QSS20: Modern Statistical Computing

Unit 11: Web-scraping

Goals for today

- Recap of APIs
- Lecture on web-scraping
  - Living in a digital era
  - Researching the digital era
  - How to scrape/crawl without reinventing the flat tire
  - Intro to packages for wrangling web data
  - Ethics (briefly)
- Notebook for basic web-scraping

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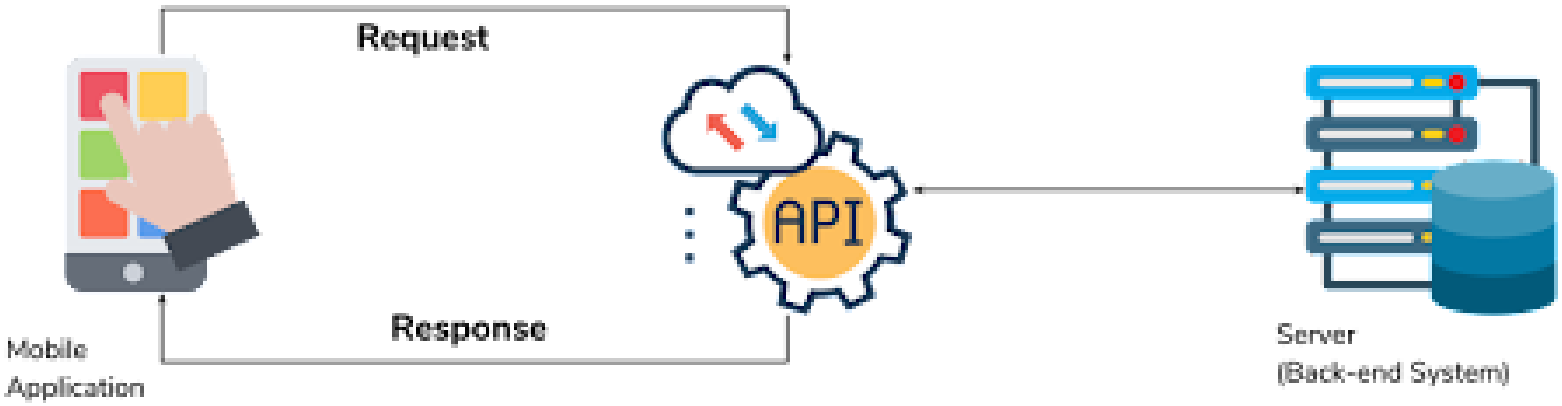
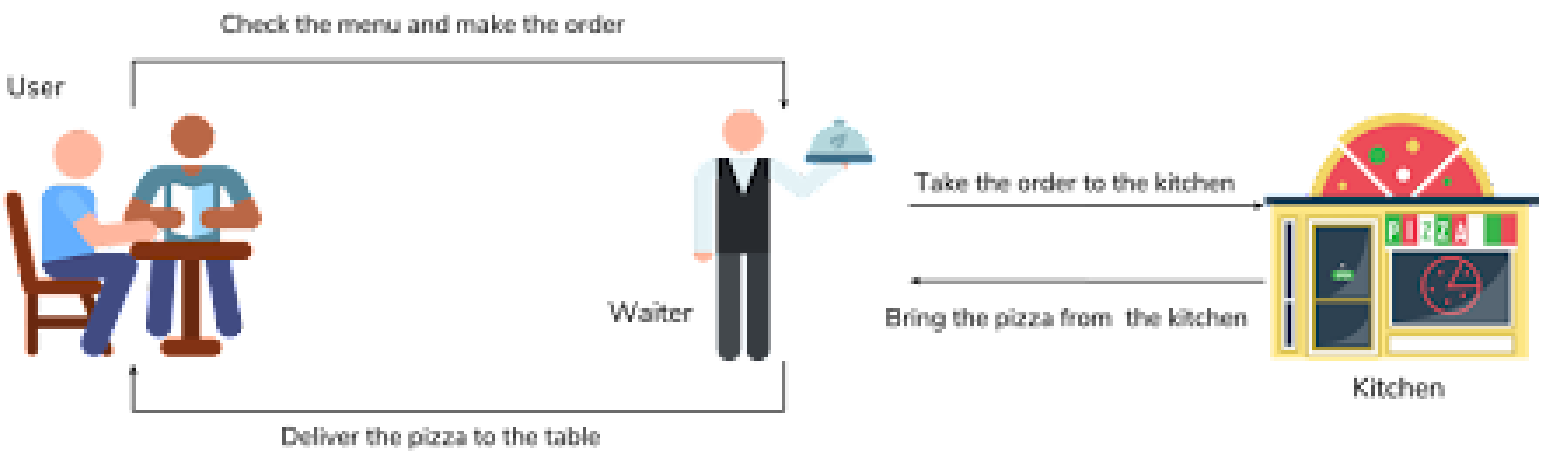
Recap of APIs

What do you remember?

How APIs work





Source: Medium blog post

Recap of APIs

Tips:

- APIs are a "front door" to web-based data (visible, accessible, controlled), scraping is the "back door" (hard to find, often locked, unique rewards)
- APIs are everywhere! New York Times, Reddit, YouTube, Google Maps, Wikipedia, Twitter, etc.
- Basic workflow: Construct query $\rightarrow$ call API $\rightarrow$ check if it worked $\rightarrow$ if so, extract content
- Constructing queries usually means starting from a template, sniffing between '&'s, and updating
- `try/except` clauses often useful for catching failures without blocking

Useful commands:

```
creds = yaml.safe_load(stream) # load API credentials file
response = requests.get(query) # call API (nearly universal)
response_j = response.json() # get JSON of result (if it worked)
data = pd.DataFrame(response_j[colname]) # make usable
```

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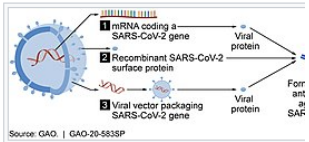
Learn about vaccines: Wikipedia

en.wikipedia.org/wiki/COVID-19_vaccine#Vaccine_types

Vaccine types

As of January 2021, nine different technology platforms – with the technology of numerous candidates remaining undefined – are under research and development to create an effective vaccine against COVID-19.[3][27] Most of the platforms of vaccine candidates in clinical trials are focused on the coronavirus spike protein and its variants as the primary antigen of COVID-19 infection.[27] Platforms being developed in 2020 involved nucleic acid technologies (nucleoside-modified messenger RNA and DNA), non-replicating viral vectors, peptides, recombinant proteins, live attenuated viruses, and inactivated viruses.[14][27][28][34]

Many vaccine technologies being developed for COVID-19 are not like vaccines already in use to prevent influenza, but rather are using "next-generation" strategies for precision on COVID-19 infection mechanisms.[27][28][34] Several of the synthetic vaccines use a 2P mutation to lock the spike protein into its prefusion configuration, stimulating an immune response to the virus before it attaches to a human cell.[90] Vaccine platforms in development may improve flexibility for antigen manipulation and effectiveness for targeting mechanisms of COVID-19 infection in susceptible population subgroups, such as healthcare workers, the elderly, children, pregnant women, and people with existing weakened immune systems.[27][28]



Conceptual diagram showing three vaccine type for forming SARS-CoV-2 proteins to prompt an immune response: (1) RNA vaccine, (2) subunit vaccine, (3) viral vector vaccine

RNA vaccines

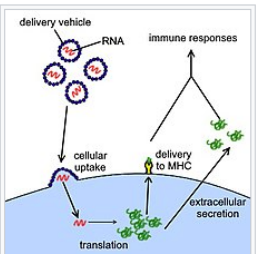
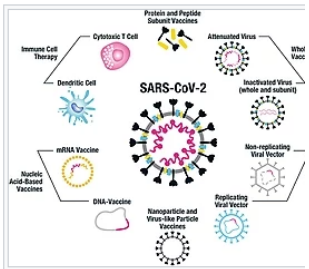


Diagram of the operation of an RNA vaccine. Messenger RNA contained in the vaccine enters cells and is translated into foreign proteins, which trigger an immune response.

An RNA vaccine contains RNA which, when introduced into a tissue, acts as messenger RNA (mRNA) to cause the cells to build the foreign protein and stimulate an adaptive immune response which teaches the body how to identify and destroy the corresponding pathogen or cancer cells. RNA vaccines often, but not always, use nucleoside-modified messenger RNA. The delivery of mRNA is achieved by a coformulation of the molecule into lipid nanoparticles which protect the RNA strands and help their absorption into the cells.[91][92][93][94]

RNA vaccines were the first COVID-19 vaccines to be authorized in the United States and the European Union.[95][96] As of January 2021, authorized vaccines of this type are the Pfizer–BioNTech COVID-19 vaccine[97][98][99] and the Moderna COVID-19 vaccine.[100][101] As of February 2021, the CVnCoV RNA vaccine from CureVac is awaiting authorization in the EU.[102]

Severe allergic reactions are rare. In December 2020, 1,893,360 first doses of Pfizer-BioNTech COVID-19 vaccine administration resulted in 175 cases of severe allergic reaction, of which 21 were anaphylaxis.[103] For 4,041,396 Moderna COVID-19 vaccine dose administrations in December 2020 and January 2021, only 10 cases of anaphylaxis were reported.[103] The lipid nanoparticles were most likely responsible for the allergic reactions.[103]



Vaccine platforms being employed for SARS-Co 2. Whole virus vaccines include both attenuated inactivated forms of the virus. Protein and peptid subunit vaccines are usually combined with an adjuvant in order to enhance immunogenicity. Th main emphasis in SARS-CoV-2 vaccine develop has been on using the whole spike protein in its trimeric form or components of it, such as the RE region. Multiple non-replicating viral vector vacci have been developed, particularly focused on adenovirus; while there has been less emphasis the replicating viral vector constructs.[89]

Adenovirus vector vaccines

These vaccines are examples of non-replicating viral vector vaccines, using an adenovirus shell containing DNA that encodes a SARS-CoV-2 protein.[104][105] The viral vector-based vaccines against COVID-19 are non-replicating, meaning that they do not make new virus particles, but rather produce only the antigen which elicits a systemic immune response.[104]

As of January 2021, authorized vaccines of this type are the Oxford–AstraZeneca COVID-19 vaccine,[106][107][108] the Sputnik V COVID-19 vaccine,[109] Convidecia, and the Johnson & Johnson COVID-19 vaccine.[110][111]

Convidecia and the Johnson & Johnson COVID-19 vaccine are both one-shot vaccines which offer less complicated logistics and can be stored under ordinary refrigeration for several months.[112][113]

The Sputnik V COVID-19 vaccine uses Ad26 for the first dose, which is the same as the Johnson & Johnson vaccine's only dose, and Ad5 for the second dose. Convidecia uses Ad5 for its only dose.[114]

Inactivated virus vaccines

Inactivated vaccines consist of virus particles that have been grown in culture and then are killed using a method such as heat or formaldehyde to lose disease producing capacity, while still stimulating an immune response.[115]

As of January 2021, authorized vaccines of this type are the Chinese CoronaVac,[116][117][118] BBIBP-CorV,[119] and WIBP-CorV; the Indian Covaxin; and the Russian CoviVac.[120] Vaccines in clinical trials include the Valneva COVID-19 vaccine.[121][122]

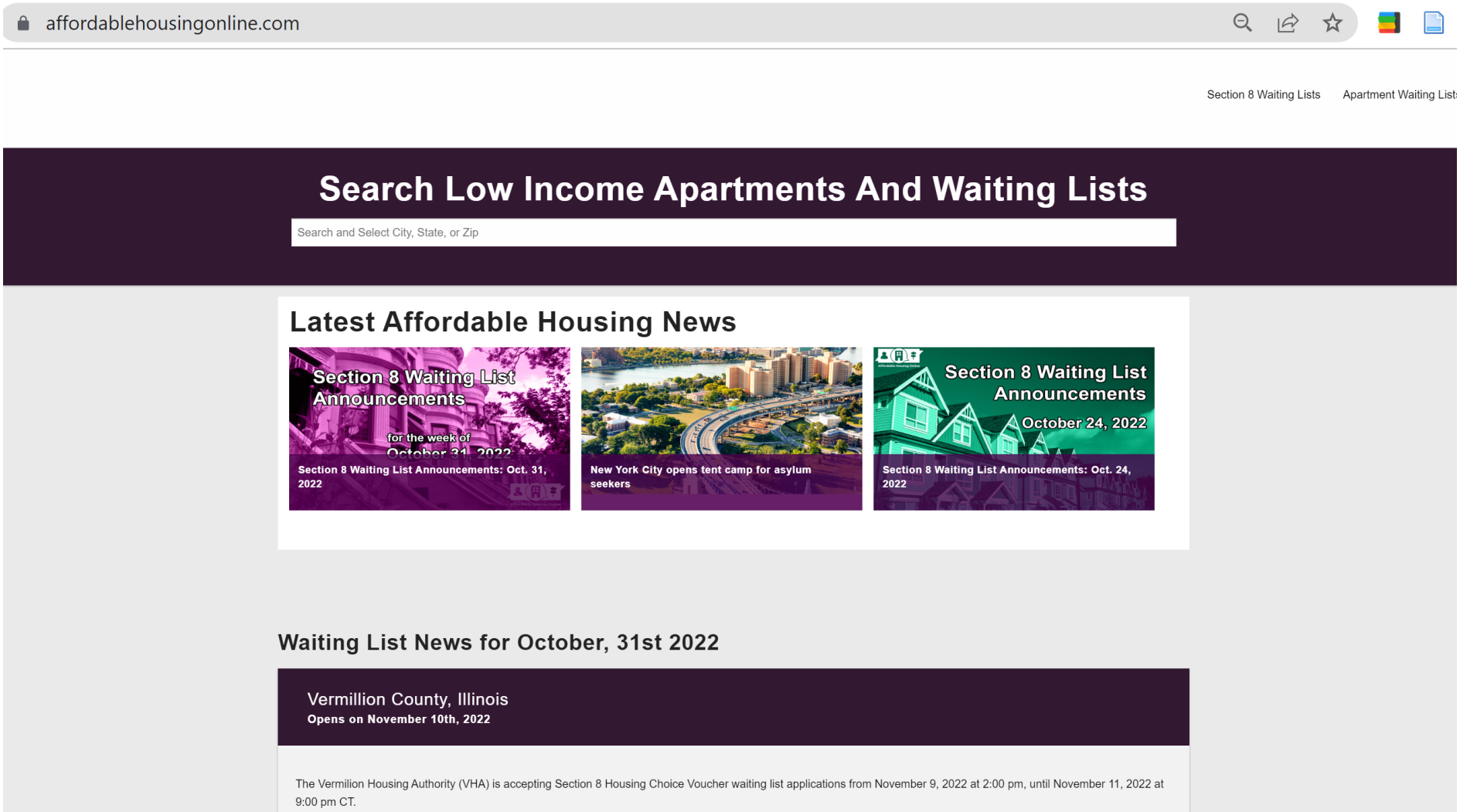
Subunit vaccines

Subunit vaccines present one or more antigens without introducing whole pathogen particles. The antigens involved are often protein subunits, but can be any molecule that is a fragment of the pathogen.[123]

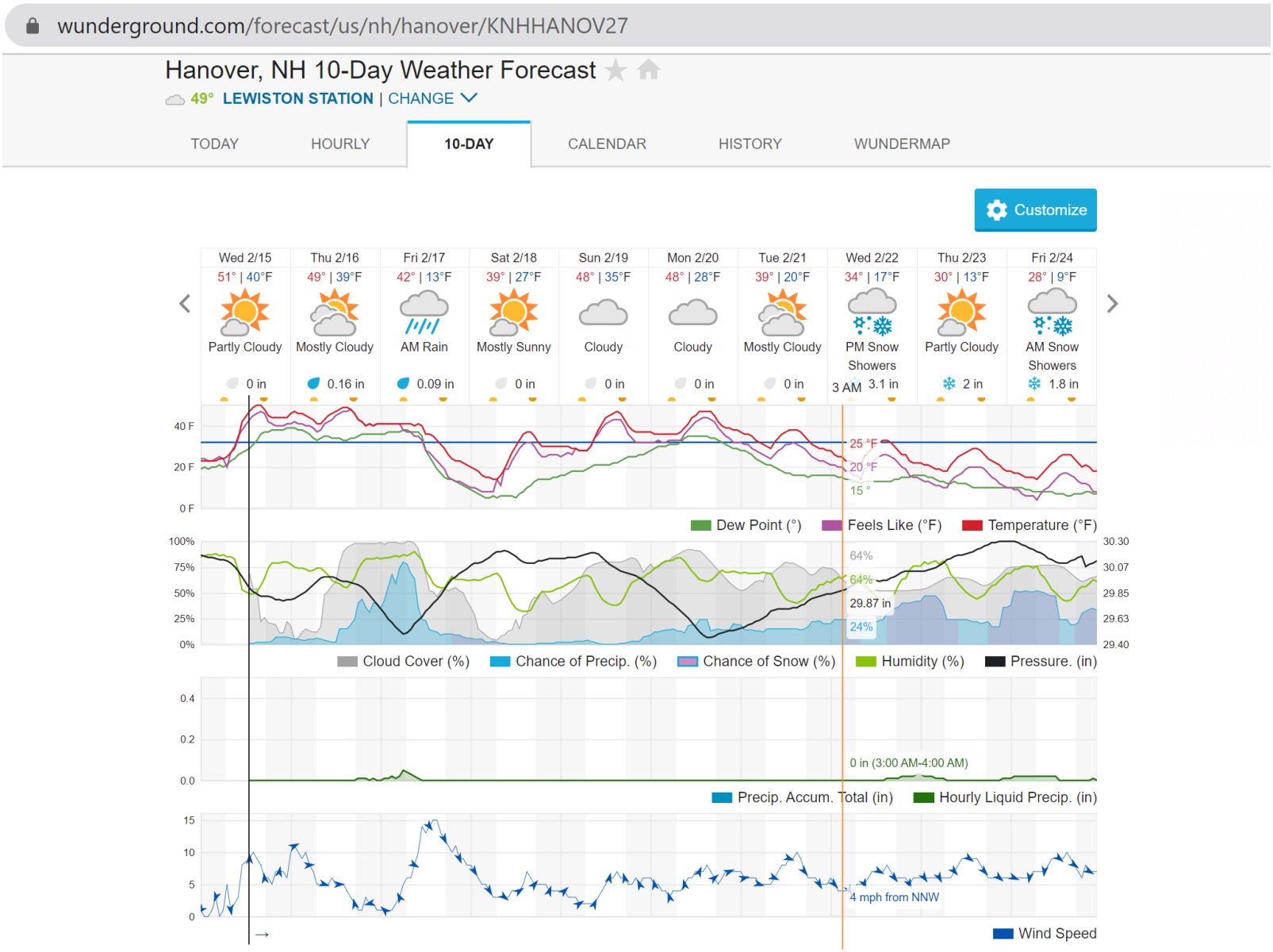
As of April 2021, the two authorized vaccines of this type are the peptide vaccine EpiVacCorona[124] and RBD-Dimer.[3] Vaccines with pending authorizations include the Novavax COVID-19 vaccine,[125] SOBERANA 02 (a conjugate vaccine), and the Sanofi–GSK va The V451 vaccine was previously in clinical trials, which were terminated because it was found that the vaccine may potentially cause incorrect results for subsequent HIV testing.[126][127]

Other types

Find housing: Affordable Housing Online



Check weather: wunderground.com



Follow current events: New York Times

nytimes.com

U.S. INTERNATIONAL CANADA ESPAÑOL 中文

PLAY THE CROSSWORD Account

Wednesday, February 15, 2023
Today's Paper

The New York Times

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Nasdaq +0.1% ↑

World U.S. Politics N.Y. Business Opinion Science Health Sports Arts Books Style Food Travel Magazine Real Estate | Cooking The Athletic Wirecutter Games

As Lawmakers Spar Over Social Security, Its Costs Are Rising Fast

- New budget forecasts, set to be released today, are expected to show that spending for Social Security is rapidly outpacing growth in tax revenues.
- President Biden scored political points this month by forcing G.O.P. leaders to profess that they will not seek cuts to the programs.

5 MIN READ

Haiyun Jiang/The New York Times

President Biden's I.R.S. nominee is expected to defend a plan to modernize the tax agency at a hearing today.

5 MIN READ

In a Bleak Russian Cemetery, a Sea of Crosses Signals the War's True Toll

A snowy plot is the final resting place for soldiers from the Wagner mercenary forces, a testament to Russia's soaring casualty count.

5 MIN READ

Nanna Heitmann for The New York Times

Losses Near Ukrainian Stronghold Cast Doubt on Russia's Offensive

Weeks of failed attacks around Vuhledar have left two Russian brigades in tatters, but the fighting has also come at a cost for Ukraine.

4 MIN READ

Daily Briefing: War in Ukraine

- A Ukrainian military official said his forces 'fought back decently' in Vuhledar.
- As Russia and Ukraine expend ammunition at a staggering rate, the race to rearm takes on added urgency.

LIVE 4m ago

Nicola Sturgeon, Scotland's Leader, Says She Will Step Down in Surprise Move

A longtime champion of Scottish

Jaida Grey Eagle for The New York Times

A Love Letter to Libraries, Long Overdue

The New York Times sent photographers to seven states to document the thrum and buzz in buildings once known for silence.

5 MIN READ

Here's how a consistent sleep schedule might protect your heart.

5 MIN READ

Netflix is shunning live sports but embracing sports documentaries.

4 MIN READ

Opinion

'Nikki Haley Will Not Be the Next President': Our Columnists Weigh In

9 MIN READ

DAVID FRENCH

The Law Is Closing In on Trump

6 MIN READ

JESSICA GROSE

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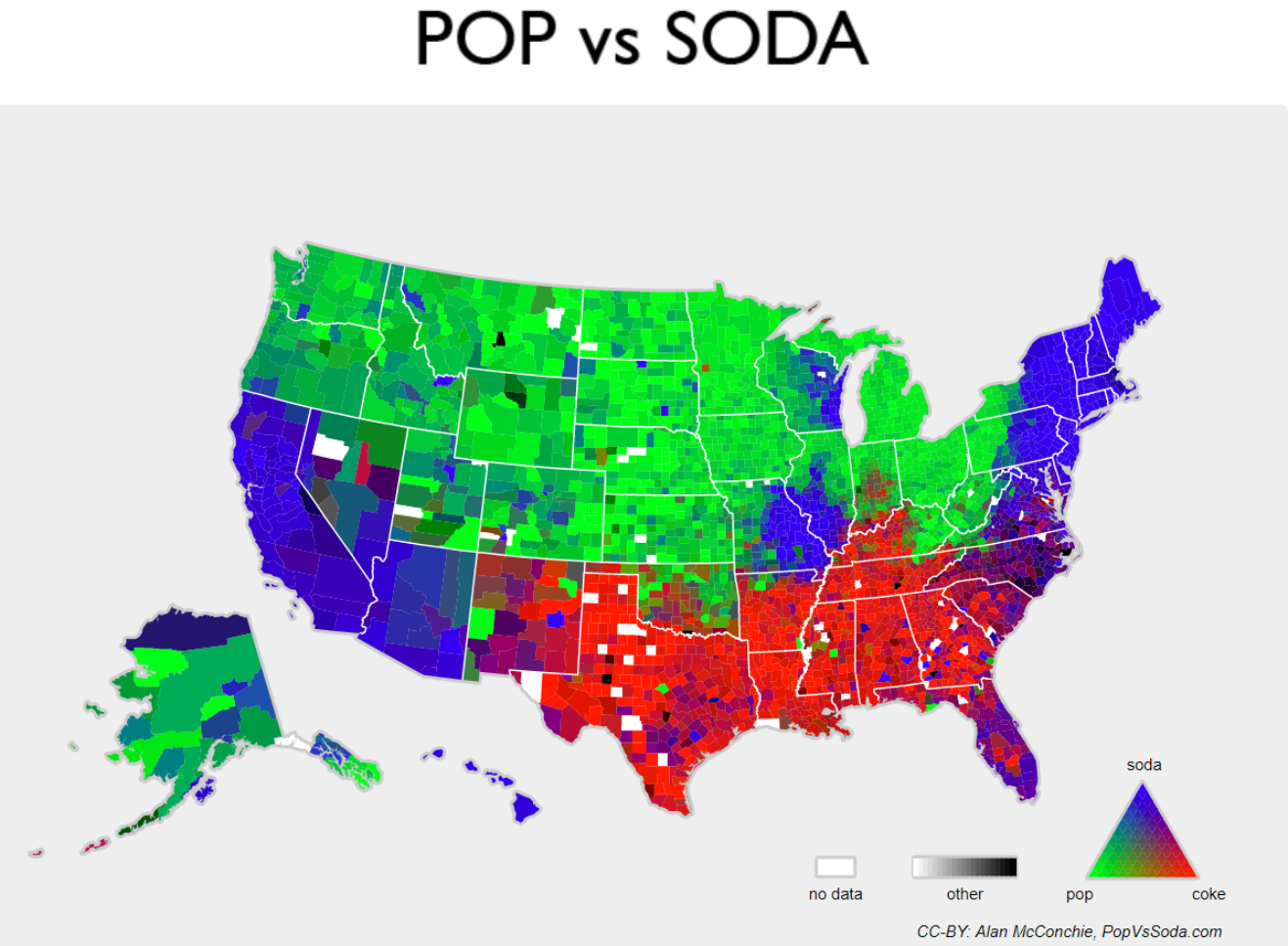
Social media → geography

Input: Tweets

Output:
Latitude,
Longitude

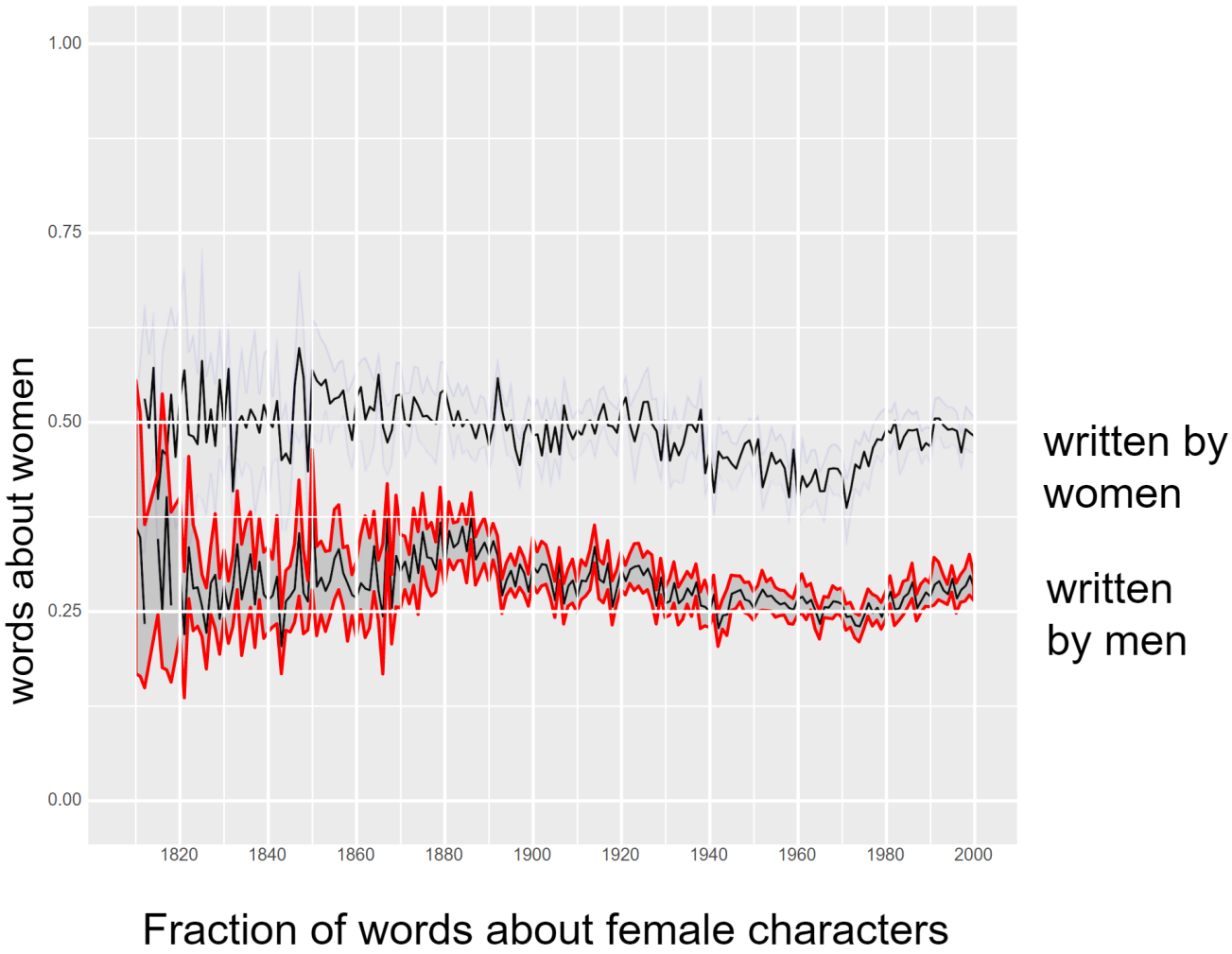


Benjamin Wing and Jason Baldridge (2011), "Simple supervised document geolocation with geodesic grids" (ACL)

Books → gendered language

Input:
Fictional texts

Output:
Prop. words about females

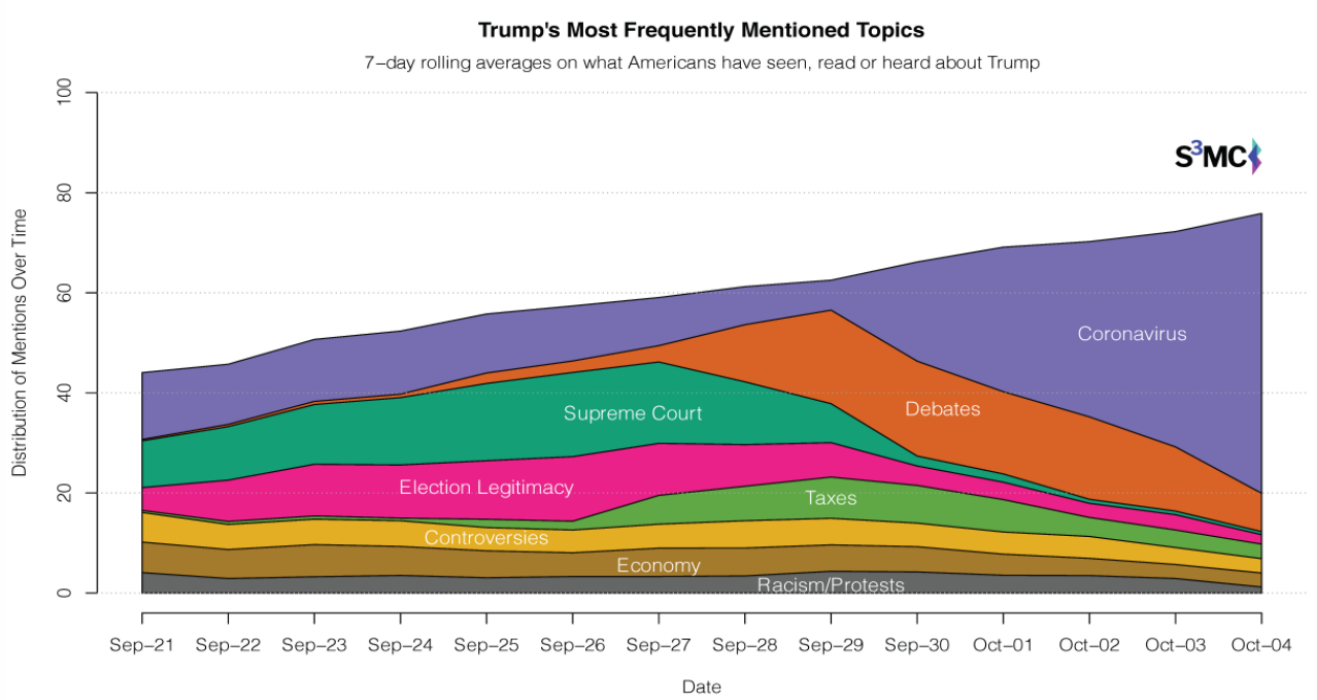


Ted Underwood, David Bamman, and Sabrina Lee (2018), "The Transformation of Gender in English-Language Fiction," (Cultural Analytics)

Presidential language → public attention

Input:
News articles

Output:
Topics recalled by public

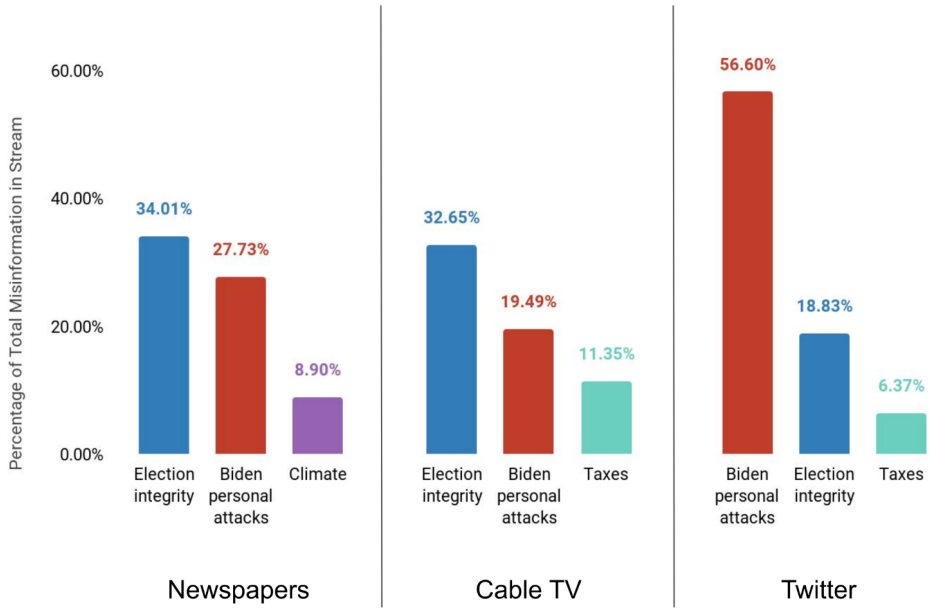


Jennifer Agiesta (2020), "In News about the Presidential Race, Coronavirus Overtakes Nearly All Else" (CNN Politics)

Digital media → misinformation over time

Input:
Articles,
tweets,
segments

Output:
Misinformation
themes pushed
by presidential
candidates

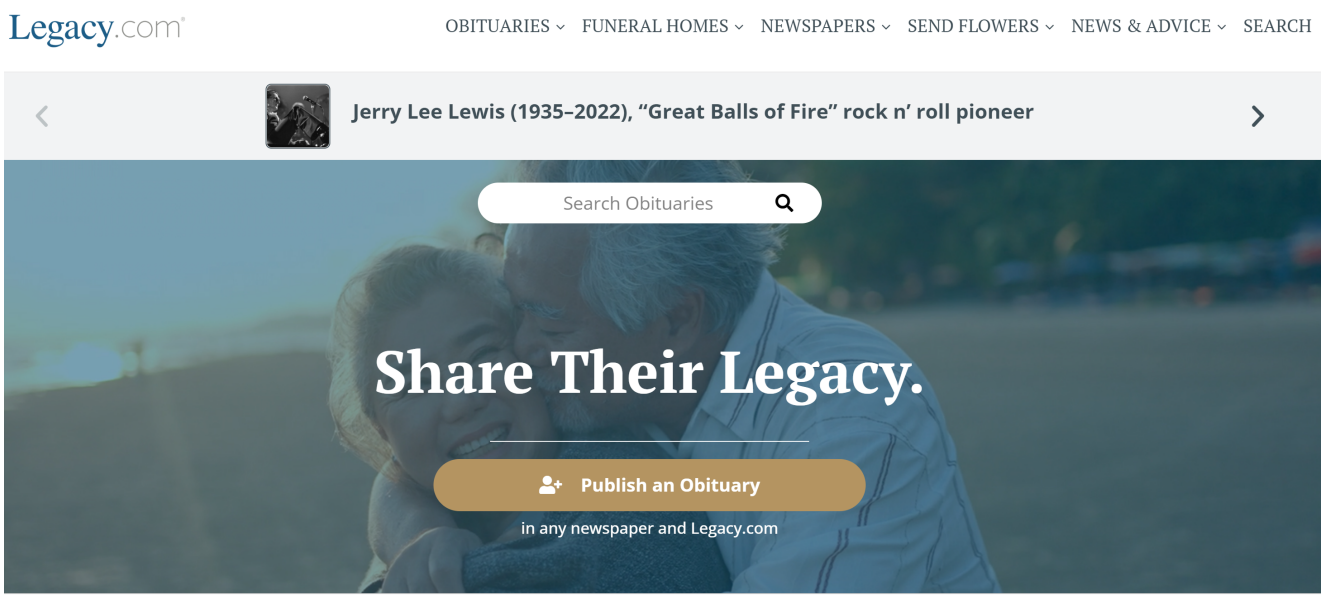


Jaren Haber, Lisa Singh, Ceren Budak, Josh Pasek, et al. (2021), Lies and presidential debates: How political misinformation spread across media streams during the 2020 election (HKS Misinfo. Review)

Obituaries → mortality by subgroups

Input:
Online obituaries from Legacy.com

Output:
Models of all-cause mortality; predicted trends



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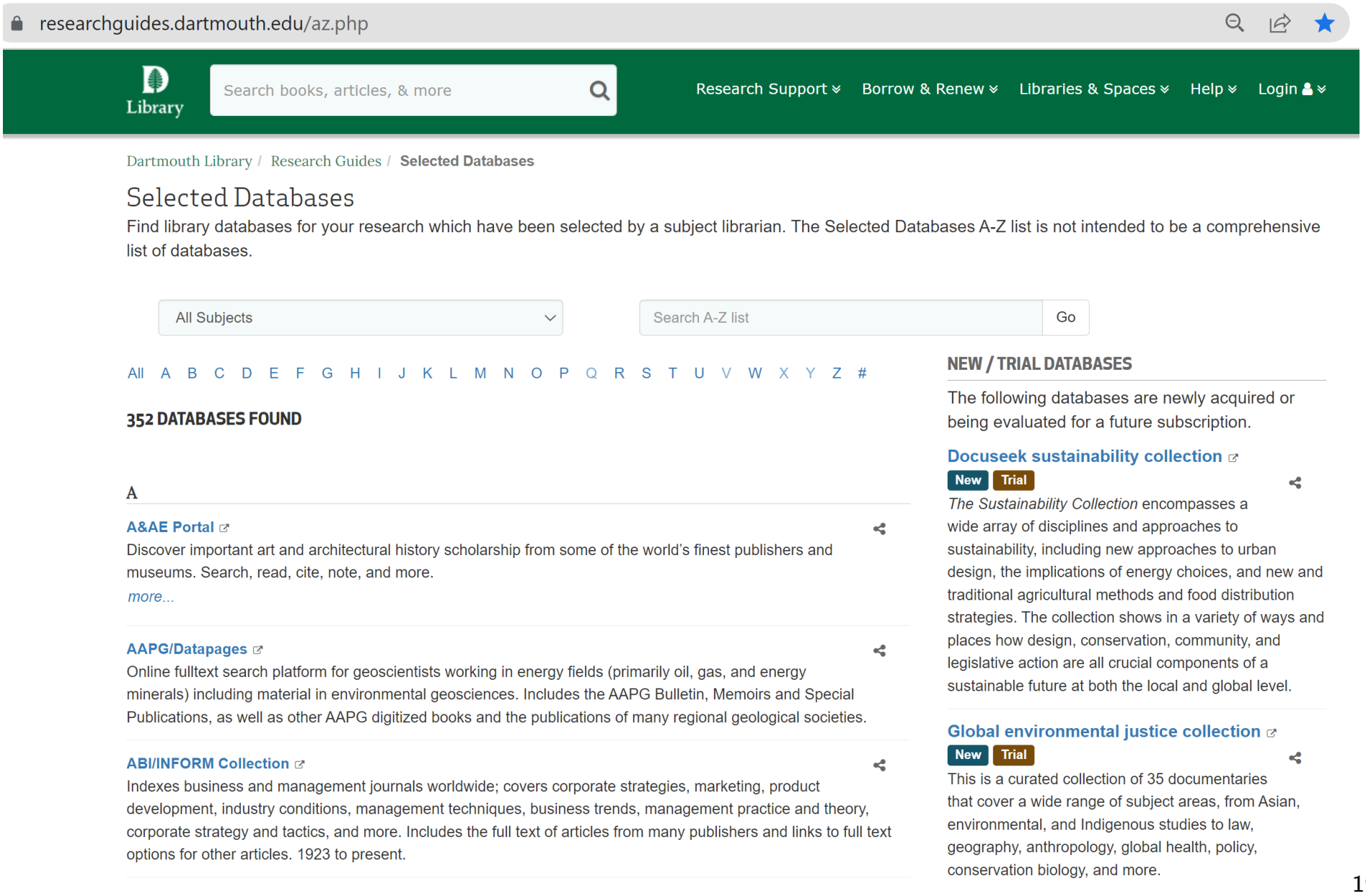
Existing data sources: Dartmouth Library



Existing data sources: Business

researchguides.dartmouth.edu/business/quicklinks

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Dartmouth Library / Research Guides / Dartmouth Library Guides / Business / Quick Links to Databases

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Find information resources on companies, industries, market research, entrepreneurship, M&A, hedge funds, private equity, finance, energy, nonprofits, healthcare, and real estate.

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QUICK LINKS TO BUSINESS DATABASES

T Restricted to Tuck
Tuck community: Find passwords/instructions
Off Campus Access: Use VDI or VPN First

Company Research

- Bloomberg
- Calcbench
- Capital IQ | Register
- D&B Hoovers
- EMIS Emerging Markets
- Intrinio | Register & Instructions
- Marketline Advantage
- Mergent Archives
- ORBIS
- PrivCo
- S&P's NetAdvantage
- Refinitiv Workspace | Register

Industry Research / Market Research

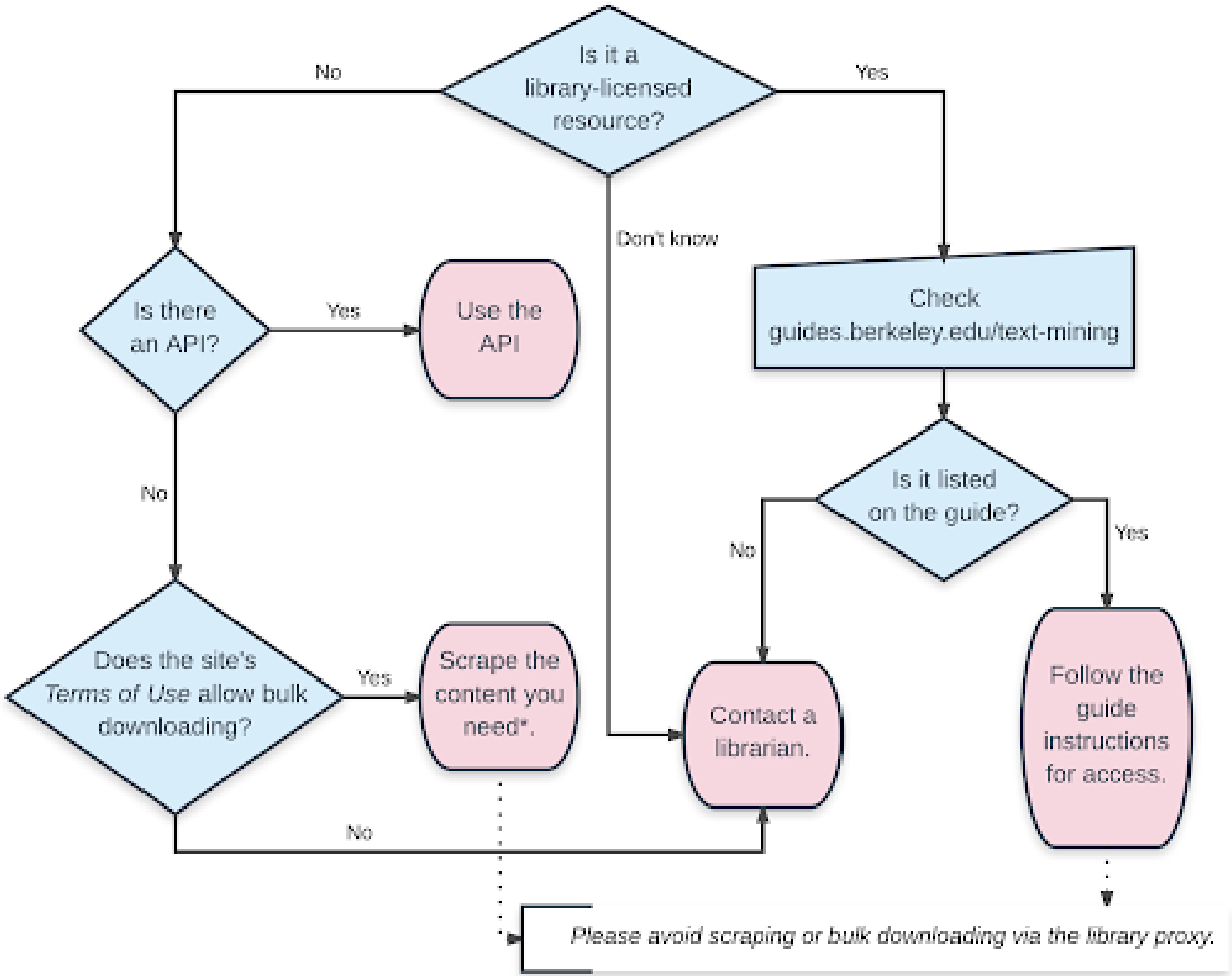
- Ad$pender
- BCC Research
- Bizminer
- Business & Community Analyst - ArcGIS
- Claritas 360
- D&B Hoovers
- EASI Market Planner
- eMarketer
- EMIS Emerging Markets
- Film Industry Data

A TO Z DATABASE DESCRIPTIONS

A-F | G-M | N-Z

- ABI/INFORM Collection
  Indexes business and management journals worldwide; covers corporate strategies, marketing, product development, industry conditions, management techniques, business trends, management practice and theory, corporate strategy and tactics, and more. Includes the full text of articles from many publishers and links to full text options for other articles. 1923 to present.
- AdSpender
  Database of top level advertising expenditure, across 18 media and for 3+ million brands. Historical 10-year database of national summary spending trends, accessible by industry, parent company, and brand.

Data acquisition decision tree: Library perspective



Web-scraping decision hierarchy

No scraping

Easy scraping

Consistent scraping

- Directory
- Scrape URLs
- Scrape HTML
- Parse HTML
- Store output
- Filter content

How the web works

Please send me the files to display this website (REQUEST)

Here you go, parse away (RESPONSE)

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```
# Simple page HTML grabbing
import requests

url =
'https://www.politifact.com/fa
ctchecks/2021/apr/02/citizens-
united/citizens-united-calls-b
idens-infrastructure-plan-g/'
response = requests.get(url)
html = response.text
```

BeautifulSoup

```
# Anchor extraction from HTML document
from bs4 import BeautifulSoup
from urllib.request import urlopen
with
urlopen('https://en.wikipedia.org/wiki/
Main_Page') as response:
    soup = BeautifulSoup(response,
'html.parser')
    for anchor in soup.find_all('a'):
        print(anchor.get('href', '/'))
```

Parsing with an exclusion list

```
soup = BeautifulSoup(open(HTML_file), "lxml")
inline_tags = ["b", "big", "i", "small", "tt", "abbr", "
    acronym", "cite", "dfn", "em", "kbd", "strong", "samp",
    "var", "bdo", "map", "object", "q", "span", "sub", "sup"
    ] # junk tags to eliminate

[s.extract() for s in soup(['style', 'script', 'head', '
    title', 'meta', '[document]'])] # Remove non-visible
    tags

for it in inline_tags:
    [s.extract() for s in soup("</" + it + ">")] # Remove
    inline tags
```

Scrapy

```
# Simple quote scraper
import scrapy
class SimpleSpider(scrapy.Spider):
    name = "simple"
    start_urls =
['http://quotes.toscrape.com/page/1/']

    def parse(self, response):
        page = response.url.split("/")[-2]
        filename = 'quotes-%s.html' % page
        with open(filename, 'wb') as f:
            f.write(response.body)
```

Terminology for scraping

- **Uniform Resource Locator (URL):** The address of information on the web and directions to get there. A URL points to resources–usually the files needed to show a website, but it can also point to raw data and such
- **Domain name**: A website identifier that begins a URL: for instance, in https://www.example.com/ this is everything from 'https' to '.com/'
- **Web-scraping (i.e., 'screen-scraping'**: Extracting structured information from the files that make up websites (i.e., what's shown in web browsers), relying on their HTML, CSS, and sometimes JS files
- **Hyper-Text Markup Language (HTML):** The standard markup language for websites, the "nuts and boltsöf WHAT a website will display, including text
- **Cascading Style Sheets (CSS):** A technology used to format the layout of a webpage, i.e. HOW to make it pretty. For web-scraping purposes, this is usually less important than the webpage's HTML

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Ethics (briefly)

Politeness good

Hacking bad

Ethics (briefly)

- How do I know what's OK to scrape?
  - Ask your IRB (they don't always know)
  - Follow the website's Terms of Service (usually)
- Am I legally liable if I break the Terms of Service?
  - Computer Fraud and Abuse Act (1986): Kindof
  - LinkedIn v. HiQ Labs (2019, 2022): Nope, web-scraping is a public right
- So is the whole web in the public domain?
  - It depends (contextual privacy; see Bit by Bit, 2017)

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Notebook for basic web-scraping

https://github.com/jhaber-zz/QSS20_public/blob/main/activities/10_part_scraping.ipynb

- Making `requests`
- Parsing HTML
- Scraping URLs

We covered

Concepts:

- Living in a digital era
- Researching the digital era
- How to scrape/crawl without reinventing the flat tire
- Intro to packages for wrangling web data
- Ethics (briefly)

Methods:

- Making `requests`
- Parsing HTML
- Scraping URLs (maybe self-study)

Last thing: Notecards

What's one thing you learned today and one lingering question or challenge?