from reserveamerica.com]
Mann ML, Batllori E, Moritz MA, Waller EK, Berck P, Flint AL, et al. (2016) Incorporating Anthropogenic Influences into Fire Probability Models: Effects of Human Activity and Climate Change on Fire Activity in California. *PLoS ONE* 11(4): e0153589. https://doi.org/10.1371/journal.pone.0153589

[scraping supermarket websites for prices]
Powell B, Nason G, Elliott D, Mayhew M, Davies J, Winton J. (2018) Tracking and Modelling Prices Using Web-Scraped Price Microdata: Towards Automated Daily Consumer Price Index Forecasting. *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 181(3):737-56. https://doi.org/10.1111/rssa.12314

[scraping forum posts for bitcoin addresses]
Fleder M, Kester MS, Pillai S. (2015) Bitcoin Transaction Graph Analysis. *arXiv preprint arXiv*:1502.01657. https://arxiv.org/abs/1502.01657

[scraping Craigslist apartment listings]
Boeing G, Waddell P. (2017) New Insights into Rental Housing Markets across the United States: Web Scraping and Analyzing Craigslist Rental Listings. *Journal of Planning Education and Research* 37(4):457-76. https://doi.org/10.1177/0739456X16664789



Considerations

- Is this data available some other way? (bulk download, API)
- Is the data well-structured on the website? Is it all on one page? Is the page dynamic/interactive?
- Are there terms of service concerning the website?
- Are there copyright concerns?
- What am I planning to do with this data? Be cautious about sharing data.

[To scrape or not to scrape: technical and ethical challenges of collecting data off the web]

Structure of a web page: HTML + CSS + JavaScript

HTML provides the basic structure of a page. The HTML is enhanced and modified by CSS and JavaScript.

CSS is used to control styling: presentation, formatting, and layout.

JavaScript is used to control the behavior of different elements.

Structure of a web page

```
<html>
    <head>
        <link href="css_file.css" rel="stylesheet" type="text/css" media="all">
    </head>
    <body>
        <div id="text-section1" class="box-around">
            <p class="bold-paragraph" style="font-size:16">
                Here's some bold text and
                <a href="https://library.gwu.edu" id="library-link">a link to GW Libraries</a>
            </p>
            <p class="bold-paragraph extra-large">
                Here's another paragraph, even bigger
            </p>
        </div>
        <table id="table1">
            <tr>
                <td>Stuff inside a table cell</td>
            </tr>
        </table>
    </body>
</html>
```

```
.bold-paragraph {
    font-weight: bold;
    color: red
}
```

href here is an *attribute* of the tag

a tag, or node

XPath

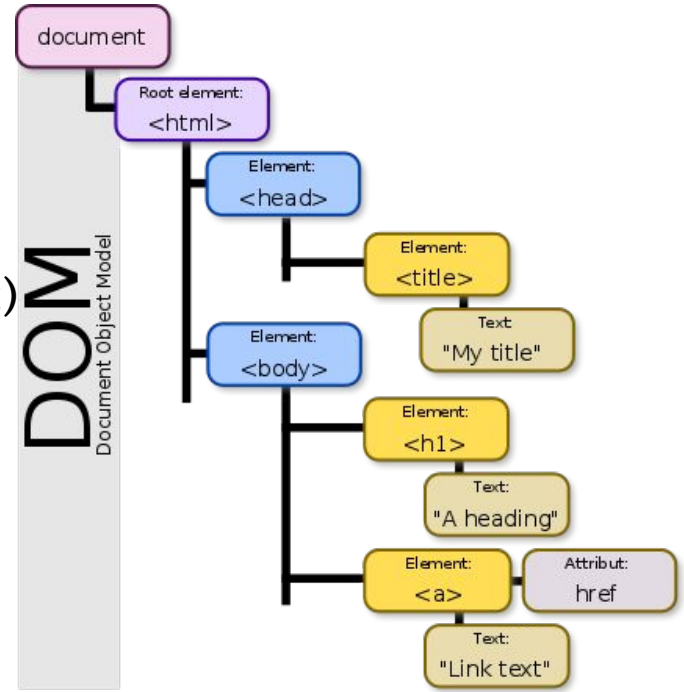
DOM = Document Object Model

"A language for addressing parts of an XML document"
(a web page is an HTML document is an XML document)

Example:

```
//div[@id='text-section1']/p/text()
```

// - At any level down in the "tree"
div - any div tag, with an id attribute of 'text-section1'
/p - get back all child <p> tags
/text() - and give me the text of each tag



en.wikipedia.org/wiki/Document_Object_Model#/media/File:DOM-model.svg

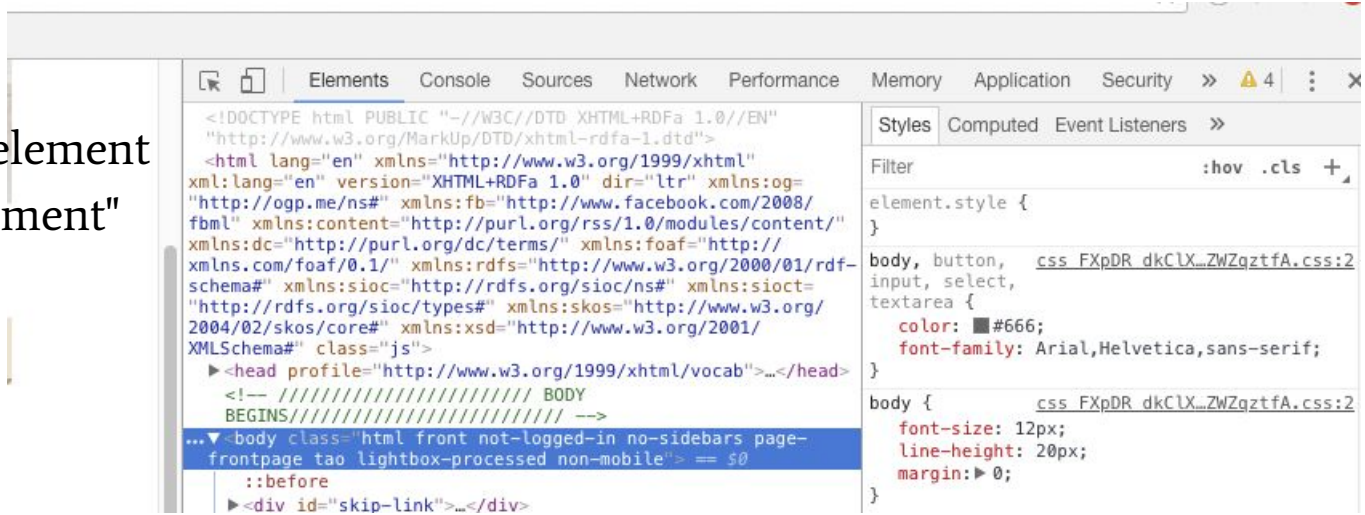
Working with a web page

In Chrome (other browsers have a similar tool):

View → Developer → Developer Tools

OR

Right-click on a page element and select "Inspect Element"



Web scraping with Scraper

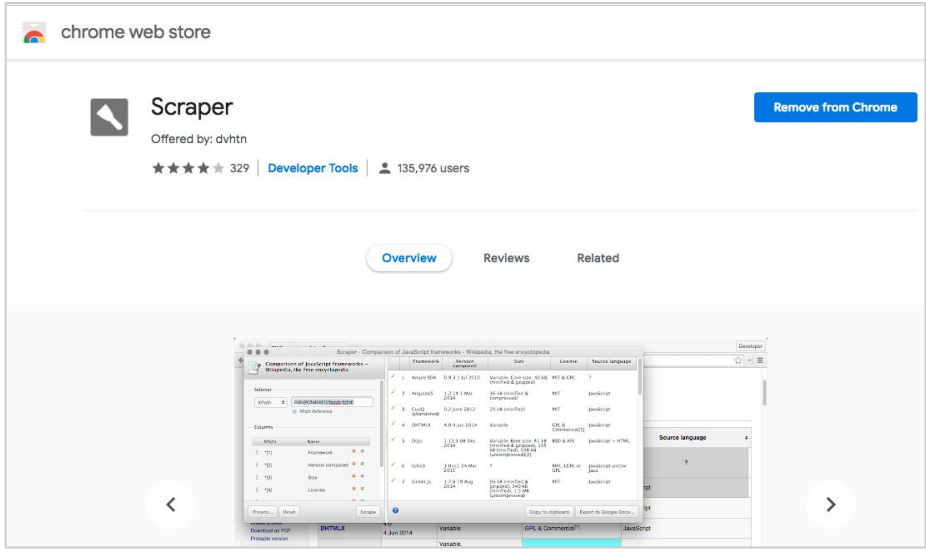
- Chrome extension for scraping web pages.
- Uses XPath to identify elements in HTML.
- Works best if data is on a single page and HTML is well-structured.
- Doesn't work with PDFs.

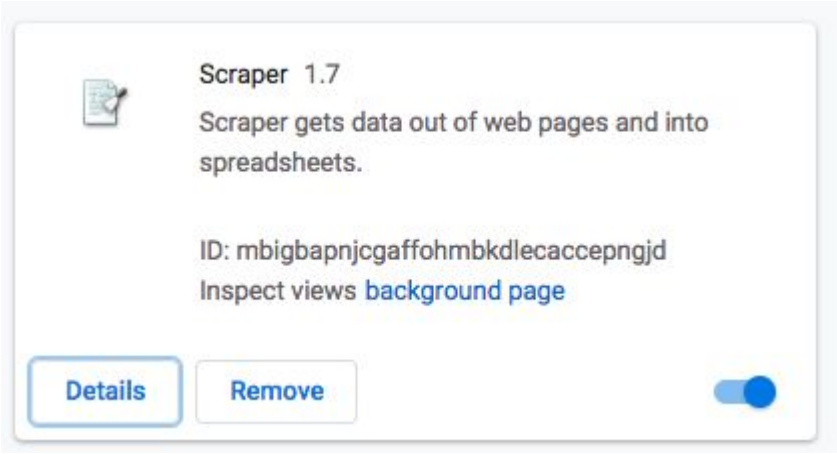
Install the Scraper Chrome extension:
bit.ly/chrome-scraper

Installing Scraper

In the Chrome Webstore:
bit.ly/chrome-scraper

Installation directions and tips:
go.gwu.edu/scraper





Scraper steps

1. Load your target web page.
2. **Highlight and right-click** on a part of the web page and click "Scrape similar...
3. Tweak the XPath to get the elements you need.
4. Export to Google Docs or copy into Excel.

GWU Schedule of Courses: https://my.gwu.edu/mod/pws/

Spring 2019: Main Campus > pick a department

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

OFFICE OF THE
REGISTRAR

Schedule of Classes

Helpful Hints:
Subject: *Click on the course number to view the Bulletin description*
Bldg/Rm: *Click on the building to view the street address*
XList: *Click to view the same course offered by another department*
Linked: *Click to view associated discussions, labs, etc.*

PRINT ALL | PRINT THIS PAGE

STATUS	CRN	SUBJECT	SECT	COURSE	CREDIT	INSTR.	BLDG/RM	DAY/TIME	FROM / TO	
OPEN	47078	AMST 1000	10	Zombie Capitalism	3.00	Orenstein, D	PHIL 108	M 12:45PM - 03:15PM	01/14/19 - 04/29/19	
Comments: Registration restricted to CCAS freshmen only. For more information about Dean's Seminars click on http://go.gwu.edu/ccasdeansseminars Course Attributes										Find Books

Scraper - American Studies Courses Spring 2019 (Main Campus) | The George Washington University

American Studies Courses Spring 2019 (Main Campus) | The George Washington University

Selector

XPath | //td/table/tbody/tr[1][td]

XPath Reference

Columns

XPath	Name
*[2]	CRN
*[3]	Course Code
*[4]	Section
*[5]	Course
*[6]	Credit
*[7]	Instructor
*[8]	Room

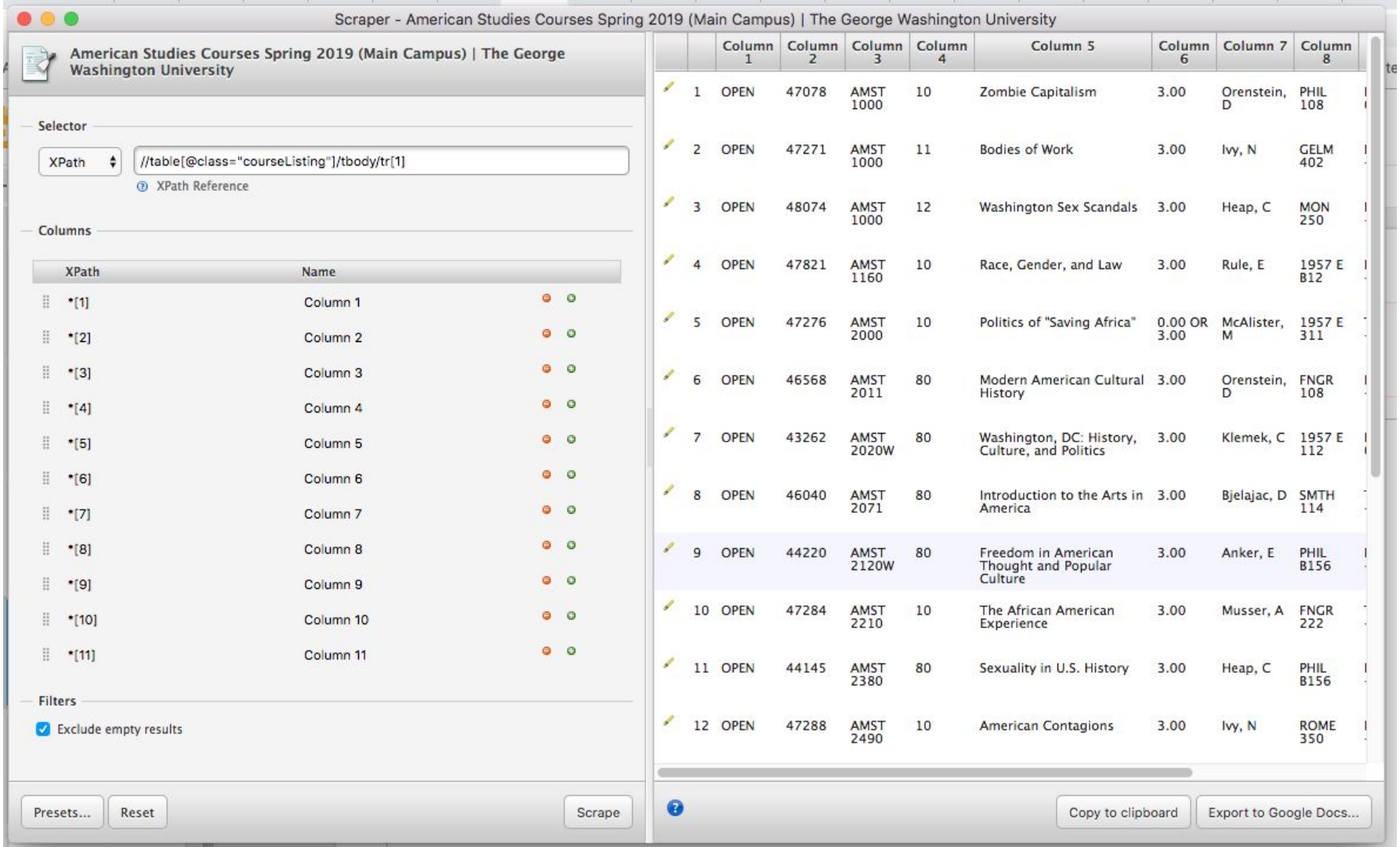
Filters

Exclude empty results

Presets... | Reset | Scrape

	CRN	Course Code	Section	Course	Credit	Instructor	Room
1	Result Page: 1 – 2	Next Page >>					
2	47078	AMST 1000	10	Zombie Capitalism	3.00	Orenstein, D	PHIL 108
3	47271	AMST 1000	11	Bodies of Work	3.00	Ivy, N	GELM 402
4	48074	AMST 1000	12	Washington Sex Scandals	3.00	Heap, C	MON 250
5	47821	AMST 1160	10	Race, Gender, and Law	3.00	Rule, E	1957 E B12
6	47276	AMST 2000	10	Politics of "Saving Africa"	0.00 OR 3.00	McAlister, M	1957 E 311
7	46568	AMST 2011	80	Modern American Cultural History	3.00	Orenstein, D	FNGR 108
8	43262	AMST 2020W	80	Washington, DC: History, Culture, and Politics	3.00	Klemek, C	1957 E 112
9	46040	AMST 2071	80	Introduction to the Arts in America	3.00	Bjelajac, D	SMTH 114
10	44220	AMST 2120W	80	Freedom in American Thought and Popular Culture	3.00	Anker, E	PHIL B156
11	47284	AMST 2210	10	The African American Experience	3.00	Musser, A	FNGR 222
12	44145	AMST 2380	80	Sexuality in U.S. History	3.00	Heap, C	PHIL B156
13	47288	AMST 2490	10	American Contagions	3.00	Ivy, N	ROME 350
14	42532	AMST 2521	80	American Architecture II	3.00	Jacks, P	SMTH 114
15	47289	AMST 2710	80	The United States in Global Context, 1898–Present	3.00	McAlister, M	1957 E 213
16	44820	AMST 3361	80	African American History Since 1865	3.00	Clement, B	MON 115
17	48373	AMST 3811	80	Historical Archaeology	3.00	Cressey, P	
18	46049	AMST 3901	10	Examining America	3.00	Anker, E	P 201
19	44822	AMST 3950	10	USConstructionsofMidEast	3.00		DUQUES 250
20	42501	AMST 4400	10	Independent Study	3.00	Wald, G	
21	46278	AMST 4701W	80	Epidemics in American History	3.00	Gamble, V	COR 204
22	$10.00						
23	$10.00						

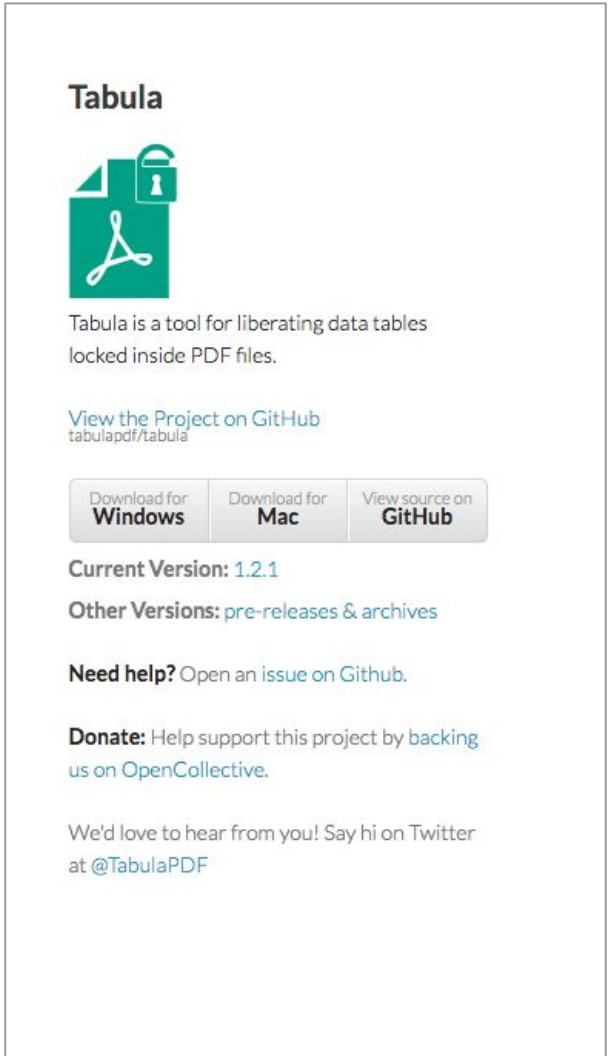
Copy to clipboard | Export to Google Docs...


Scraper - American Studies Courses Spring 2019 (Main Campus) | The George Washington University
American Studies Courses Spring 2019 (Main Campus) | The George Washington University
Selector
XPath
//table[@class="courseListing"]/tbody/tr[1]
XPath Reference
Columns
XPath
Name
*[1] Column 1
*[2] Column 2
*[3] Column 3
*[4] Column 4
*[5] Column 5
*[6] Column 6
*[7] Column 7
*[8] Column 8
*[9] Column 9
*[10] Column 10
*[11] Column 11
Filters
Exclude empty results
Presets...
Reset
Scrape
Column 1
Column 2
Column 3
Column 4
Column 5
Column 6
Column 7
Column 8
1 OPEN 47078 AMST 1000 10 Zombie Capitalism 3.00 Orenstein, D PHIL 108
2 OPEN 47271 AMST 1000 11 Bodies of Work 3.00 Ivy, N GELM 402
3 OPEN 48074 AMST 1000 12 Washington Sex Scandals 3.00 Heap, C MON 250
4 OPEN 47821 AMST 1160 10 Race, Gender, and Law 3.00 Rule, E 1957 E B12
5 OPEN 47276 AMST 2000 10 Politics of "Saving Africa" 0.00 OR 3.00 McAlister, M 1957 E 311
6 OPEN 46568 AMST 2011 80 Modern American Cultural History 3.00 Orenstein, D FNGR 108
7 OPEN 43262 AMST 2020W 80 Washington, DC: History, Culture, and Politics 3.00 Klemek, C 1957 E 112
8 OPEN 46040 AMST 2071 80 Introduction to the Arts in America 3.00 Bjelajac, D SMTH 114
9 OPEN 44220 AMST 2120W 80 Freedom in American Thought and Popular Culture 3.00 Anker, E PHIL B156
10 OPEN 47284 AMST 2210 10 The African American Experience 3.00 Musser, A FNGR 222
11 OPEN 44145 AMST 2380 80 Sexuality in U.S. History 3.00 Heap, C PHIL B156
12 OPEN 47288 AMST 2490 10 American Contagions 3.00 Ivy, N ROME 350
Copy to clipboard
Export to Google Docs...

Tabula for PDFs

https://tabula.technology

- Free, open-source application for identifying and extracting data tables from PDFs.
- Useful when tables don't cleanly cut-and-paste into a spreadsheet, or are on many pages.
- Exports data as CSV, TSV, or JSON.
- Does not work with "image" PDFs. Must be OCR.
- Data may require further clean-up.



Tabula for PDFs

GW Daily Crime and Fire Log (https://safety.gwu.edu/daily-crime-and-fire-log)

More tools for web scraping

- Python libraries:
  - `requests`
  - `bs4 / BeautifulSoup`
  - `selenium / webdriver`
- R packages:
  - `rvest`
- JavaScript
  - `puppeteer, cheerio`
- Command-line tools (bash/Linux shell):
  - `curl - gets a URL  (also: wget)`
- OpenRefine
  - Has some html parsing functions
- Other browser plug-ins

Web scraping with Python

Libraries you may need:

- `import requests  # to retrieve the web page`
- `from bs4 import BeautifulSoup  # to parse the HTML`
- `from selenium import webdriver  # to control a browser`

Do you need to interact with the page?

- No: Try web scraping with requests + beautifulsoup
- Yes: You may need something like Selenium WebDriver

Python example

From github.com/gwu-libraries/alma-notebooks/blob/master/release-notes-scraping.ipynb

```
import requests
from bs4 import BeautifulSoup

r = requests.get(url)
soup = BeautifulSoup(r.text)
headings = soup.find_all('h3')

for heading in headings:
  print(heading['id'])
```

R example

```
library(magrittr)
library(rvest)

alma_url <-
'https://knowledge.exlibrisgroup.com/Alma/Release_Notes/010_2018/001Alma_2018_Release_Notes?mon=201812BASE'
page_html <- read_html(alma_url)
page_h3_text <- page_html %>%
                  html_nodes('h3') %>%
                  html_text()
df <- data.frame(page_h3_text)
```

Web scraping can be easy or hard

- Is the page static or dynamic? Do you have to interact with the page to get the content you want?
- A web page's structure can change without warning!
- Does the content you want require clicking through multiple pages?
- How well-written is the page's HTML? Do tags have 'id' attributes?

Web scraping code of conduct

Ask nicely. If your project requires data from a particular organisation, for example, you can try asking them directly if they could provide you what you are looking for. With some luck, they will have the primary data that they used on their website in a structured format, saving you the trouble.

Don't download copies of documents that are clearly not public. For example, academic journal publishers often have very strict rules about what you can and what you cannot do with their databases. Mass downloading article PDFs is probably prohibited and can put you (or at the very least your friendly university librarian) in trouble. If your project requires local copies of documents (e.g. for text mining projects), special agreements can be reached with the publisher. The library is a good place to start investigating something like that.

From Library Carpentry: "Introduction to Web Scraping". November 2018. https://librarycarpentry.github.io/lc-webscraping/05-conclusion/index.html

Check your local legislation. For example, certain countries have laws protecting personal information such as email addresses and phone numbers. Scraping such information, even from publicly available web sites, can be illegal (e.g. in Australia).

Don't share downloaded content illegally. Scraping for personal purposes is usually OK, even if it is copyrighted information, as it could fall under the fair use provision of the intellectual property legislation. However, sharing data for which you don't hold the right to share is illegal.

Share what you can. If the data you scraped is in the public domain or you got permission to share it, then put it out there for other people to reuse it (e.g. on datahub.io). If you wrote a web scraper to access it, share its code (e.g. on GitHub) so that others can benefit from it.

From Library Carpentry: "Introduction to Web Scraping". November 2018. https://librarycarpentry.github.io/lc-webscraping/05-conclusion/index.html

Don't break the Internet. Not all web sites are designed to withstand thousands of requests per second. If you are writing a recursive scraper (i.e. that follows hyperlinks), test it on a smaller dataset first to make sure it does what it is supposed to do. Adjust the settings of your scraper to allow for a delay between requests. By default, Scrapy uses conservative settings that should minimize this risk.

Publish your own data in a reusable way. Don't force others to write their own scrapers to get at your data. Use open and software-agnostic formats (e.g. JSON, XML), provide metadata (data about your data: where it came from, what it represents, how to use it, etc.) and make sure it can be indexed by search engines so that people can find it.

From Library Carpentry: "Introduction to Web Scraping". November 2018. https://librarycarpentry.github.io/lc-webscraping/05-conclusion/index.html

Resources

- Tutorials
  - Programming Historian tutorials on web scraping
  - Lynda.com tutorials (lynda.it.gwu.edu): search on web scraping
  - Library Carpentry tutorial on web scraping
  - Automate The Boring Stuff w/Python - Web Scraping (Chapter 11)
- Make an appointment for a coding consultation: calendly.com/gwul-coding
- Slides go.gwu.edu/scraping
- Handout go.gwu.edu/scrapinghandout

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