

GEOG 4/590: Geospatial Data Science

Lecture 7: Data access



Email: jryan4@uoregon.edu

Office: 163A Condon Hall

Office hours: Monday 15:00-16:00 and Tuesday 14:00-15:00

- Max/Anna A/Isaac: Tsunami evacuation from the Oregon coast
- Emerson: Rainfall and household water supply
- Hana: Vegetation recovery times in response to fire regimes/disturbances in Siberia
- Dalton/Timmy/Shauny: Coastal erosion/water levels in the Great Lakes region
- Addy/Kelly: Ice breakup in the Yukon River Delta
- Haley/Lauren/Kent/Anna J: Grocery store access in Eugene via public transport
- Jasper/Sam F/Bowie: Short and long-term vegetation recovery post-wildfire
- Ethan: School funding and education outcomes
- Adamaryz: Rural access to higher education
- Parker: Barriers to lamprey fish migration
- Sam G: Tracking neighborhood cat using GPS
- Devlin: Hillslope analysis from LiDAR data

No assignment this week!

- Recommend that time is used to get started on projects
 - Directory structure
 - Package installations
 - GitHub workflow
 - Data!
- We will check-in next week to make sure everyone has data and a plan
- Designate a team leader and assign tasks to team members

Data access

Finding, downloading, and cleaning data is an important, but laborious, part of geospatial data science. In this demo, we will download data programmatically using Application Programming Interfaces (APIs). We will also talk about strategies for downloading data when an API is unavailable or insufficient.

APIs

So far in this course we have mainly been using data that has been downloaded **locally** from point-and-click GUIs. But it is becoming more and more common to access data programmatically from an online server. These platforms often have a **public API** that we can use to pull data inside our Python environment.

APIs

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An API is a type of **software** that provides a **standard set of protocols/functions** so that our computer can **communicate** with other computers (in contrast, a **user interface** is a type of software that connects a **computer to a person**)

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The basic idea is we send a **request** (which may include query parameters and access credentials) to an endpoint. That endpoint will return a **response** code plus the data we asked for. For these kind of tasks, we have to carefully inspect the API **documentation** to understand what functions are available and what keyword arguments they require.

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Many organizations have great APIs because they want people to use their data.

Census Bureau

The US Census Bureau has a great API that makes demographic, socio-economic and housing statistics more accessible than ever before.

Developers use customize these statistics to create apps that:

- Provide a local government a range of socioeconomic statistics on its population.
- Show commuting patterns for every city in America.
- Display the latest numbers on owners and renters in a neighborhood someone may want to live in.

Many students will use Census Bureau data in their final projects.

CenPy

CenPy is an interface to explore and query the US Census API in Python. It conveniently returns the data in Pandas Dataframes for further analysis.

We know CenPy is legitimate because it has an **active GitHub repository**.

[Code](#)[Issues 41](#)[Pull requests 5](#)[Actions](#)[Projects 1](#)[Wiki](#)[Security](#)[Insights](#)[master](#)[1 branch](#)[3 tags](#)[Go to file](#)[Add file](#)[Code](#) **ljwolf** Merge pull request #151 from ljwolf/b150 ...

✓ 63d368e on Sep 22, 2022 ⏲ 386 commits

 .ci	add Python 3.9 to testing matrix	2 years ago
 .github/workflows	add Windows to testing matrix	2 years ago
 cenpy	fix string quoting in init	5 months ago
 docs	add set_sitekey to the documentation	4 years ago
 docsrc	add set_sitekey to the documentation	4 years ago
 img	move census hierarchy image to org-safe location	4 years ago
 notebooks	clarifications to text	3 years ago
 .gitattributes	Add .gitattributes [skip ci]	2 years ago
 .gitignore	add cenpy feedstock to gitignore	4 years ago
 .pre-commit-config.yaml	add black & black commit hook	4 years ago
 LICENSE	add attribution clause to cenpy license	8 years ago
 MANIFEST.in	changed cases for requirements.txt	4 years ago
 README.rst	update wrong status address for GHA badge	2 years ago
 api.key	add fips lookup	8 years ago
 environment.yml	keep environment.yml for binder usage	2 years ago
 requirements.txt	stop shouting about requirements files	4 years ago
 setup.py	fix string quoting in init	5 months ago

About

Explore and download data from Census APIs

[Readme](#)[View license](#)[157 stars](#)[10 watching](#)[43 forks](#)

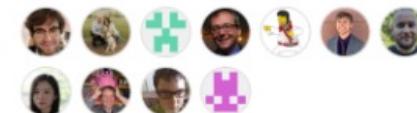
Releases 3

 **Bugfix release** Latest on Sep 22, 2022[+ 2 releases](#)

Packages

No packages published

Contributors 14

[+ 3 contributors](#)

CenPy

First we should find how to install it, either using `conda` or `pip` depending on which virtual environment manager (`conda` or `venv`) we are using.

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Installation

Cenpy is easiest to install using `conda`, a commonly-used package manager for scientific python. First, [install Anaconda](#).

Then, `cenpy` is available on the `conda-forge` channel:

```
conda install -c conda-forge cenpy
```

Alternatively, you can install cenpy via `pip`, the python package manager, if you have installed `geopandas` and `rtree`:

```
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```

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```

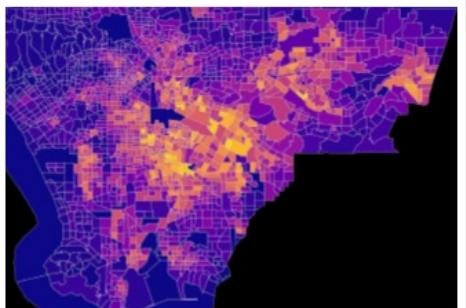
```
# Import library
from cenpy import products
import matplotlib.pyplot as plt
```

CenPy

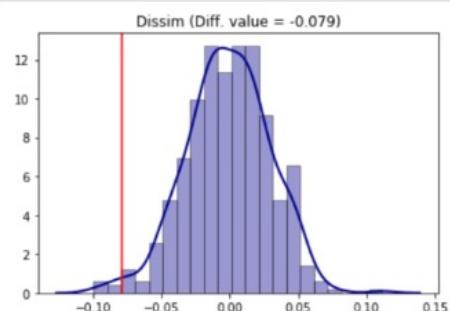
Then search the documentation for examples...

Cenpy

Cenpy (pronounced sen-pie) is a package that automatically discovers US Census Bureau API endpoints and exposes them to Python in a consistent fashion. It also provides easy-to-use access to certain well-used data products, like the American Community Survey (ACS) and 2010 Decennial Census. To get started, check out one of the case studies shown below.

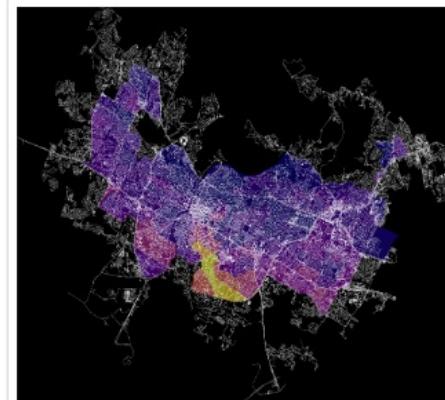


Getting Data using cenpy



Thus, we see that Austin is significantly less segregated than Phoenix, even when accounting for the uncertainty around estimating the Dissimilarity metric.

Segregation in Time and Space with cenpy and pysal



A Road to Frictionless Urban Data Science: osmnx and cenpy

The building blocks of cenpy

Cenpy (sen - pie) is a package that exposes APIs from the US Census Bureau and makes it easy to pull down and work with Census data in Pandas.

The Underlying Architecture of cenpy

CenPy

```
acs = products.ACS(2019)  
acs
```

Connection to American Community Survey: 5-Year Estimates: Detailed Tables 5-Year (ID: https://
With MapServer: Census ACS 2019 WMS

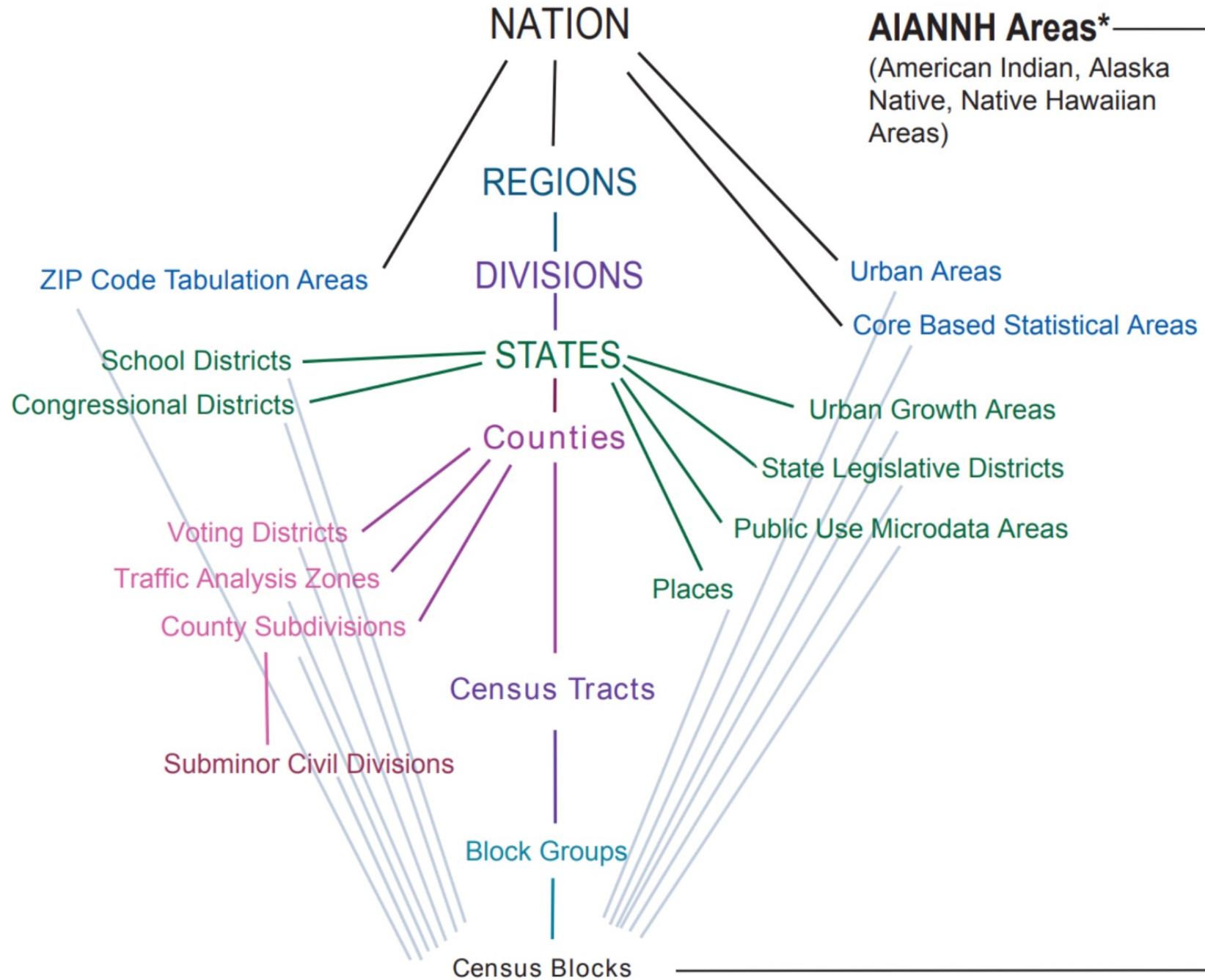
CenPy

```
acs = products.ACS(2019)  
acs
```

Connection to American Community Survey: 5-Year Estimates: Detailed Tables 5-Year (ID: <https://>)
With MapServer: Census ACS 2019 WMS

```
# Find tables containing keyword  
acs.filter_tables('POPULATION', by='description')
```

table_name	description	columns
B01003	TOTAL POPULATION	[B01003_001E]
B05006	PLACE OF BIRTH FOR THE FOREIGN-BORN POPULATION...	[B05006_001E, B05006_002E, B05006_003E, B05006...]
B05007	PLACE OF BIRTH BY YEAR OF ENTRY BY CITIZENSHIP...	[B05007_001E, B05007_002E, B05007_003E, B05007...]
B05008	SEX BY PLACE OF BIRTH BY YEAR OF ENTRY FOR THE...	[B05008_001E, B05008_002E, B05008_003E, B05008...]
B05013	SEX BY AGE FOR THE FOREIGN-BORN POPULATION	[B05013_001E, B05013_002E, B05013_003E, B05013...]



CenPy

```
# Download data
lane_pop = products.ACS(2019).from_county('Lane County, OR',
                                             level='tract',
                                             variables=['B01003_001E']) # don't worry about the a
```

```
/opt/anaconda3/envs/gds/lib/python3.8/site-packages/cenpy/products.py:762: FutureWarning: The
  return self._from_name(county, variables, level, "Counties", **kwargs)
```

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return self._from_name(county, variables, level, "Counties", **kwargs)
```

```
lane_pop.head()
```

	GEOID	geometry	B01003_001E	NAME	state	county	tract
0	41039000705	POLYGON ((-13817570.420 5462507.770, -13817562...))	3686.0	Census Tract 7.05, Lane County, Oregon	41	039	000705
1	41039004000	POLYGON ((-13705354.030 5475460.590, -13705335...))	2473.0	Census Tract 40, Lane County, Oregon	41	039	004000
2	41039003000	POLYGON ((-13704040.350 5477214.460, -13704036...))	4542.0	Census Tract 30, Lane County, Oregon	41	039	003000

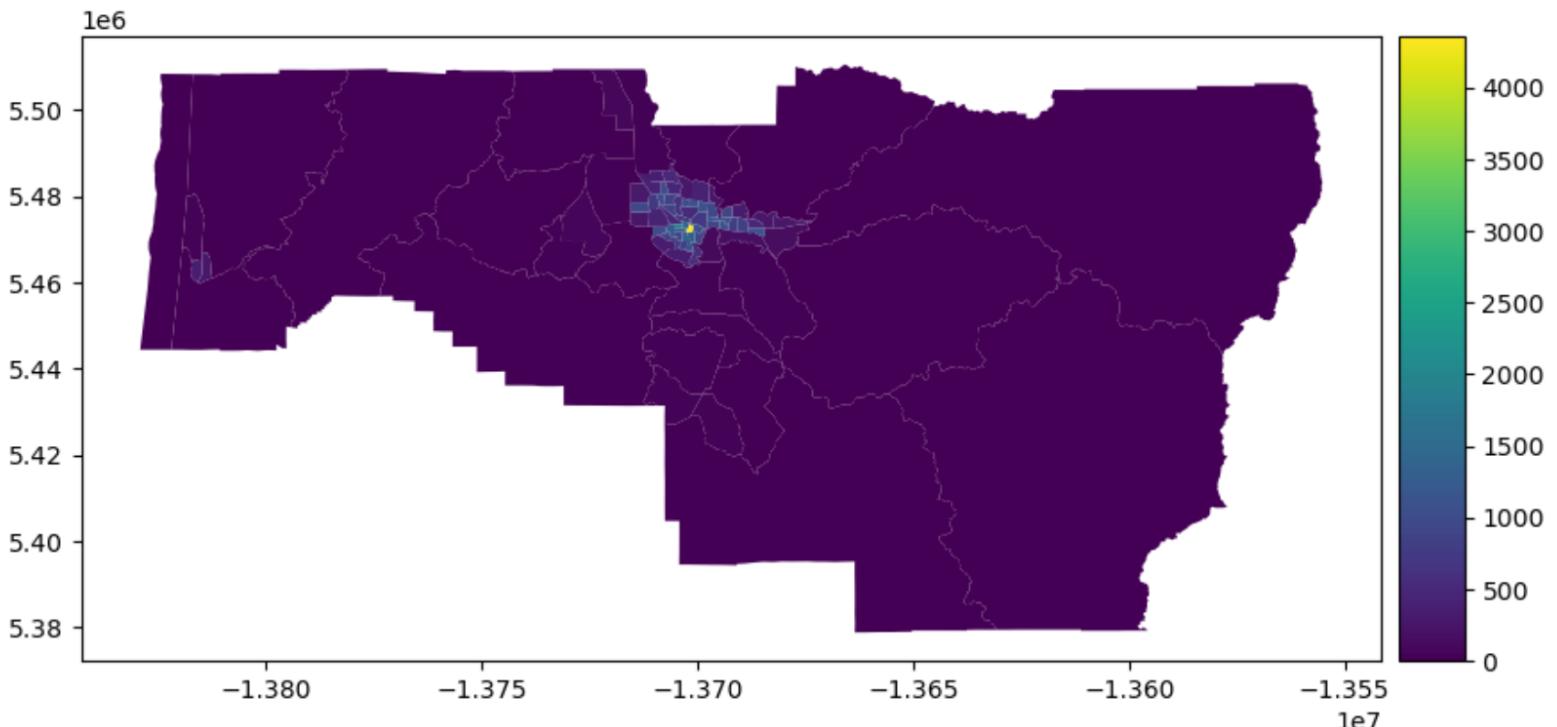
```
# Compute population density
lane_pop['pop_density'] = lane_pop['B01003_001E'] / (lane_pop['geometry'].area / 1e+6)

from mpl_toolkits.axes_grid1 import make_axes_locatable

# Plot map
f, ax = plt.subplots(1, 1, figsize=(10,10))

# These two lines make the colorbar the same size as the axes.
divider = make_axes_locatable(ax)
cax = divider.append_axes("right", size="5%", pad=0.1)

lane_pop.plot('pop_density', ax=ax, legend=True, cax=cax)
```



USGS hydrologic data

Let's have a look at another API called [dataretrieval](#) which was developed by USGS to retrieve hydrologic data.

[Code](#) [Issues 15](#) [Pull requests 1](#) [Projects](#) [Security](#) [Insights](#)[master](#) [5 branches](#) [7 tags](#)[Go to file](#)[Add file](#)[Code](#)

 thodson-usgs	Update DISCLAIMER.md	✓ 73f3ae8 5 days ago	⌚ 98 commits
 .github/workflows	Defining a user-agent in GET requests (#86)		last week
 .gitlab	Domain and code review		last week
 dataretrieval	Defining a user-agent in GET requests (#86)		last week
 demos	Improve documentation (#72)		2 months ago
 docs	Defining a user-agent in GET requests (#86)		last week
 tests	Defining a user-agent in GET requests (#86)		last week
 .gitignore	Defining a user-agent in GET requests (#86)		last week
 CONTRIBUTING.md	Revised Contributing File (#81)		3 weeks ago
 DISCLAIMER.md	Update DISCLAIMER.md		5 days ago
 LICENSE.md	HTML Rendered Documentation via Sphinx (#54)		3 months ago
 README.md	Domain and code review		last week
 code.json	Update code.json for release		5 days ago
 pyproject.toml	Defining a user-agent in GET requests (#86)		last week
 requirements-dev.txt	Improve documentation (#72)		2 months ago
 requirements.txt	Broaden Continuous Integration Workflow (#52)		3 months ago
 setup.py	Update setup.py		2 months ago

About

Tools for downloading hydrologic and climate data.

[doi-usgs.github.io/dataretrieval-python/](#)

 Readme

 View license

 72 stars

 7 watching

 21 forks

Releases 6

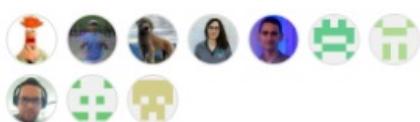
 v1.0.2 Latest
4 days ago

[+ 5 releases](#)

Packages

No packages published

Contributors 10



USGS hydrologic data

On the GitHub [REAMDE.md](#) for this package it says we can also install `dataretrieval` using `conda` or `pip`.

Quick start

`dataretrieval` can be installed using `pip`:

```
$ python3 -m pip install -U dataretrieval
```

or `conda`:

```
$ conda install -c conda-forge dataretrieval
```

More examples of use are include in [demos](#).

USGS hydrologic data

Now we can look through the documentation and test some examples

```
# Import the functions for downloading data from NWIS
import dataretrieval.nwis as nwis

# Specify the USGS site code
site = '03339000'

# Get instantaneous values (iv)
df = nwis.get_record(sites=site, service='dv', start='2020-10-01', end='2021-09-30')
df.head()
```

00010_Mean 00010_Mean_cd site_no 00060_Mean 00060_Mean_cd 00

datetime

2020-10-01 00:00:00+00:00	14.9	A	03339000	75.7	A
------------------------------	------	---	----------	------	---

2020-10-02 00:00:00+00:00	14.5	A	03339000	66.0	A
------------------------------	------	---	----------	------	---

2020-10-03 00:00:00+00:00	14.2	A	03339000	60.2	A
------------------------------	------	---	----------	------	---

2020-10-04 00:00:00+00:00	14.4	A	03339000	68.8	A
------------------------------	------	---	----------	------	---

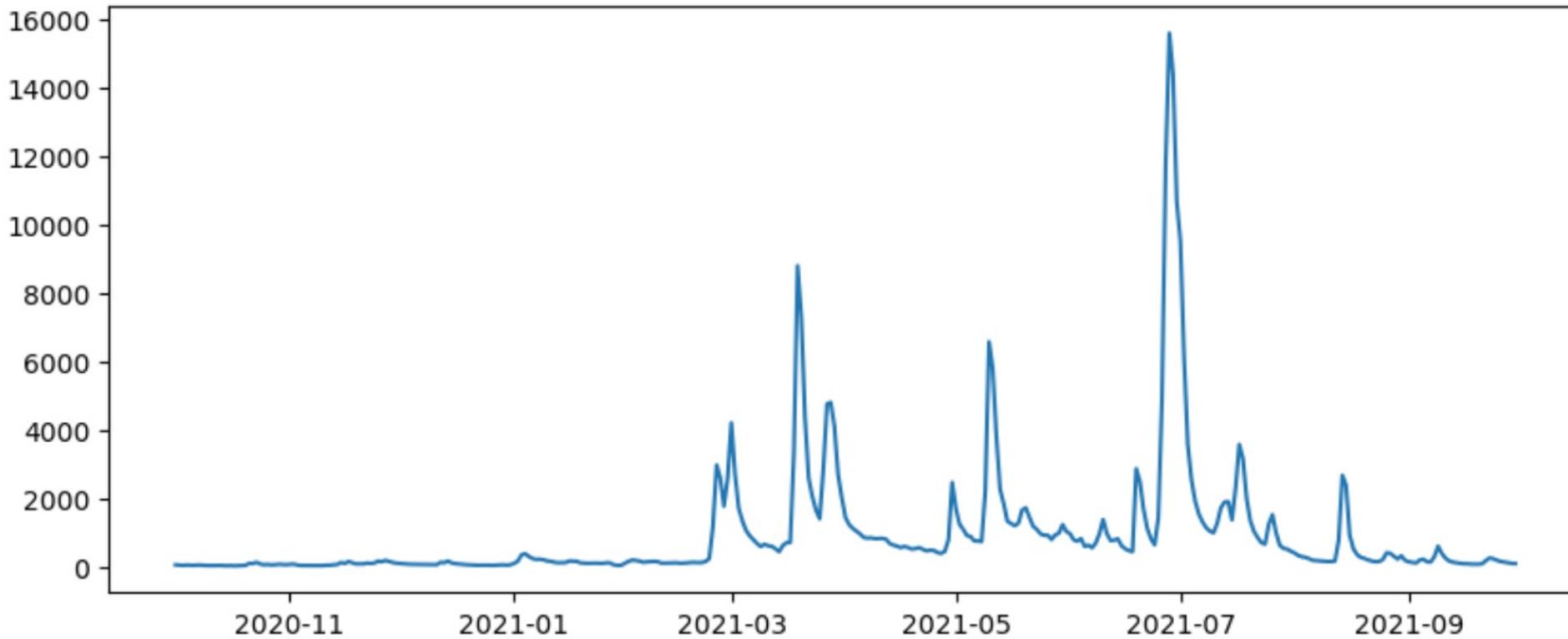
2020-10-05 00:00:00+00:00	13.4	A	03339000	66.8	A
------------------------------	------	---	----------	------	---

5 rows × 59 columns

USGS hydrologic data

```
# Plot  
f, ax = plt.subplots(1, 1, figsize=(10,4))  
ax.plot(df['00060_Mean'])
```

```
[<matplotlib.lines.Line2D at 0x7fc731f81b50>]
```



Tips for APIs

- Take a minute to make sure that package is used (e.g. lots of forks, stars) and up-to-date (e.g. last commit)
- Read the `docs`, `demos`, `examples` and hope we find what we're looking for (sometimes they are not that comprehensive)
- If you can't find what you're looking for, inspect the source code (`.py` files)

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API limits

Often APIs are sometimes not available or have limitations. Technology companies **hoard data** to secure market dominance. But this is a problem because, by guarding data, they are also preventing it **being used** for good causes. Without access to their data it is difficult to tell whether they are in **compliance**.

Zillow API

Data Usage

Q: Can we retrieve and store Zillow data?

A: No. You may use the API only to retrieve and display dynamic content from Zillow. You are not permitted to store information locally.

Q: Instead of using the API, can we reverse engineer a data feed or manually pull information from Zillow?

A: No. We permit third parties to retrieve data from our site only through the API. Any reverse engineering, spiders, or other techniques used to directly pull data without using the Zillow API is a violation of our [Terms of Use](#).

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Terms of Use

Q: What happens when my site hits 1,000 calls in a day?

A: Zillow is no longer actively adjusting call volumes on our self-register API. All future API access will be managed through our middleware platform Bridge. If you would like to learn more about accessing Bridge, and discussing adjusted call volumes, please contact api@bridgeinteractive.com.

Q: How many API calls can I have on the same page?

A: You can run up to 20 API calls on one page at one time.

Frequently asked questions

^ How can I get access to Airbnb's API?

At this time, we are not accepting new access requests for our API. Our global team of partner managers will reach out to prospective partners based on the supply opportunity your business represents, strength of your technology, and ability to support our shared customers.

Web scraping

- Since web pages are usually organized in a specific way, we can still download data from them.
- Web scraping (also known as crawling or harvesting) is the practice of **automatically** gathering data from the internet without the use of an **API**
- Most commonly accomplished by writing a program that **queries** a web server, **requests** data (usually in the form of HTML), and **parses** that data to extract information

Pricing

	Business	Enterprise Basic	Enterprise Premium	On Demand
	\$ 150+ <small>①</small> per month per website Monthly subscription required One-time setup fees additional	\$ 1000+ <small>①</small> per month Monthly subscription required One-time setup fees additional	\$ 5000+ <small>①</small> per month Monthly subscription required Setup fees included	\$ 450+ <small>①</small> per website per refresh No subscription required Setup fees included
Frequency of Data Gathering	Monthly or Weekly	Any	Any	One Time
Best for Number of Sites	3 or less	Up to 10	Any	1+
Number of Pages per month	Up to 10K per site <small>①</small>	Any with 1MM included <small>①</small>	Any with 1MM+ included <small>①</small>	1-10K pages per site <small>①</small>
Resources and Support	Shared <small>①</small>	Shared <small>①</small>	Dedicated <small>①</small>	Shared <small>①</small>
Site Complexity	Basic to Medium	Any	Any	Any
Pricing for Additional Pages	-	\$450+ per million pages <small>①</small>	\$300+ per million pages <small>①</small>	-

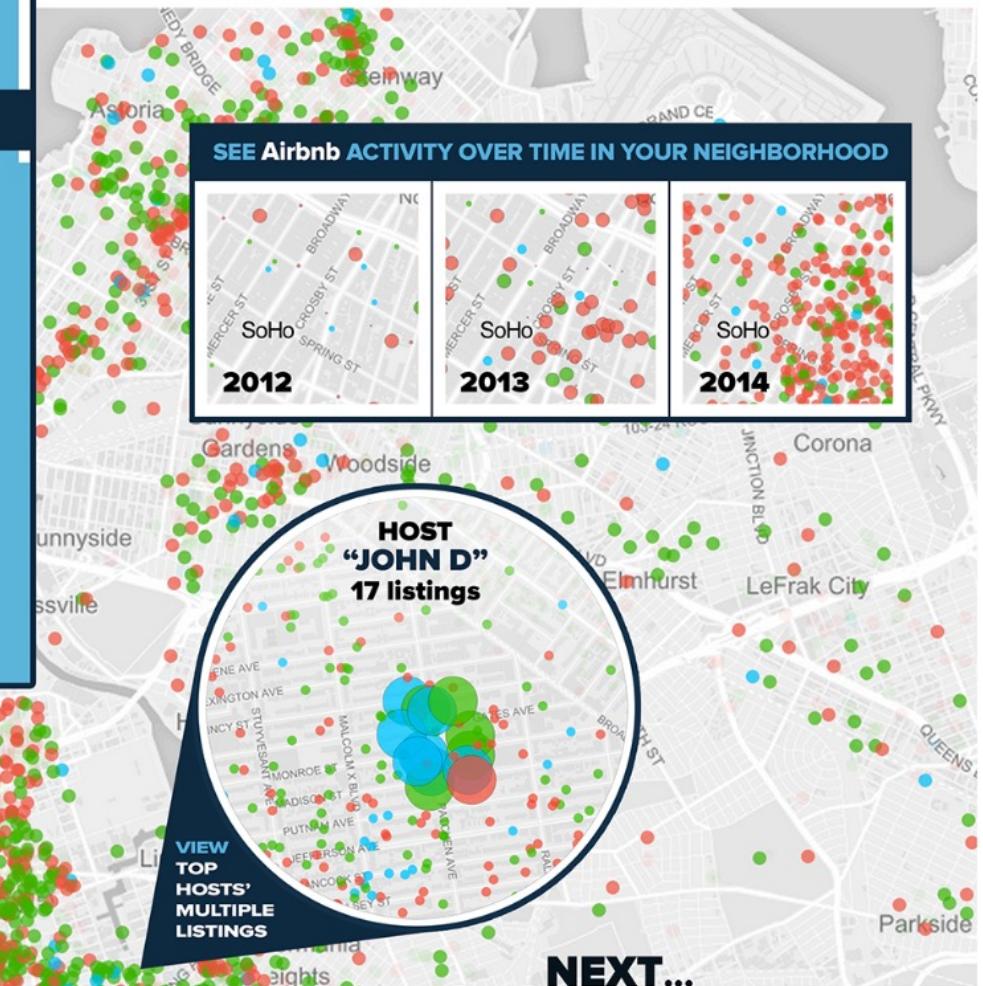
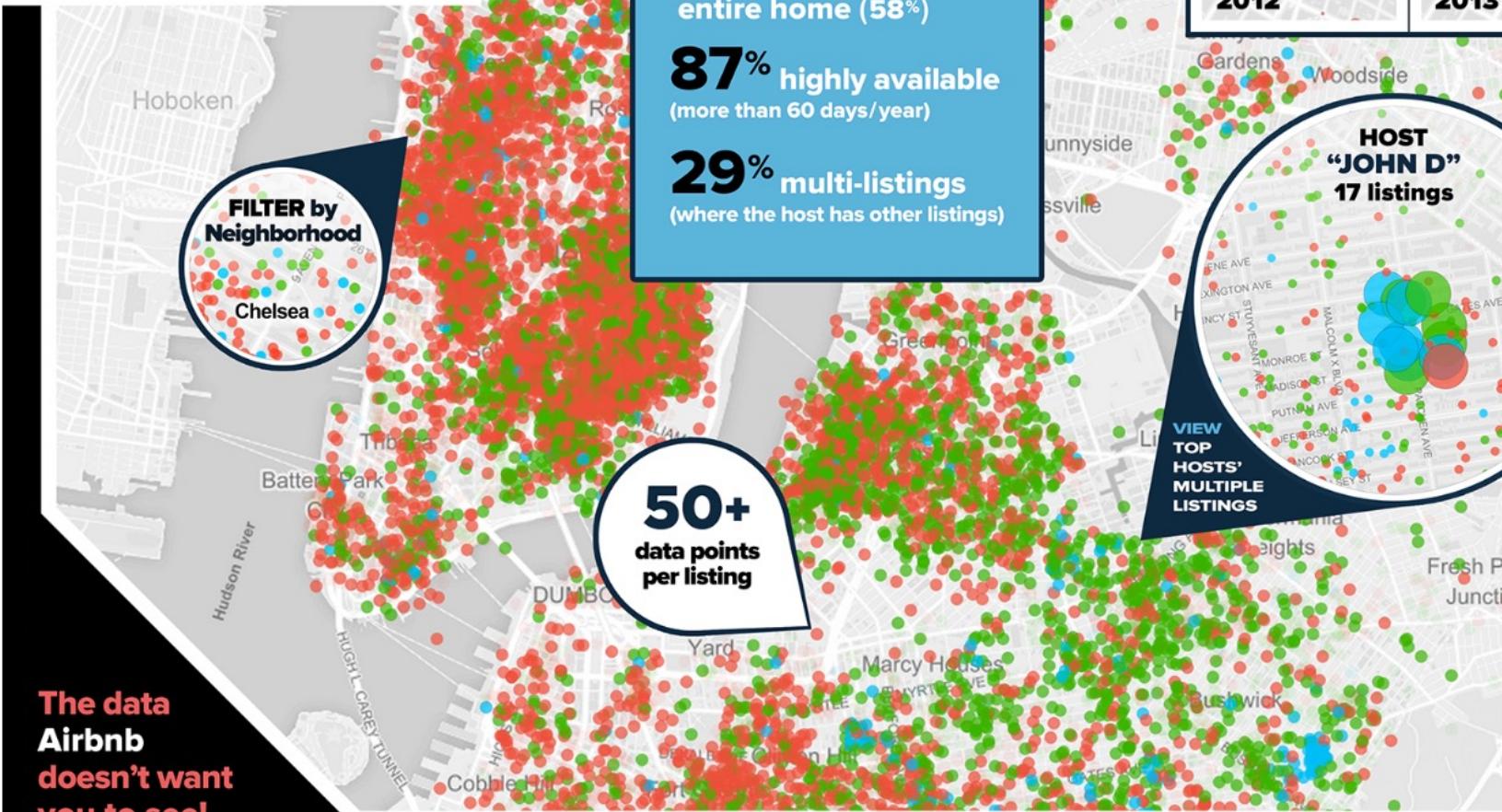
[Sign up for these plans](#)

Inside Airbnb

Adding data to the debate

INDEPENDENT, NON-COMMERCIAL,
OPEN SOURCE DATA TOOL

How is Airbnb really
being used in and affecting
your neighborhood?



- VISIT insideairbnb.com
- SHARE it widely
 - f
 - t
 - #insideairbnb #illegalhotels
#affordablehousing #nyc
- DOWNLOAD the data
(open source; 50+ data points per listing)

Suppose a friend wanted to do this?

- `requests`: standard Python library for requesting data from the web
- `BeautifulSoup`: a library for pulling data out of HTML and XML files
- `selenium`: is a library for performing **web browser automation**

requests

A lot of data on Wikipedia is contained in HTML tables which have the following syntax.

- The table itself starts with the `<table>` tag and finishes with `</table>`
- Table rows start with the `<tr>` tag and finish with `</tr>`
- Table headers start with the `<th>` tag and finish with `</th>`
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requests

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The table below, showing some of the biggest soccer clubs in the world, is an example of a simple HTML table.

Team	Manager	Country
Real Madrid	Carlo Ancelotti	Spain
Bayern Munich	Julian Nagelsmann	Germany
Hull City	Liam Rosenior	England
Paris Saint-Germain	Christophe Galtier	France

```
<table>
  <tr>
    <th>Team</th>
    <th>Manager</th>
    <th>Country</th>
  </tr>
  <tr>
    <td>Real Madrid</td>
    <td>Carlo Ancelotti</td>
    <td>Spain</td>
  </tr>
  <tr>
    <td>Bayern Munich</td>
    <td>Julian Nagelsmann</td>
    <td>Germany</td>
  </tr>
  <tr>
    <td>Hull City</td>
    <td>Liam Rosenior</td>
    <td>England</td>
  </tr>
  <tr>
    <td>Paris Saint-Germain</td>
    <td>Christophe Galtier</td>
    <td>France</td>
  </tr>
</table>
```

requests

```
# Import packages
import requests

# Open a webpage
html = requests.get('https://en.wikipedia.org/wiki/Climate_of_Oregon')

# HTML
html
```

```
<Response [200]>
```



Climate of Oregon

From Wikipedia, the free encyclopedia

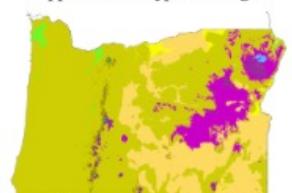
According to the Köppen climate classification, most of Western Oregon has a warm-summer mediterranean climate (or Csb type), which features warm summers, and wet winters with frequent overcast and cloudy skies. Eastern Oregon falls into the cold semi-arid climate (or BSk type), which features drier weather.

West of the Cascade Range, winters are chilly with frequent rain and occasional snow. Temperatures can get very cold, but only occasionally, as the result of Arctic cold waves. The high desert region of the state is much drier, with less rain, more snow, colder winters, and hotter summers.^[1]

Contents [hide]

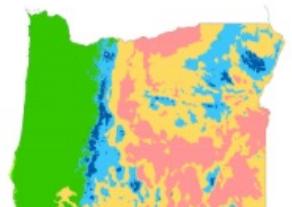
- 1 Precipitation
 - 1.1 Snow
- 2 Temperature
- 3 Selected climate charts
- 4 See also
- 5 References
- 5.1 Works cited

Köppen climate types of Oregon



Köppen climate types in Oregon

Trewartha climate types of Oregon



Trewartha climate types of Oregon



Precipitation [edit]

Precipitation in the state varies widely: some western coastal slopes approach 200 inches (5,100 mm) annually, while the driest places, such as the Alvord Desert (in the rain shadow of Steens Mountain) in eastern Oregon, get as little as 5 inches (130 mm).^{[2][3]}

The Pacific Ocean, the moisture-laden air above it, and the storms moving from it over the Oregon coast, are major factors in the state's precipitation patterns. As humid ocean air flows east from the ocean and encounters the Coast Range, it rises steeply, cools, and loses moisture through condensation, which produces heavy rain. The heaviest precipitation in the state occurs at 2,000 to 4,000 feet (610 to 1,220 m) above sea level in these coastal mountains. At lower elevations along the coast, orographic precipitation is less intense but still produces 60 to 80 inches (1,500 to 2,000 mm) a year.^[2]

In the Willamette Valley east of the Coast Range, storms "blowing" from the Pacific retain enough moisture to drop from 35 to 45 inches (890 to 1,140 mm) annually in the most heavily populated part of the state. East of the valley, the storm air rises again as it meets the Cascade Range, cooling once more and forming condensate at elevations often as low as 3,000 feet (910 m).^[2] Since volcanic peaks in the range are quite high—more than 11,000 feet (3,400 m) in the case of Mount Hood^[4]—most of the remaining Pacific moisture falls here in the form of rain or snow.^[2]

The remaining two-thirds of the state is relatively dry, classified as semi-arid, with large areas receiving no more than 12 inches (300 mm) a year. Exceptions occur at higher elevations in the Blue Mountains and the Wallowa Mountains to the northeast, which get 50 to 80 inches (1,300 to 2,000 mm) a year.^[2]

Across Oregon, the wet season runs from November through March, when the jet stream is strongest in the Northern Hemisphere. Precipitation is less in the months between winter and summer: April through June in the spring and September and October in the fall. Statewide, the dry months are July and August, when moisture arrives during afternoon thunderstorms, mainly in the mountains, and less often from storms that reach the north coast and adjacent counties.^[5]

Snow [edit]

Snowfall in Oregon is greatest in the Cascade Range. Based on data from ski resorts and a few official weather stations, average annual snowfall in the Cascades can range from 300 to 550 inches (760 to 1,400 cm).^[3] The state's largest annual snowfall on record, 903 inches (2,290 cm), occurred at Crater Lake in the Cascades in 1950.^[6] In the Blue Mountains of eastern Oregon, snowfall totals can also be large, between 150 and 300 inches (380 and 760 cm). On the other hand, most winter precipitation in the Coast Range falls as rain, though heavy snow sometimes occurs.^[3]

In most mountain areas in Oregon, the ground above 4,500 feet (1,400 m) is covered with snow from December through April. Snow depths, which vary with elevation and time of year, average an estimated 50 to 100 inches (130 to 250 cm) in the Cascades and 25 to 65 inches (64 to 165 cm) in the Blue Mountains at the end of January; by the end of April, they diminish to 40 to 120 inches (100 to 300 cm) in the Cascades and 5 to 45 inches (13 to 114 cm) in the Blues. Glaciers remain year-round on some Cascade peaks higher than 7,000 feet (2,100 m) above sea level.^[3]

Annual snowfall along the coastal plain averages 1 to 3 inches (2.5 to 7.6 cm) a year, including years with none. Further inland, between the Coast Range and the Cascades, snowfall generally averages from 5 to 10 inches (13 to 25 cm) a year. East of the Cascades, in non-mountain settings, the annual totals range from 15 to 75 inches (38 to 191 cm), depending on location; they are smallest in the north-central region and the Snake River basin in the southeast and largest in the northeastern valleys and in the high

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[Enlarge](#)

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Extreme Weather: Oregon experiences occasional extreme weather events, including major flooding events like the 1996 John Day River flood and the 2012 Willamette River flood. The state also experiences occasional droughts, particularly in the interior high desert areas.

Human Impact: Human activity has had a significant impact on Oregon's climate. Deforestation, urbanization, and agricultural practices have all contributed to changes in the state's climate. The state's climate is also affected by global climate change, with increasing temperatures and more frequent extreme weather events.

Conclusion: The Climate of Oregon is a complex and varied topic. The state's unique geography and climate patterns make it a fascinating subject for study. Whether you're interested in the state's natural history or its impact on human society, there's a lot to learn about the Climate of Oregon.

[Jump to navigation](#)[Jump to content](#)

A large square image representing the K鰐ppen climate classification for Oregon, showing a map of the state with various colors indicating different climate zones.

[Enlarge](#)

Jump to search Jump to navigation Jump to content

Climate of Oregon is the climate of the U.S. state of Oregon. The state has a wide range of climates, from the arid desert in the southeast to the temperate rainforest in the northwest. The climate is influenced by the Pacific Ocean to the west and the Cascade Range to the east.

The state's climate is generally characterized as being cool and wet, with significant seasonal variation. The

BeautifulSoup4

- Now we could write a program to **parse** this HTML code (i.e. split into useful blocks)...
- ...or we could use another package called **BeautifulSoup** (also known as **bs4**) a Python library for parsing data out of HTML and XML files



BeautifulSoup4

- Now we could write a program to **parse** this HTML code (i.e. split into useful blocks)...
- ...or we could use another package called **BeautifulSoup** (also known as **bs4**) a Python library for parsing data out of HTML and XML files



```
# Import package
from bs4 import BeautifulSoup, SoupStrainer

# Read HTML content as "soup object" and define default parser
soup = BeautifulSoup(html.text, 'html.parser')
```

BeautifulSoup4

Parse HTML

The `.find` and `.find_all` are the most common methods we will use. They can be used to filter HTML code to find a list of tags or tags with specific attributes.

BeautifulSoup4

Parse HTML

The `.find` and `.find_all` are the most common methods we will use. They can be used to filter HTML code to find a list of tags or tags with specific attributes.

```
# Define heading tags
heading_tags = ["h1", "h2"]

# Find heading tags in HTML code
headings = soup.find_all(heading_tags)

# Loop over every heading and print text
for tags in headings:
    print(tags.name + ' -> ' + tags.text.strip())
```

```
h2 -> Contents
h1 -> Climate of Oregon
h2 -> Precipitation[edit]
h2 -> Temperature[edit]
h2 -> Selected climate charts[edit]
h2 -> See also[edit]
h2 -> References[edit]
```

BeautifulSoup4

```
# Find every hyperlink
links = soup.find_all('a')

# Loop over every link and print hyperlink
for link in links[0:10]:
    print(link.get('href'))
```

```
#bodyContent
/wiki/Main_Page
/wiki/Special:Search
/w/index.php?title=Special>CreateAccount&returnto=Climate+of+Oregon
/w/index.php?title=Special>UserLogin&returnto=Climate+of+Oregon
/w/index.php?title=Special>CreateAccount&returnto=Climate+of+Oregon
/w/index.php?title=Special>UserLogin&returnto=Climate+of+Oregon
/wiki/Help:Introduction
/wiki/Special:MyContributions
/wiki/Special:MyTalk
```

BeautifulSoup4

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/wiki/Main_Page
/wiki/Special:Search
/w/index.php?title=Special>CreateAccount&returnto=Climate+of+Oregon
/w/index.php?title=Special>UserLogin&returnto=Climate+of+Oregon
/w/index.php?title=Special>CreateAccount&returnto=Climate+of+Oregon
/w/index.php?title=Special>UserLogin&returnto=Climate+of+Oregon
/wiki/Help:Introduction
/wiki/Special:MyContributions
/wiki/Special:MyTalk
```

```
# Find number of images on page
len(soup.find_all('img'))
```

BeautifulSoup4

```
# Print details of first image
print(soup.find_all('img')[5])
```

```
<img class="thumbimage" data-file-height="1206" data-file-width="776" decoding="async" height=
```

BeautifulSoup4

```
# Print details of first image
print(soup.find_all('img')[5])
```

```
<img class="thumbimage" data-file-height="1206" data-file-width="776" decoding="async" height=
```

```
# Find attributes of first image
print(soup.find_all('img')[5].attrs['src'])
```

```
//upload.wikimedia.org/wikipedia/commons/thumb/8/80/Oregon_Average_Annual_Precipitation_%28196
```

BeautifulSoup4

```
# Print details of first image
print(soup.find_all('img')[5])
```

```
<img class="thumbimage" data-file-height="1206" data-file-width="776" decoding="async" height=
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# Find attributes of first image
print(soup.find_all('img')[5].attrs['src'])
```

```
//upload.wikimedia.org/wikipedia/commons/thumb/8/80/Oregon_Average_Annual_Precipitation_%28196
```

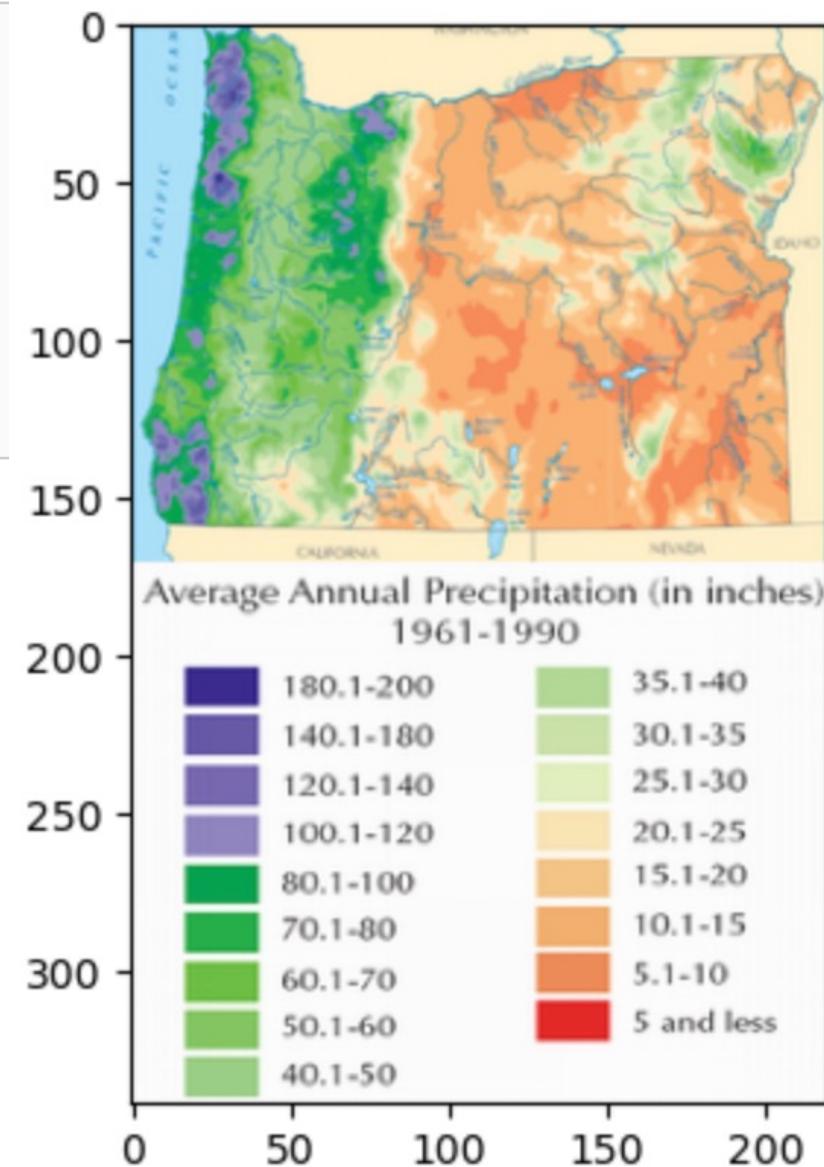
```
# Download image
url = 'https://' + soup.find_all('img')[5].attrs['src'][2:]
response = requests.get(url)
if response.status_code == 200:
    with open("images/test_image.jpg", 'wb') as f:
        f.write(response.content)
```

BeautifulSoup4

```
# Import packages
import matplotlib.pyplot as plt
import matplotlib.image as mpimg

# Read image
img = mpimg.imread('images/test_image.jpg')

# Plot image
plt.imshow(img)
```



Selenium

- Sometimes we want even more control...
- Selenium is a package for performing **web browser automation**
- We can use Selenium to enter text in search boxes, click buttons etc.



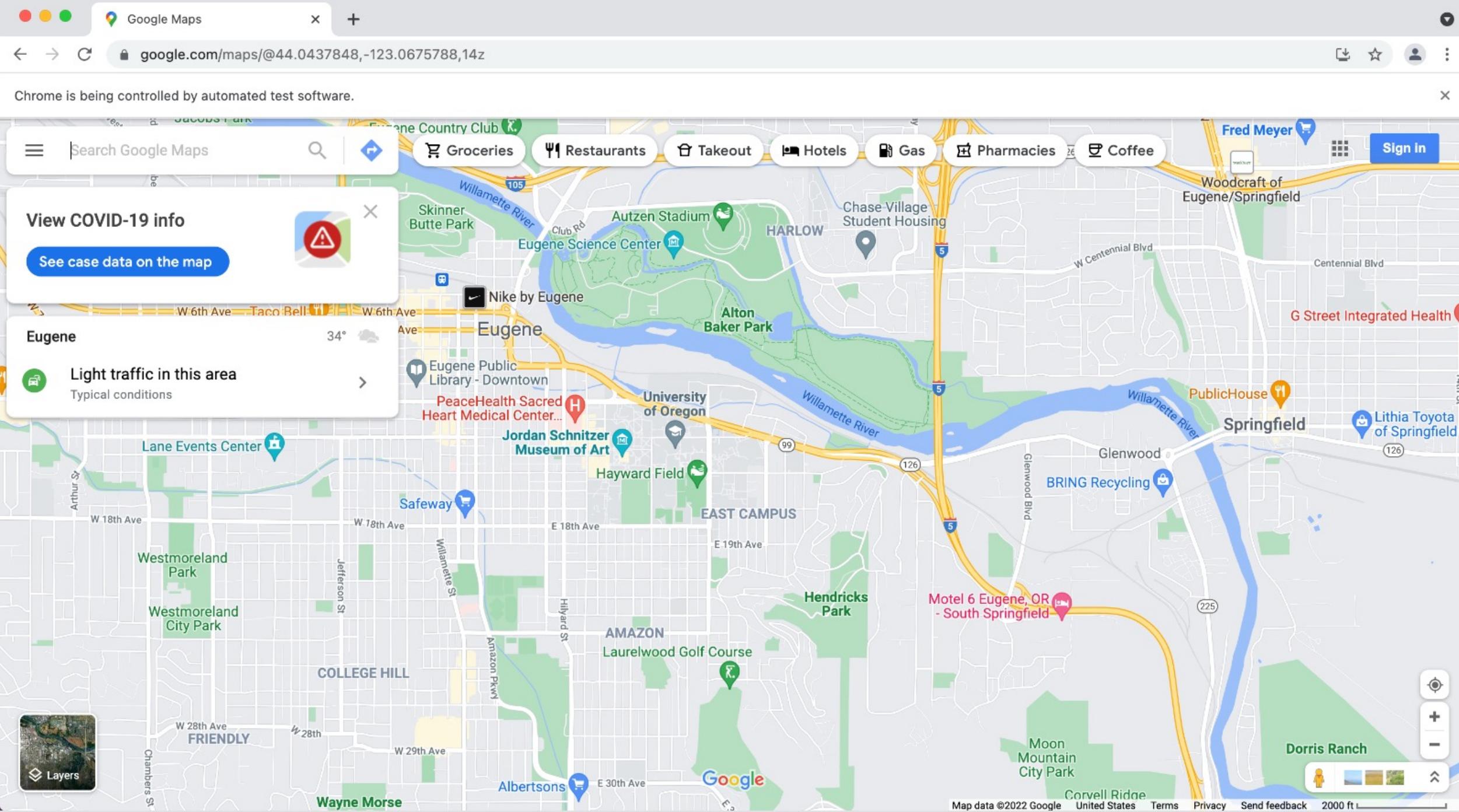
Selenium

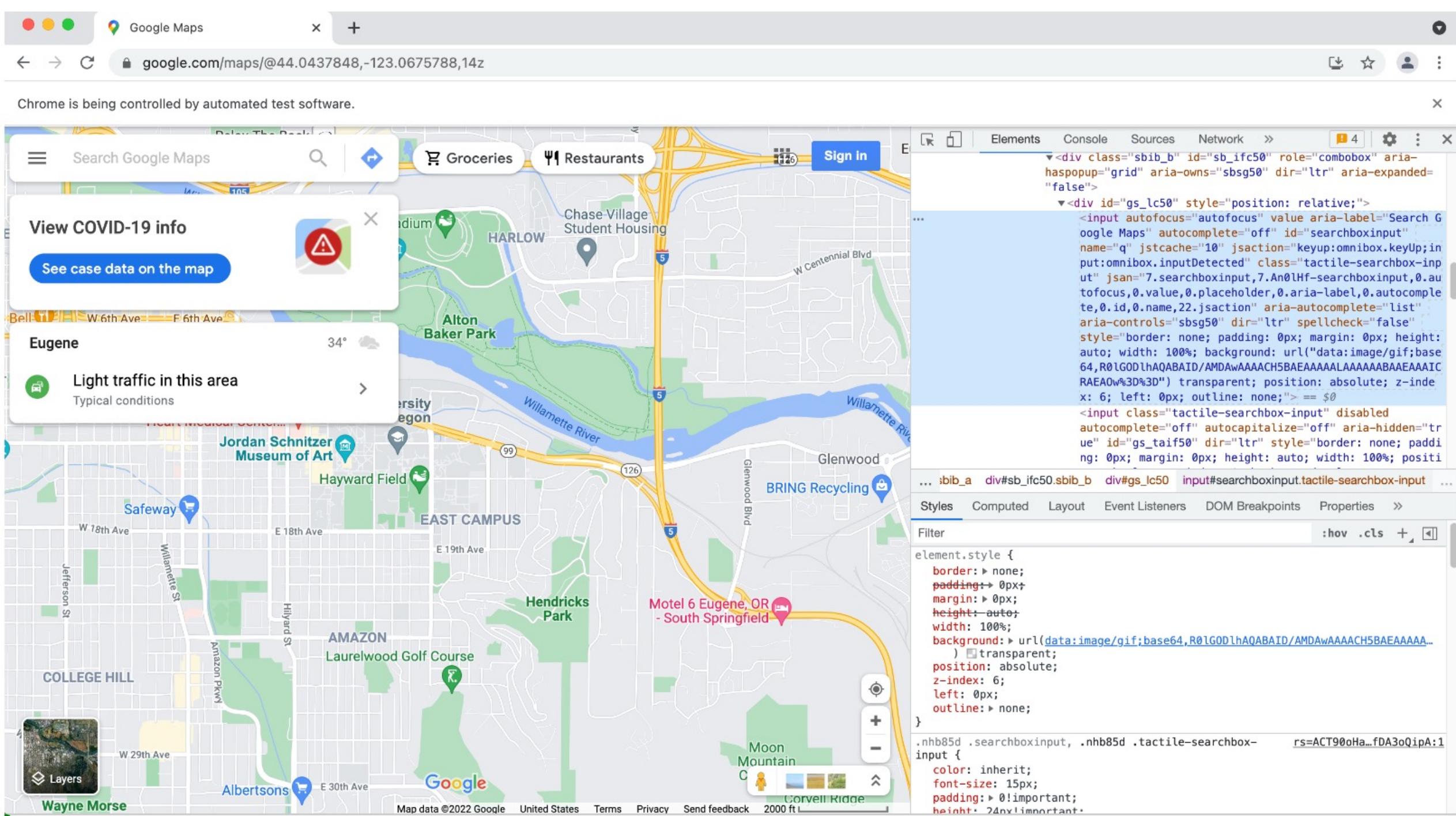
```
# Import packages
from selenium import webdriver
from selenium.webdriver.chrome.service import Service
from selenium.webdriver.common.by import By
from webdriver_manager.chrome import ChromeDriverManager
```

```
# Install Chrome webdriver
driver = webdriver.Chrome(service=Service(ChromeDriverManager().install()))

# Open a web browser at the following page
driver.get("https://www.google.com/maps")
```

[WDM] – Downloading: 100%|██████████





Selenium

```
# Enter some text in the search box
inputElement = driver.find_element(By.ID, "searchboxinput")
inputElement.send_keys('South Sister Oregon')
```

Google Maps

google.com/maps/@44.0437848,-123.0675788,14z

Chrome is being controlled by automated test software.

South Sister Oregon

Groceries Restaurants Sign in

South Sister Oregon

South Sister Mountain Oregon

Devils Lake/South Sister Trailhead Cascade Lakes Nati...

South Sister Skin & Nails Northeast Division Street, Ben...

South Sister Road Drain, Oregon

View COVID-19 info

See case data on the map

Eugene 34° Light traffic in this area Typical conditions

COLLEGE HILL

AMAZON Laurelwood Golf Course

Wayne Morse Albertsons E 30th Ave

Map data ©2022 Google United States Terms Privacy Send feedback 2000 ft Corvallis Ridge

Elements Console Sources Network

```
<div class="sbib_b" id="sb_ifc50" role="combobox" aria-haspopup="grid" aria-owns="sbsg50" dir="ltr" aria-expanded="true">
  <div id="gs_lc50" style="position: relative;">
    <input autofocus="autofocus" value="" aria-label="Search Google Maps" autocomplete="off" id="searchboxinput" name="q" jstcache="10" jsaction="keyup:omnibox.keyUp;input:omnibox.inputDetected" class="tactile-searchbox-input" jsan="7.searchboxinput,7.An0lHf-searchboxinput,0.autofocus,0.value,0.placeholder,0.aria-label,0.autocomplete,0.id,0.name,22.jsaction" aria-autocomplete="list" aria-controls="sbsg50" dir="ltr" spellcheck="false" style="border: none; padding: 0px; margin: 0px; height: auto; width: 100%; background: url(data:image/gif;base64,R0lGODlhAQABAI/AMDAwAAAACH5BAEAAAAALAAAAAABAAEAAICRAEAQw%3D%3D") transparent; position: absolute; z-index: 6; left: 0px; outline: none;"> = $0
    <input class="tactile-searchbox-input" disabled autocomplete="off" autocapitalize="off" aria-hidden="true" id="gs_taif50" dir="ltr" style="border: none; padding: 0px; margin: 0px; height: auto; width: 100%; position: absolute; z-index: 5; left: 0px; outline: none;">
  ... sbib_a div#sb_ifc50.sbib_b div#gs_lc50 input#searchboxinput.tactile-searchbox-input ...

```

Styles Computed Layout Event Listeners DOM Breakpoints Properties

Filter

```
element.style {
  border: none;
  padding: 0px;
  margin: 0px;
  height: auto;
  width: 100%;
  background: url(data:image/gif;base64,R0lGODlhAQABAI/AMDAwAAAACH5BAEAAAA...
}
.nhb85d .searchboxinput, .nhb85d .tactile-searchbox-input {
  color: inherit;
  font-size: 15px;
  padding: 0 !important;
  height: 24px !important;
}
```

Selenium

```
# Click search button
element = driver.find_element(By.ID, "searchbox-searchbutton")
element.click()
```

South Sister - Google Maps

google.com/maps/place/South+Sister/@44.1034779,-121.7866725,14z/data=!3m1!4b1!4m5!3m4!1s0x54bf52eb084cefc3:0xf7aaa481db7b0891!8m2!3d44.103449!4d-121.7692...

Chrome is being controlled by automated test software.

South Sister Oregon

Restaurants Hotels Sign in

Upper Chambers Lakes

South Sister

4.8 ★★★★★ 61 reviews

Mountain peak

Directions Save Nearby Send to your phone Share

Oregon 97413

Photos

Lewis Glacier Cirque Lake Amy's Summit

Layers

Map data ©2022 United States Terms Privacy Send feedback 2000 ft

Elements Console Sources Network

Search button

Search

Clear search

Styles Computed Layout Event Listeners DOM Breakpoints Properties

Filter

```
.An0lHf-searchbox:not(.searchbox-empty) .nhb85d-BIqFsb, .rs=ACT90oHa...fDA3oQipA:1 .searchbox-active .nhb85d-BIqFsb { cursor: pointer; }
```

```
.nhb85d-BIqFsb { display: block; padding: 12px 15px; }
```

```
button, input, textarea { color: inherit; }
```

```
a, button, h1, h2, h3, h4, h5, h6, input, ol, p, textarea, th, ul { background: transparent; border: 0; border-radius: 0; }
```

Next time: Careers in Geospatial Data Science



Email: jryan4@uoregon.edu

Office: 163A Condon Hall

Office hours: Monday 15:00-16:00 and Tuesday 14:00-15:00