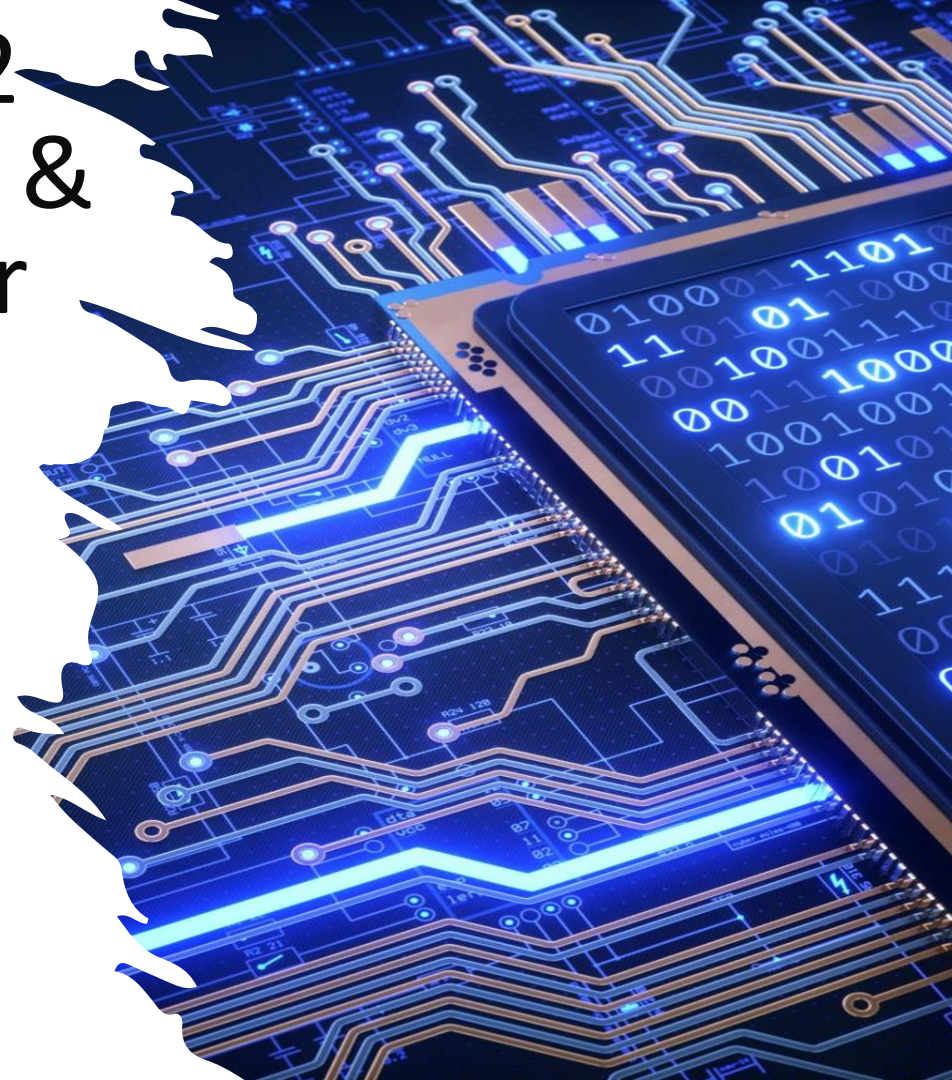


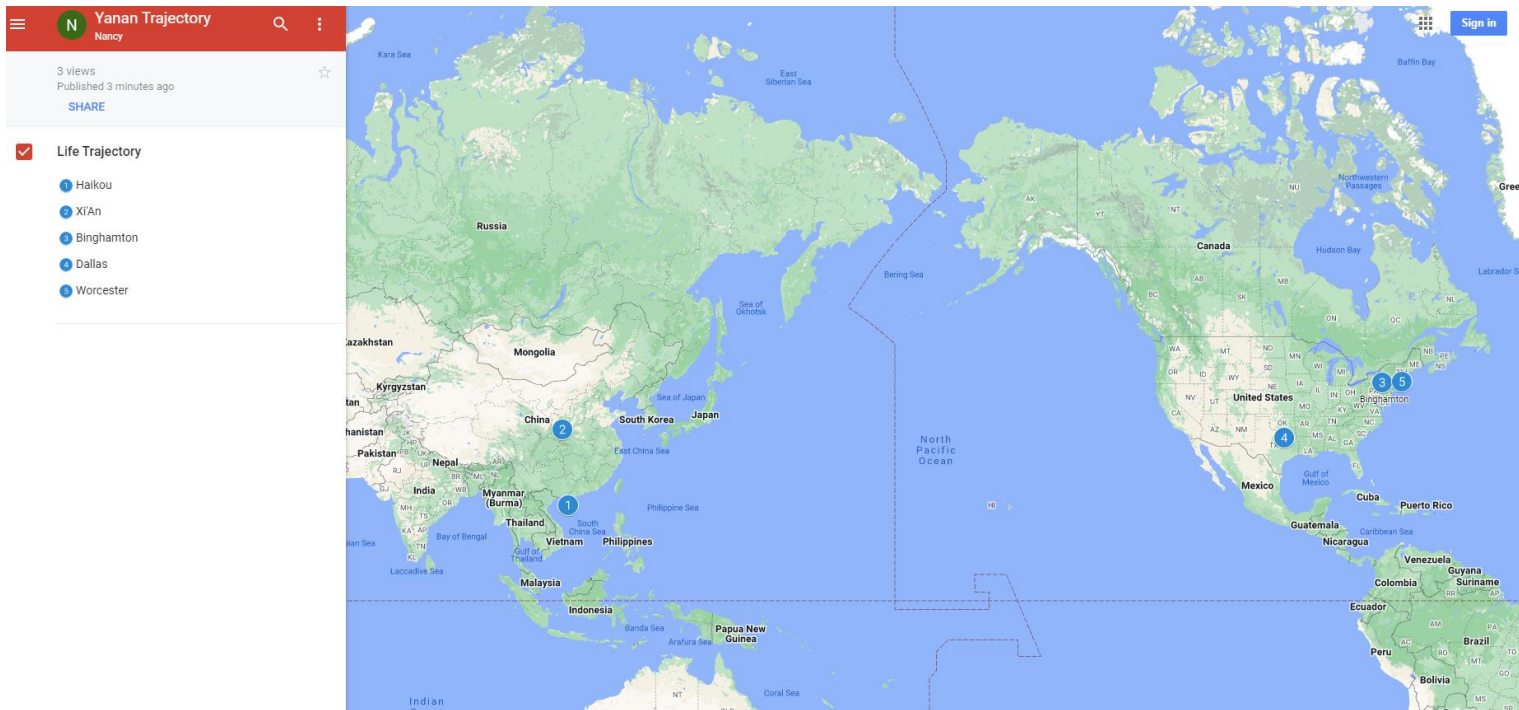
Welcome to SSJ 302 Python Programming & SSJ 30274 Computer PROG for GIS

Instructor: Yanan Wu



Yanan Wu – Visiting Assistant Professor

Education & Experience



Teaching

- **Python Programming & Computer PROG for GIS**



1. Manipulating Spatial Data
2. Web Mapping
3. Processing Raster
4. Data Analysis
5. Creating Custom Tool
6. Data Visualization
7. ...

- **Web Mapping & Open Source GIS**



1. GitHub
2. HTML & CSS
3. JavaScript
4. Python
5. R
6. ArcGIS Online
7. ...

TA Introduction

Shradha Birdika

- Majored in Geography, Minored in Economics
- First honors on the Clark University Dean's List

How about you?

- Your background (e.g., name, major, where you come from)
- What is your funniest thing that happened during your summer break?
- What relevant experience do you have with python?
- What are your expectations for this course?

Course Format

- **Lectures:** Physics/Math, 3rd Floor, Room 310
Monday: 12:00 – 1:15 PM
Wednesday: 11:00 – 11:50 AM
- **Labs:** Physics/Math, 3rd Floor, Room 310
Wednesday: 12:00 PM – 1:15 PM
- Office Hours: Monday & Wednesday: 2:00 – 3:00 PM (or by appointment)
- Office Location: Geography Main Office, Jeff 220

Course Schedule

- Week 7 (Oct 7)
Review Topic about Midterm on Monday
Midterm on Wednesday (TBD: Topic and format)
- Week 15 (Dec 2)
Final Presentation Due
- Week 16 (Dec 9)
Final Project Due



*schedule for other weeks please see syllabus

Course Requirements

- Labs: 11 in total.

For any graded assignment, if the you do not agree with the grade received, the instructor must be notified within one week after the assignment is graded.

- Late policy for lab (excluding midterm and final project)
- One midterm exam & One Final Project (Oral presentation and paper report)

Extra Credit

- The instructor reserves **30 extra credit points (3% of total grade)** for those students who actively respond to the questions from other students posted on Discussion Forum.
- The instructor will strive to respond to questions within two business day, i.e., 48 hours excluding weekends.

Grade

- **11 lab (70%):**
- **Midterm exam (15%):**
- **Final Project (15%)**

700 points (70%)

150 points (15%)

150 points (15%)

1000 points total (100%)

Extra credit (3%) 30 Points



Letter Grade	% of Points
A	(93.0 to 100%)
A-	(90.0 to 92.9%)
B+	(87.0 to 89.9%)
B	(83.0 to 86.9%)
B-	(80.0 to 82.9%)
C+	(77.0 to 77.9%)
C	(73.0 to 76.9%)
C-	(70.0 to 72.9%)
D+	(67.0 to 69.9%)
D	(63.0 to 66.9%)
D-	(60.0 to 62.9%)
F	(0.0 to 59.9%)

Textbook

Free Online learning source

- Ujaval Gandhi (2024). *Python Foundation for Spatial Analysis*. <https://courses.spatialthoughts.com/python-foundation.html>
- Dave Whipp (2023). *Geo-Python 2023*. <https://geo-python-site.readthedocs.io>
- Qiusheng Wu (2023). *Earth Engine and Geemap: Geospatial Data Science with Python*. <https://book.geemap.org>

Non-open Source Textbook

- Eric Pimpler, ***Programming ArcGIS Pro with Python, 2nd Edition***

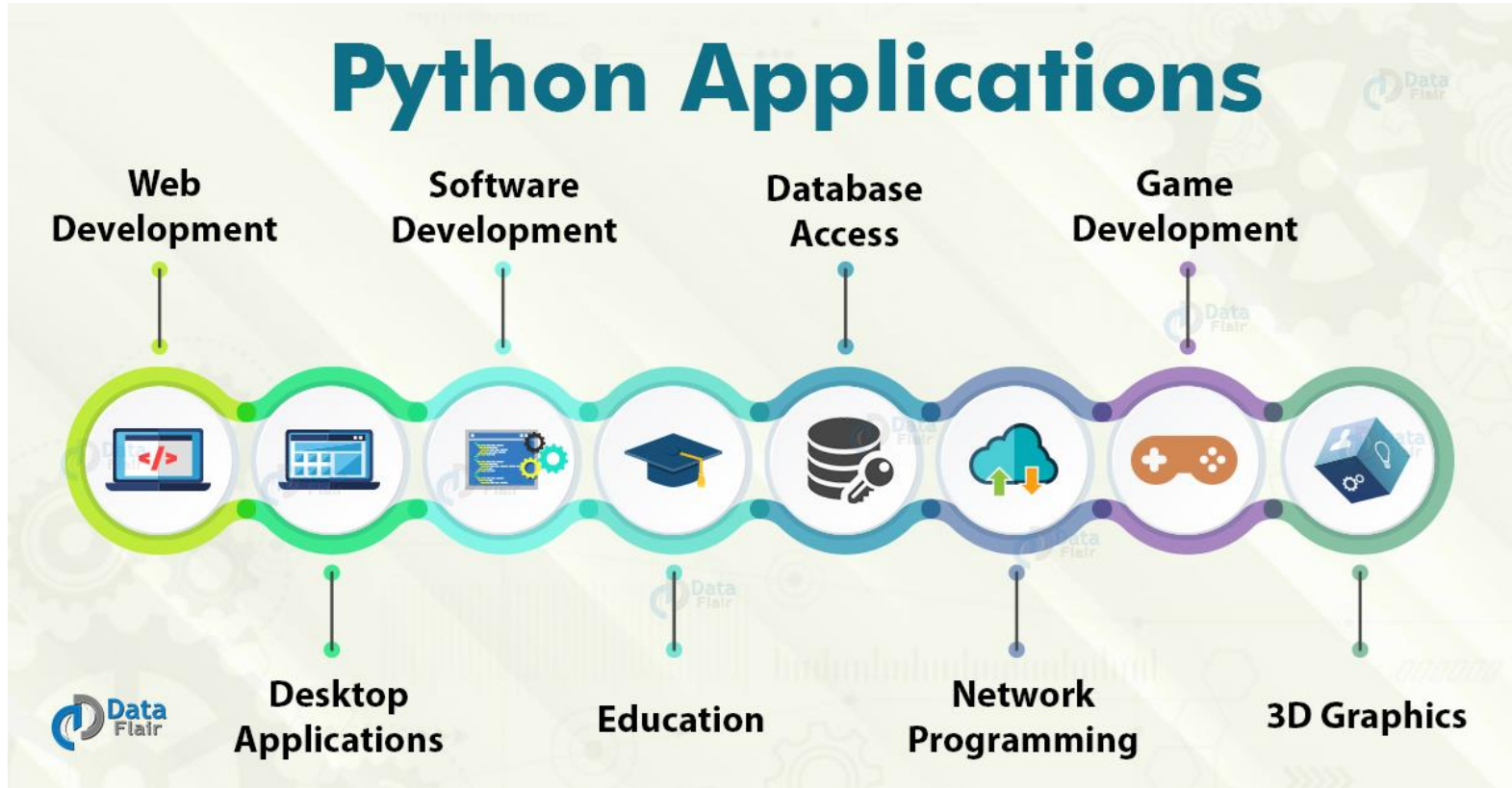
Emailing the TA and Instructor

- Use “SSJ-Python” as the subject of the email

Why taking this class?

- Our focus is on **problem solving**
- Two module together
- **Exercise/project-oriented, not theory-oriented**
- We take care of **what** and **how** but not **why**!

Overview



The popular YouTube video sharing system is largely written in Python

Google makes extensive use of Python in it's web search system

Dropbox storage service codes both its server and client software primarily in Python

The Raspberry Pi single-board computer promotes Python as its educational language



COMPANIES USING PYTHON



NETFLIX

BitTorrent peer-to-peer file sharing system began its life as a Python Program

NASA uses Python for specific Programming Task

The NSA uses Python for cryptography and intelligence analysis

Netflix and Yelp have both documented the role of Python in their software infrastructures

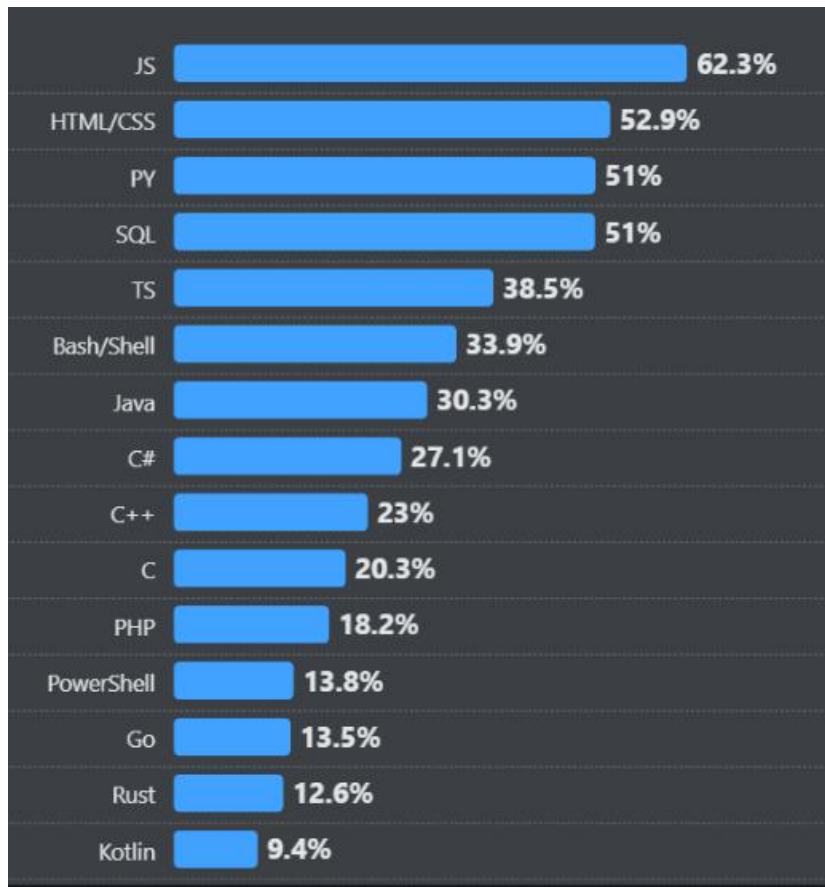
Why Programming?

☐ Customize applications and tools

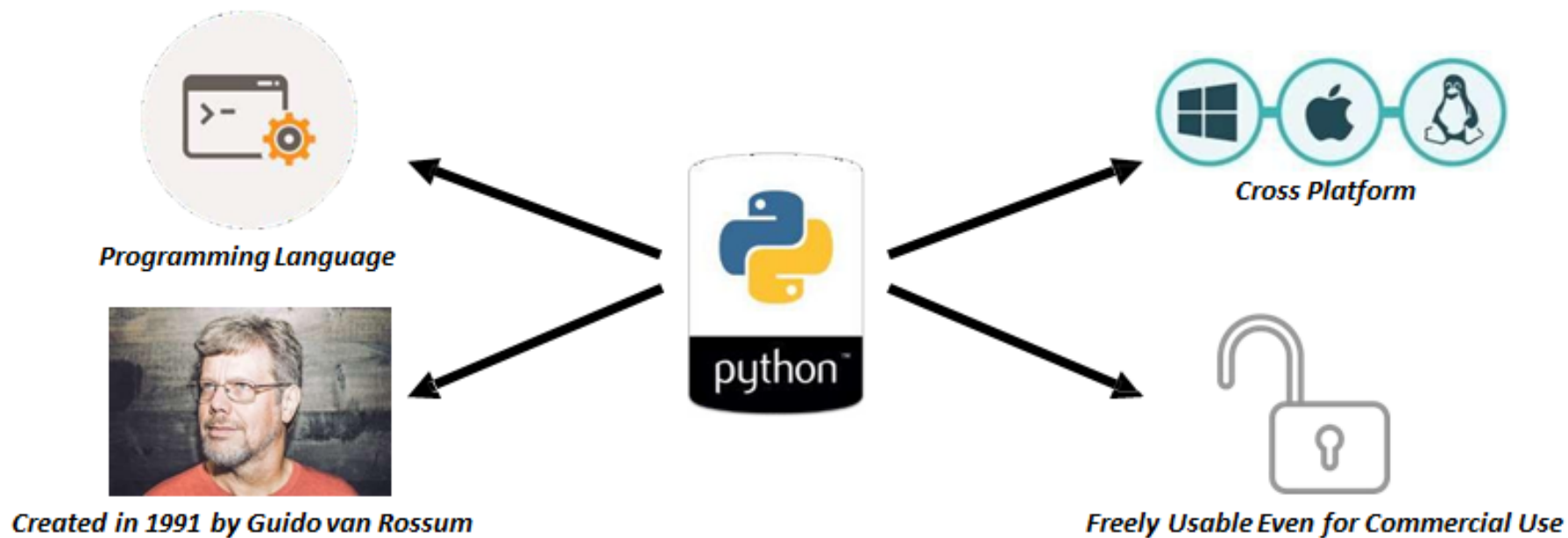
- Reduce repetitive work
- Access more functionality
- Add new functionality / Extend GIS functionality into non-GIS applications

Why Python?

- An open-source language
 - Packages, libraries, functions, resources...ALL FREE (Our textbooks have free versions as well)
 - GREAT documentation!
 - <https://docs.python.org/3/>
 - [ArcPy](#) (Not usable separately)
 - [PyQGIS](#)
- Cross-platform



Source: survey.stackoverflow.co



NOTE

- There are 2 widely used versions of Python: Python2.7 and Python3.x
- We'll use Python**3**
- Many help forums still refer to Python2, so make sure you're aware which version is being referenced

Python Version

→ Python [versions](#)

2.x up to 2.7, 3.x (currently 3.12.x)

- *Python 2.x is legacy, Python 3.x is the present and future of the language*
- 3.x may have compatibility issue with other software

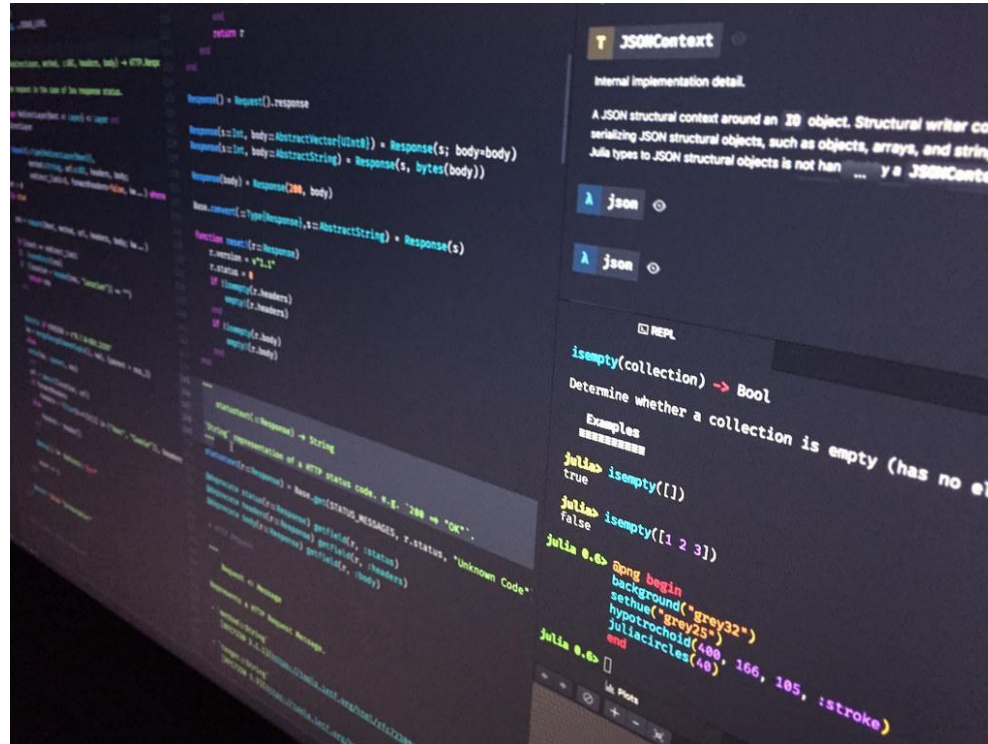
Be careful when you download different versions

- Especially when you install external libraries and packages

One way to know the version of Python!

- ❑ Command Prompt
- ❑ Why this is important?
 - Different libraries
 - Functionality
 - Version reliability

What if I do not want to deal with the command prompt?



You can have both ways of writing
python in most of text editors!



Visual Studio Code (VS code)

- Developed by Microsoft for Windows, Linux, macOS
- Used with a variety of programming languages: Python, Java, JavaScript, C++
- Various features: debugging, syntax highlighting, intelligent code completion, version control with Git

[Download Link](#)

How Do I Program In Python?



ANACONDA

- An **open-source** Python distribution platform ([Download link](#))
- Manages packages and working environments

Google Colab

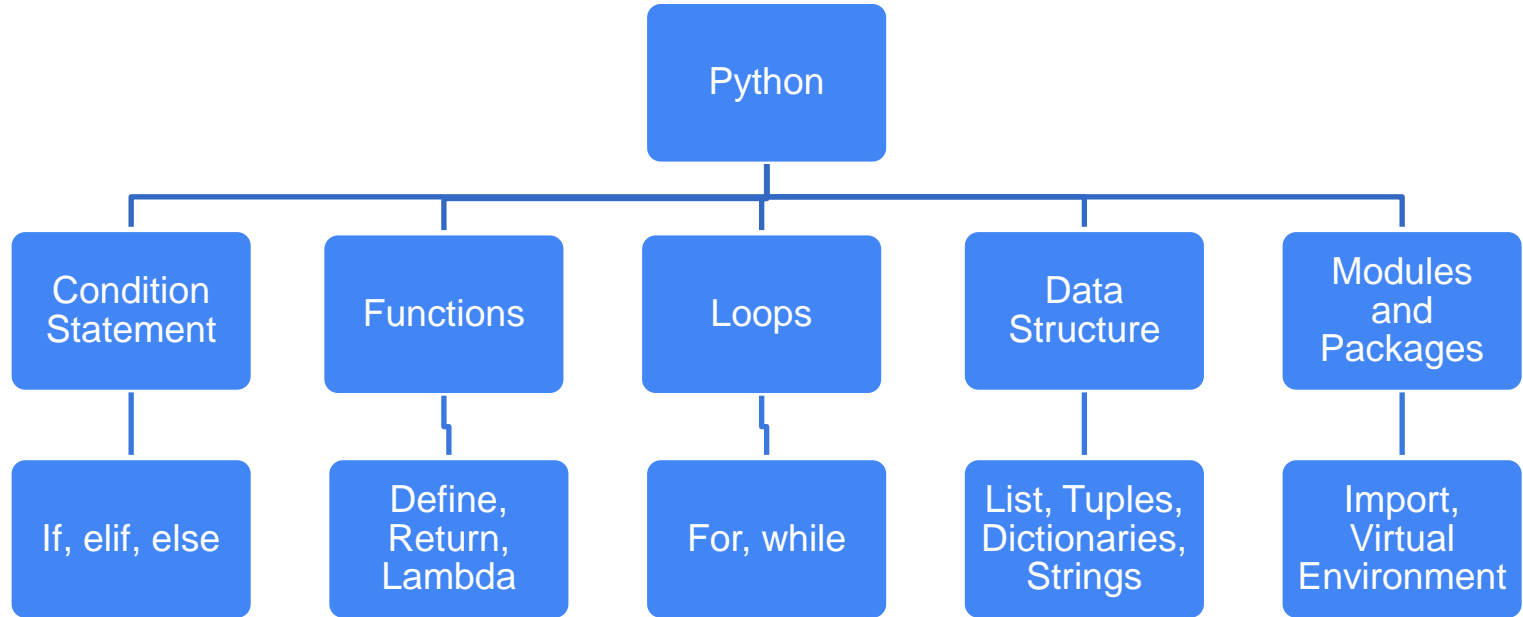
- What we covered so far was based on the fact that you want to use your own computer as a Python interpreter!
- What if I want to practice programming on the web?
 - ◆ [Google Colab](#)
 - ◆ Github (Not recommended for now!)

COLAB.

While Using Colab

- A folder will be created automatically in your Google Drive

Python Fundamental



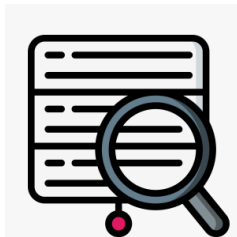
Non-spatial data processing: [Pandas](#)



DataFrame Creation



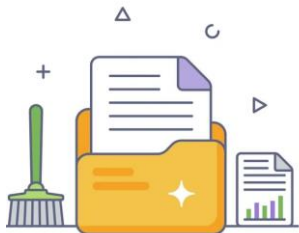
Data Inspection



Data Selection



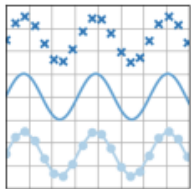
Data Cleaning



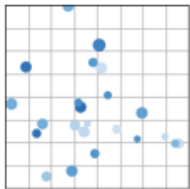
Data Manipulation



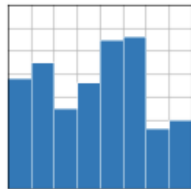
Data Visualization: [Matplotlib](#)



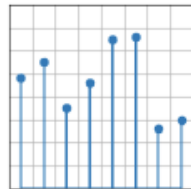
`plot(x, y)`



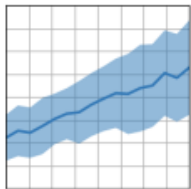
`scatter(x, y)`



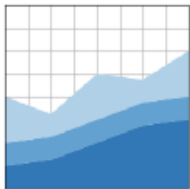
`bar(x, height)`



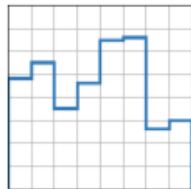
`stem(x, y)`



`fill_between(x, y1,
y2)`



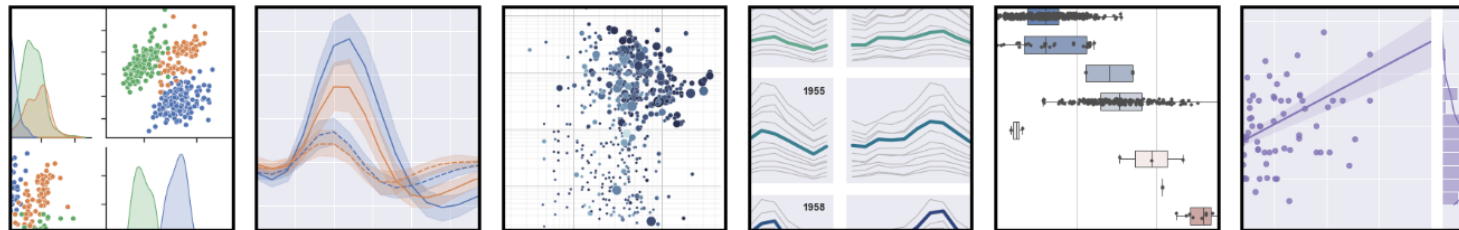
`stackplot(x, y)`



`stairs(values)`

Data Visualization: seaborn

seaborn: statistical data visualization



Seaborn is a Python data visualization library based on [matplotlib](#). It provides a high-level interface for drawing attractive and informative statistical graphics.

For a brief introduction to the ideas behind the library, you can read the [introductory notes](#) or the [paper](#). Visit the [installation page](#) to see how you can download the package and get started with it. You can browse the [example gallery](#) to see some of the things that you can do with seaborn, and then check out the [tutorials](#) or [API reference](#) to find out how.

To see the code or report a bug, please visit the [GitHub repository](#). General support questions are most at home on [stackoverflow](#), which has a dedicated channel for seaborn.

Contents

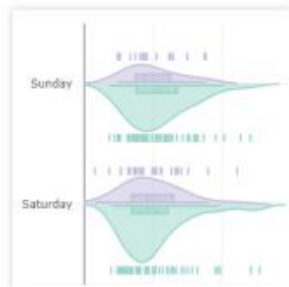
[Installing](#)
[Gallery](#)
[Tutorial](#)
[API](#)
[Releases](#)
[Citing](#)
[FAQ](#)

Features

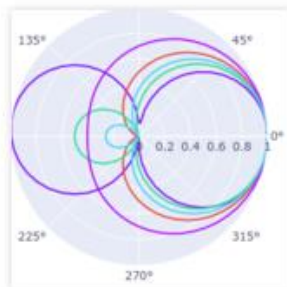
- **New** Objects: [API](#) | [Tutorial](#)
- Relational plots: [API](#) | [Tutorial](#)
- Distribution plots: [API](#) | [Tutorial](#)
- Categorical plots: [API](#) | [Tutorial](#)
- Regression plots: [API](#) | [Tutorial](#)
- Multi-plot grids: [API](#) | [Tutorial](#)
- Figure theming: [API](#) | [Tutorial](#)
- Color palettes: [API](#) | [Tutorial](#)

[Seaborn cheatsheets and](#) handouts

Data Visualization: [plotly](#)



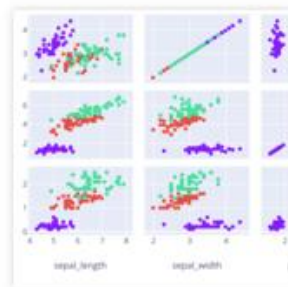
The Figure Data Structure



Creating and Updating Figures



Displaying Figures

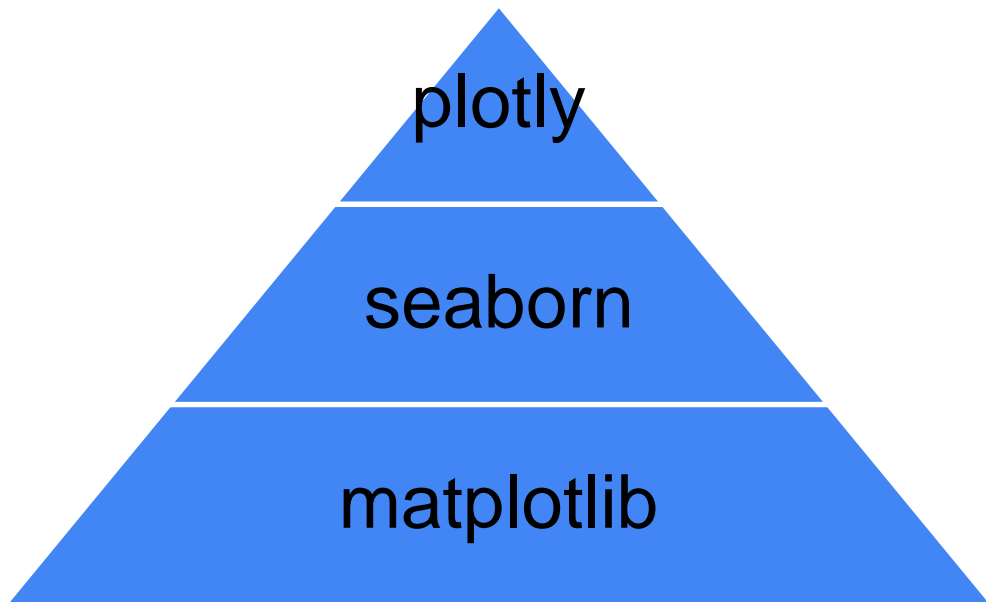


Plotly Express



Analytical Apps with Dash

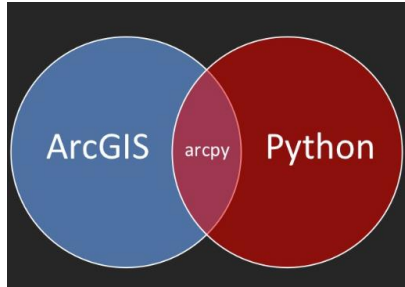
Difference among three



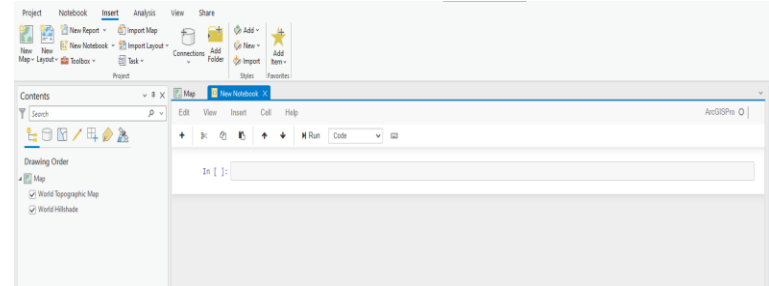
- matplotlib: Low-level library
- seaborn: built on top of matplotlib
- plotly: focused on interactive plots

Geoprocessing - Arcpy

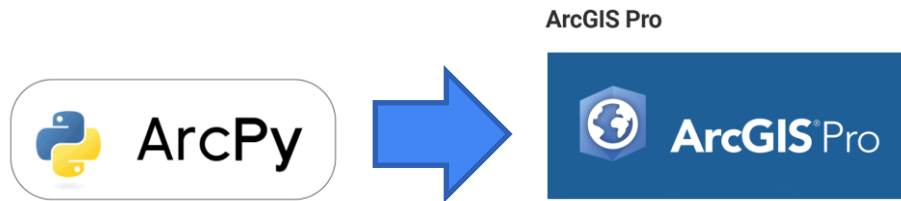
Integration with ArcGIS Pro



Scripting & Automation



Access to Geoprocessing Tools



Interact with other Esri products

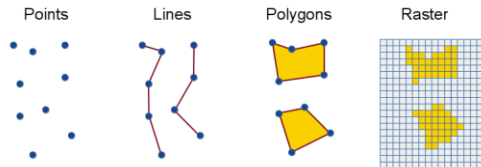


Web maps using the ArcGIS API for Python

1. [Esri User Document](#)
2. [Esri official Repo on GitHub](#)

Web maps using the Open Source Spatial Libraries

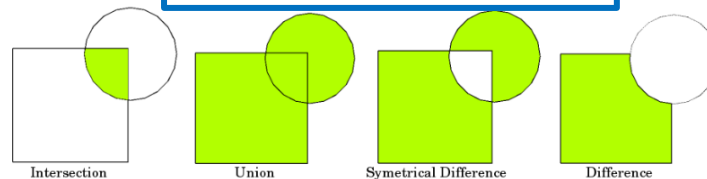
Spatial Data Structure



Interactive map



Geometric Operation



Open Source


- Installing with Anaconda/conda

geemap – Google Earth Engine Python API

Google Earth Engine

[Platform](#) [Datasets](#) [Noncommercial](#) [Commercial](#) [Timelapse](#) [Case Studies](#) [FAQ](#) [Get Started](#)

Starting November 13, 2024, all Earth Engine access will [require a Cloud project](#). We will be limiting [quotas](#) for accounts without Cloud projects starting September 16, 2024.




A planetary-scale platform for Earth
science data & analysis

Powered by Google's cloud infrastructure

▶ Watch Video

Meet Earth Engine

geemap – Google Earth Engine Python API

 giswqs


Overview


Repositories 282

Projects

Packages

Stars 1.1k

 Type to search



Qisheng Wu
giswqs

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Associate Professor at the University of Tennessee, Knoxville | Amazon Visiting Academic | Google Developer Expert (GDE) for Earth Engine

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Dr. Qisheng Wu is an Associate Professor and the Director of Graduate Studies in the Department of Geography & Sustainability at the University of Tennessee, Knoxville. He also serves as an Amazon Visiting Academic. Dr. Wu specializes in geospatial data science and open-source software development, with a research focus on utilizing big geospatial data and cloud computing to study environmental changes, particularly in surface water and wetland inundation dynamics. He is the creator of several widely used open-source Python packages, including geemap, leafmap, and segment-geospatial, which are designed for advanced geospatial analysis and visualization. Explore his open-source contributions on GitHub at <https://github.com/opengeos>.

Open-source Projects

- Linux: [manjaro-linux](#)
- R packages: [whiteboxR](#)
- Python packages: [geemap](#) | [leafmap](#) | [ee folium](#) | [geehydro](#) | [lidar](#) | [whitebox](#) | [whiteboxgui](#) | [geospatial](#) | [pygis](#) | [pypackage](#)
- ArcGIS Toolboxes: [WhiteboxTools-ArcGIS](#) | [Depression Analysis Toolbox](#) | [Wetland Hydrology Analyst](#)
- Google Earth Engine: [Awesome-GEE](#) | [earthengine-py-notebooks](#) | [qgis-earthengine-examples](#) | [earthengine-apps](#)

Latest Blog Posts

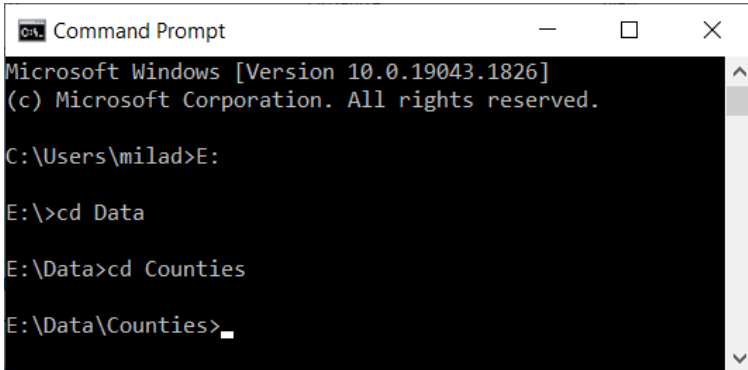
- [Visualizing satellite image time series interactively](#)
- [Segment-geospatial presentation at SERVIR](#)
- [Segmenting remote sensing imagery with box prompts](#)
- [New book release: Earth Engine and Geemap](#)
- [Creating satellite timelapse with Streamlit and Earth Engine](#)

How Do I Program In Python?

Two Main Ways (You should add python to the system variable):

◆ Normal mode (Script Mode)

- Write your code in a file (it could be any type of file:txt,word) and save it with the .py extension
- Execute the file by using the shell (terminal, CMD, Command Prompt): **The picture on the right**
 - You need to direct the shell to where you have the code saved:
 - ◆ If the file (your code) is stored directly in a Drive (in my case it is saved in **D** drive) you will use the following command: **D:**
 - ◆ If the file is stored in a nested folder (e.g., “E:\Data\Counties”) then you need to use the **cd** command: **The picture on the left**



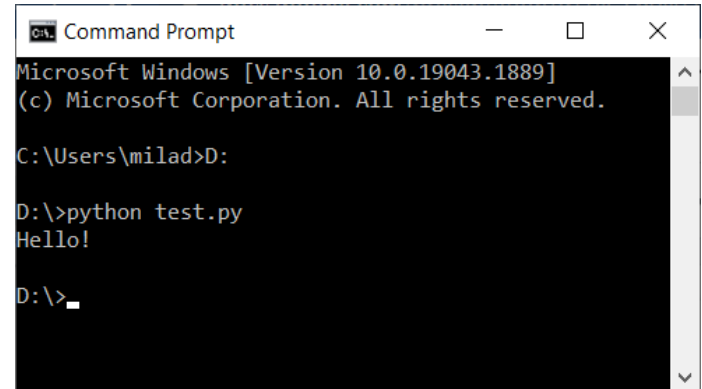
```
Command Prompt
Microsoft Windows [Version 10.0.19043.1826]
(c) Microsoft Corporation. All rights reserved.

C:\Users\milad>E:

E:\>cd Data

E:\Data>cd Counties

E:\Data\Counties>_
```



```
Command Prompt
Microsoft Windows [Version 10.0.19043.1889]
(c) Microsoft Corporation. All rights reserved.

C:\Users\milad>D:

D:\>python test.py
Hello!

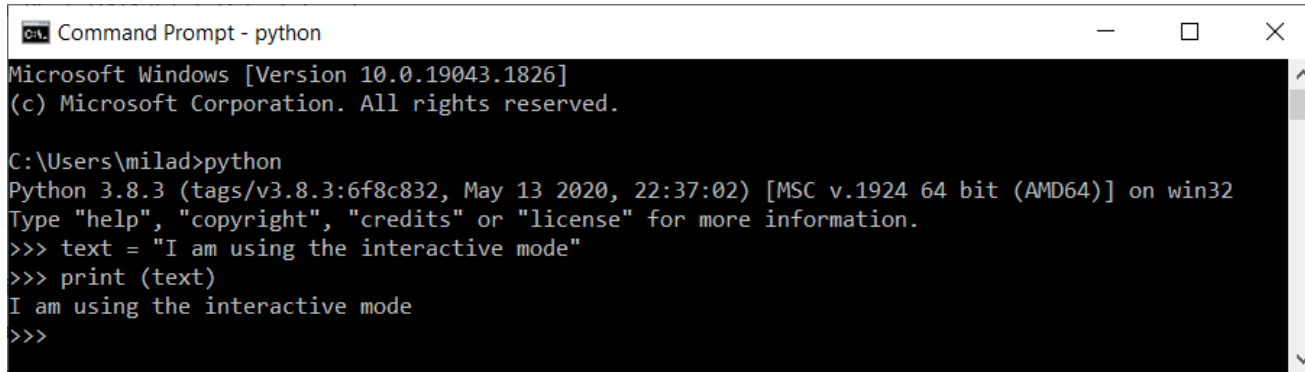
D:\>_
```

How Do I Program In Python?

The other way:

◆ **Interactive mode** (interacting directly with the interpreter)

- Bring up a terminal (command prompt, shell)
- Type python
- After the info about the version the cursor will transform to **>>>**
- Start writing your code
- After each time you press Enter on your keyboard the command line goes to the next line and if there is something to be executed it will be executed:



```
Command Prompt - python
Microsoft Windows [Version 10.0.19043.1826]
(c) Microsoft Corporation. All rights reserved.

C:\Users\milad>python
Python 3.8.3 (tags/v3.8.3:6f8c832, May 13 2020, 22:37:02) [MSC v.1924 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> text = "I am using the interactive mode"
>>> print(text)
I am using the interactive mode
>>>
```


Interactive Mode

Start writing in the python interpreter of your chosen python editor.

- Pay attention to the indentation

```
>>> the_world_is_flat = True
```

```
>>> if the_world_is_flat:
```

```
...     print("Be careful not to fall off!")
```

```
...
```

```
Be careful not to fall off!
```

Conclusion

1. Class Schedule
2. Topics for this course
3. Command prompt

Next

1. Install Visual Studio Code
2. Install Anaconda
3. Set up environment in VS Code