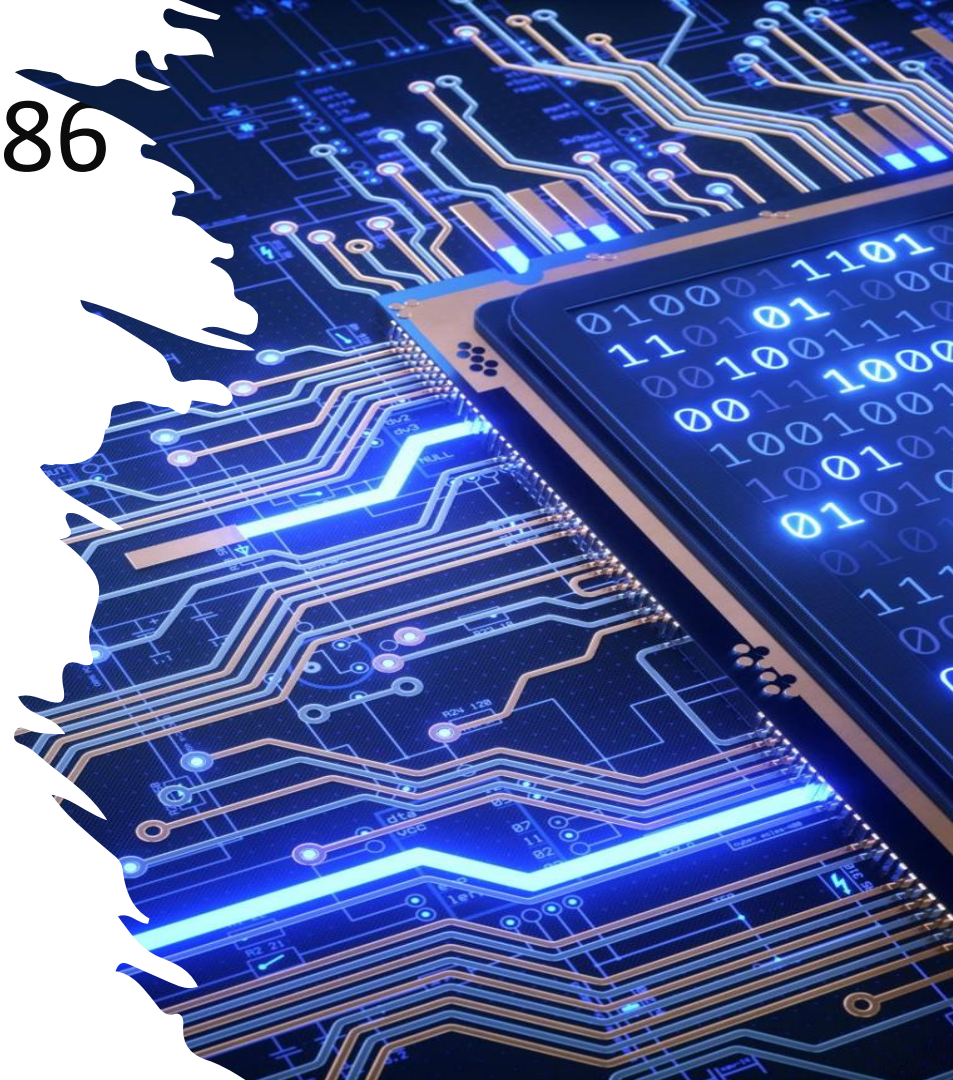
Welcome to GEOG 286 & 386 PYTHON PROGRAMMING

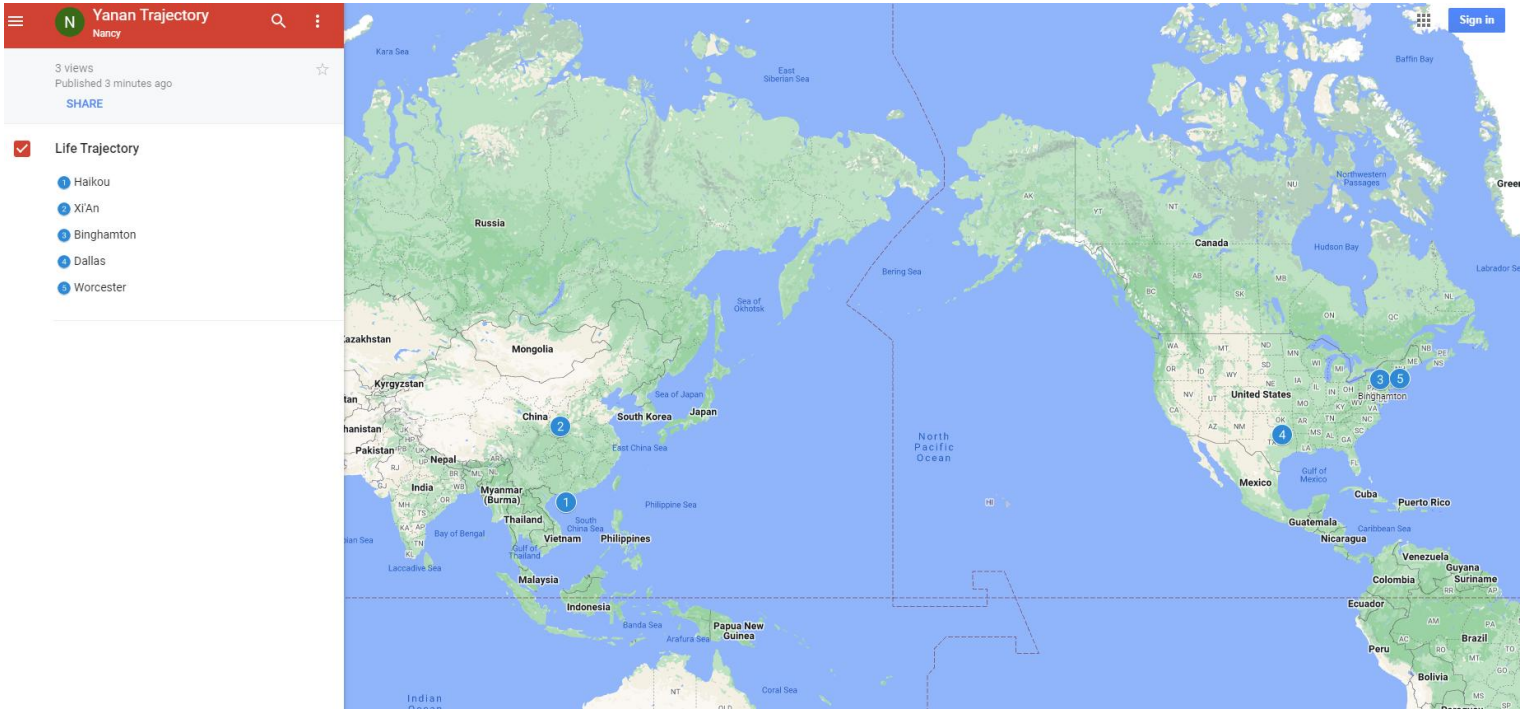
Instructor: Yanan Wu

TA: Shradha Birdika



Yanan Wu – Visiting Assistant Professor

Education & Experience



Teaching

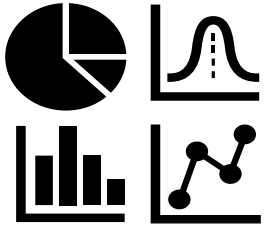
- **Python Programming**

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

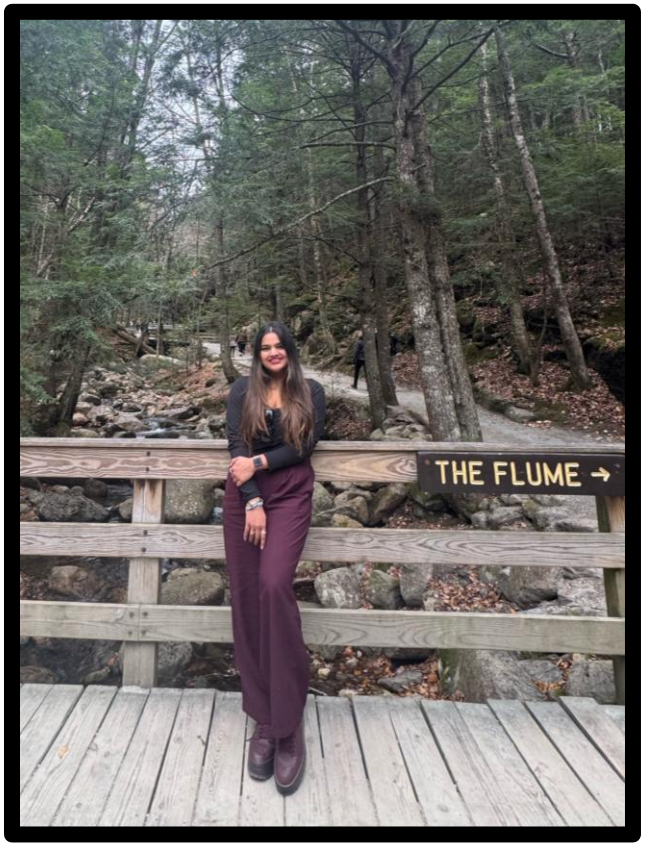
- **Spatial Database**

1. Geodatabase
2. SQL
3. Proximity Analysis
4. Geometry processing
5. Raster processing
6. PostSQL with python
7. …

- **Intermediate Statistics**



1. Bivariate regression
2. Logistics regression
3. PCA
4. GWR
5. Spatial Autocorrelation
6. …



PYTHON PROGRAMMING

COURSE ASSISTANT

SHRADHA BIRDIKA

OFFICE HOURS:
WEDNESDAY
2:00 – 4:00 PM

JF 123
(ADP MA GIS LAB)

Education

Clark University

Master of Science;
Geographic Information Science (MS-GIS)
Expected Graduation: May 2025

Bachelor of Arts;
Geography major, GIS concentration,
Economics minor
Graduated Summa Cum Laude: May 2024

Hobbies

- ❑ Traveling
- ❑ Adventure Sports
- ❑ Astronomy

How about you?

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

Course Format

- **Lectures:** Jonas Clark Hall JC103 (Instructor & TA)
  Monday: 9:00 – 10:15 AM
  Thursday: 4:15 – 5:30 AM

- **Labs:** Jonas Clark Hall JC103 (TA)
  Friday: 9:00 – 10:15 AM

- Instructor Office Hours: Tuesday & Thursday: 1: 30 – 2:30 PM (or by appointment)

- Instructor Office Location: Geography Main Office, Jeff 220

IMPORTANT DATES

- **Jan 22.** Add/Drop ends (& last day to request audit) Full Semester

- No class
  - Jan 20. University holiday
  - Feb 17. Wellness day
  - March 3-7 Spring Break
  - March 24-27 AAG Conference

- Midterm
  - March 10

- Final project
  - April 14-24 Working on final project
  - April 28 – May 1 Final project presentation
  - May 5 Final report due

Course Requirements

- Labs: 9 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.

- One midterm exam & One Final Project (Oral presentation and paper report)

Grade

- **9 labs (70%):** 700 points (70%)
- **Midterm exam (15%):** 150 points (15%)
- **Final Project (15%)** 150 points (15%)

1000 points total (100%)

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%)

GIS HELP DESK

NEW SPRING 2025 HOURS:

Need help with GIS? Can't make it to visit your professor or TA for office hours? Stop by our GIS Help Desk in the Jefferson Tower (6th floor), or in Jefferson 220A (2nd floor Jefferson building, Geog Main office) on Wednesdays, and visit one of our Help Desk Assistants!

MONDAYS	SASHA 9 AM - 11 AM
TUESDAYS	SASHA 9 AM - 12 PM
WEDNESDAYS @ JF220A	SASHA 9 AM - 12 PM WYNNIE 2 PM - 5 PM
THURSDAYS	WYNNIE 2 PM - 5 PM
FRIDAYS	WYNNIE 3 PM - 5 PM

GIS Help Desk hours follow a University schedule. If the University is closed from remote/online operations for any reason, the GIS Help Desk may also be unavailable. GIS Help Desk Assistants operate on a first-come, first-serve drop-in basis. Contact Marjorie Miller (marmiller@clarku.edu) with any questions, or call the Geography Main Office at 508-793-7336 for more information. The GIS Help Desk is sponsored by the Graduate School of Geography at Clark University.

SPRING 2025 HOURS

GIS HELP DESK

Please contact either of our GIS Help Desk Assistants during their specified hours for more information.

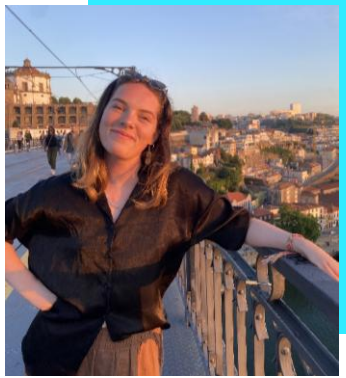
SASHA GANNON | GEOG '24 MS-GIS '25

MONDAYS 9AM – 11AM

TUESDAYS 9AM – 12PM

WEDNESDAYS* 9AM – 12PM

WYNNIE GROSS | GEOG '24 MS-GIS '25



WEDNESDAYS*
3PM – 5PM
THURSDAYS
2PM – 5PM
FRIDAYS
3PM – 5PM

Help Desk hours follow a University schedule. If the University is closed (or if the Geography office is closed), the GIS Help Desk will be unavailable. Hours may be limited or extended during midterms/final exams. Any changes will be announced or posted on the Clark University Geography Facebook page. Appointments operate on a first-come, first-serve drop-in basis unless otherwise scheduled.

508.793.7336 | JEFFERSON TOWER, 6TH FLOOR; *WEDNESDAYS ARE IN JEFFERSON 220A, GEOG MAIN OFFICE, JEFFERSON BUILDING, 2ND FLOOR*

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 “**geog-Python**” as the subject of the email

COURSE WEBSITEs ON GITHUB

Spatial Database

- Intermediate Statistics

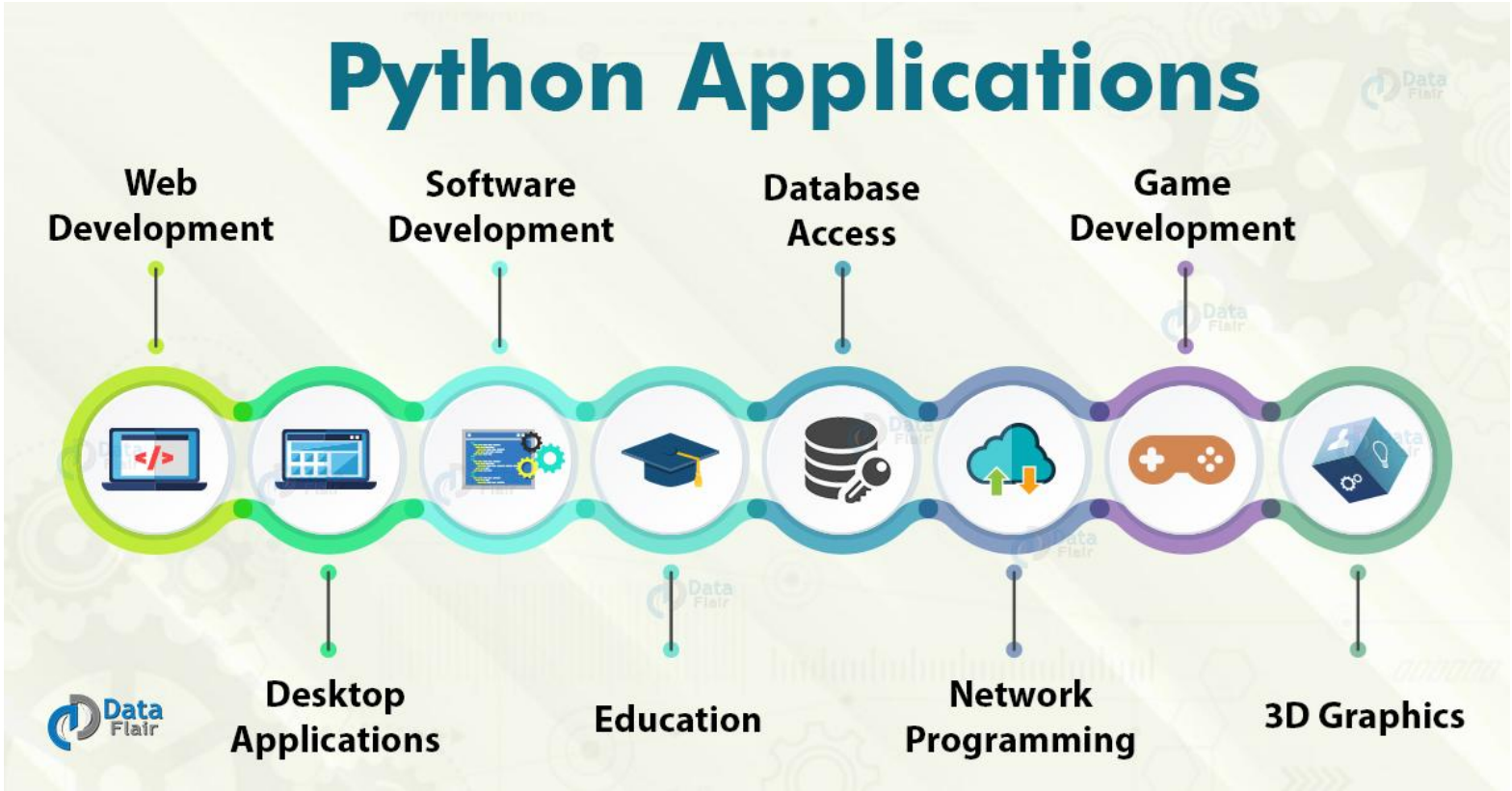
- Python Programming

- Web Mapping

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


Python Applications
Web Development
Software Development
Database Access
Game Development
Desktop Applications
Education
Network Programming
3D Graphics
Data Flair

COMPANIES USING PYTHON

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

Google

Dropbox

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

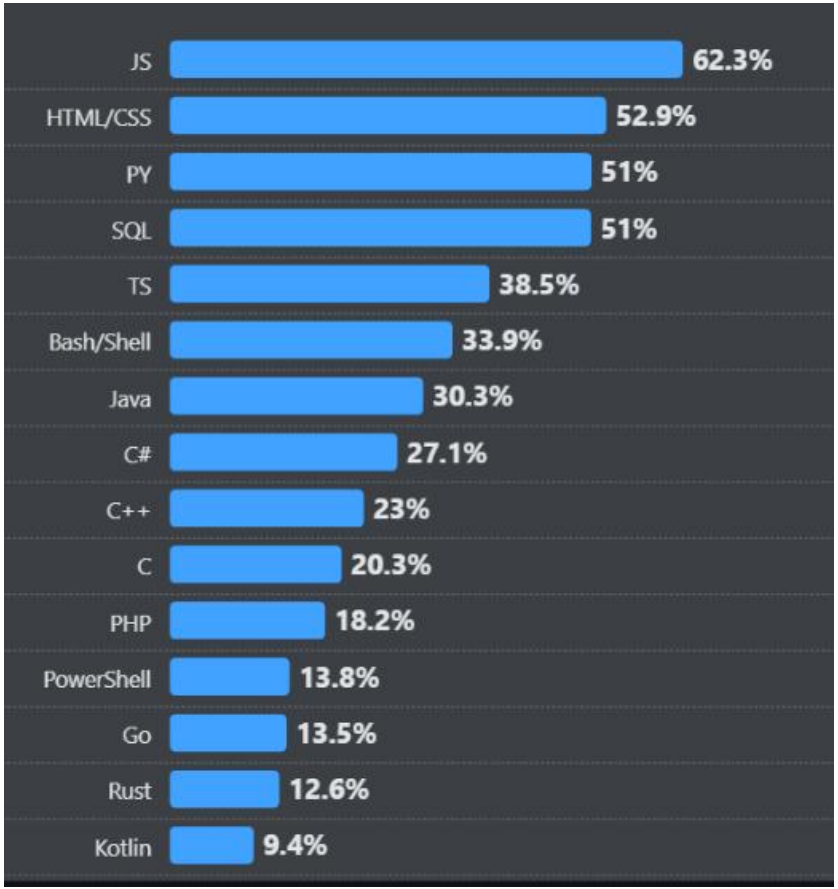
Why Programming?

- 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

Programming Language

Created in 1991 by Guido van Rossum

Cross Platform

Freely Usable Even for Commercial Use

NOTE

- There are 2 widely used versions of Python: Python2.7 and Python3.x
- We'll use Python3
- 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

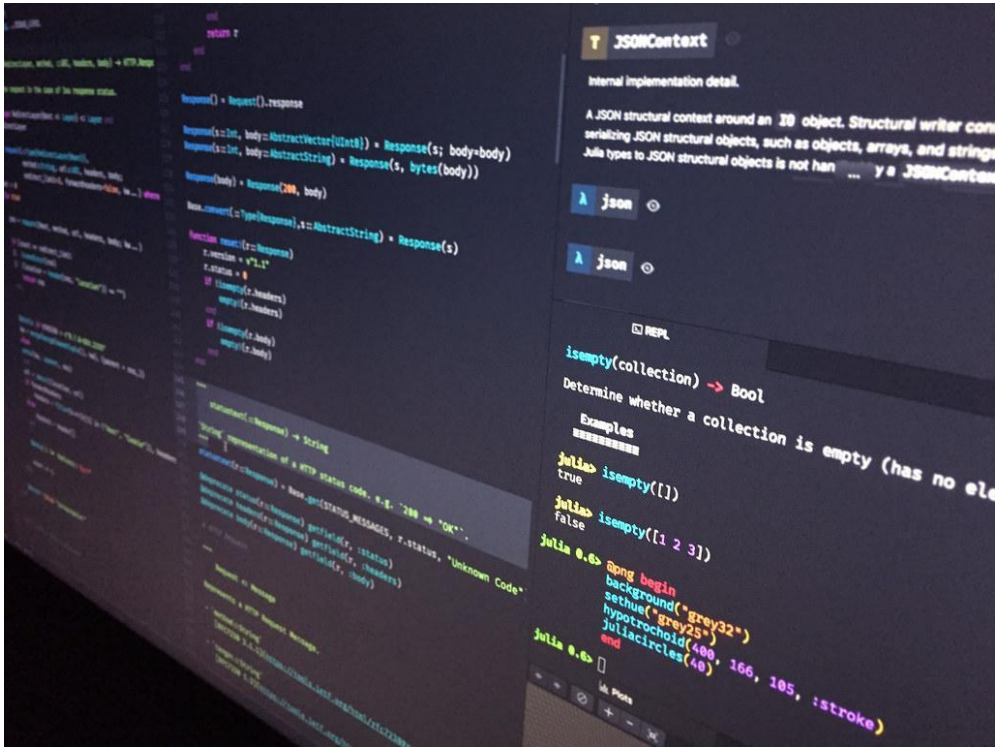
Be careful when you download different versions

- 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!

Source

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

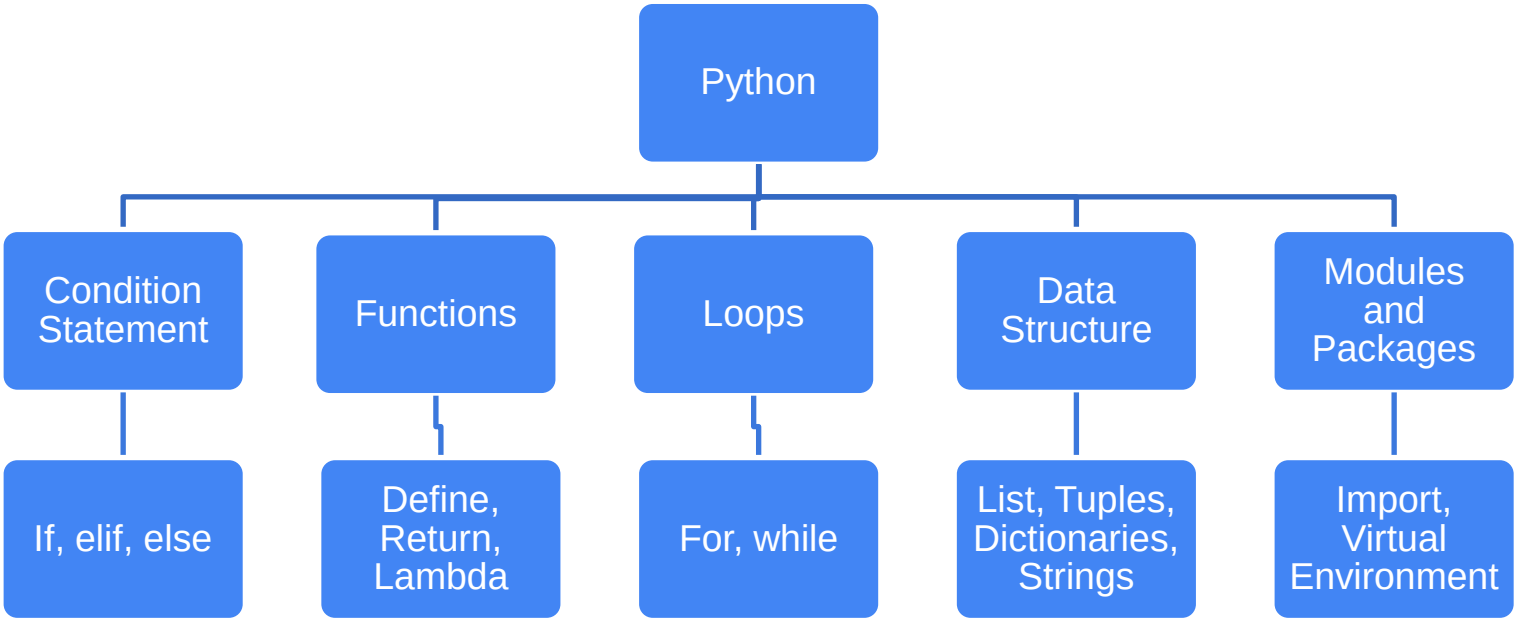
Google Colab

- ➔ 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!)

While Using Colab

- A folder will be created automatically in your Google Drive

Python Fundamental



Non-spatial data processing: Pandas

DataFrame Creation

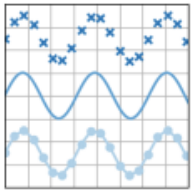
Data Inspection

Data Selection

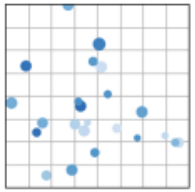
Data Cleaning

Data Manipulation

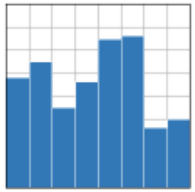
Data Visualization: Matplotlib



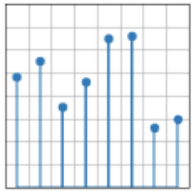
plot(x, y)



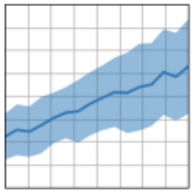
scatter(x, y)



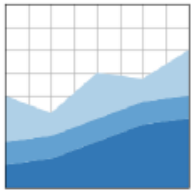
bar(x, height)



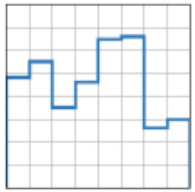
stem(x, y)



fill_between(x, y1, y2)



stackplot(x, y)

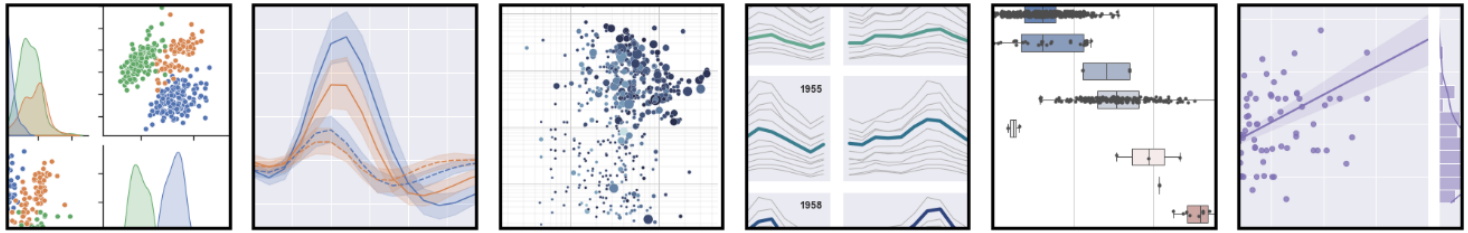


stairs(values)

Matplotlib cheatsheets and handouts

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.

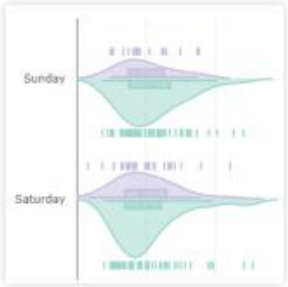
Contents

Features

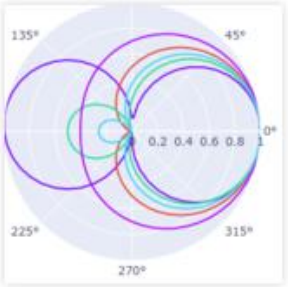
- New Objects: API | Tutorial
- Relational plots: API | Tutorial
- Distribution plots: API | Tutorial
- Categorical plots: API | Tutorial
- Regression plots: API | Tutorial
- Multi-plot grids: API | Tutorial
- Figure theming: API | Tutorial
- Color palettes: API | Tutorial

Seaborn cheatsheets and handouts

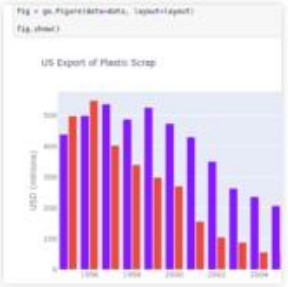
Data Visualization: plotly



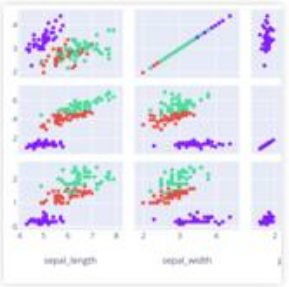
The Figure Data Structure



Creating and Updating Figures



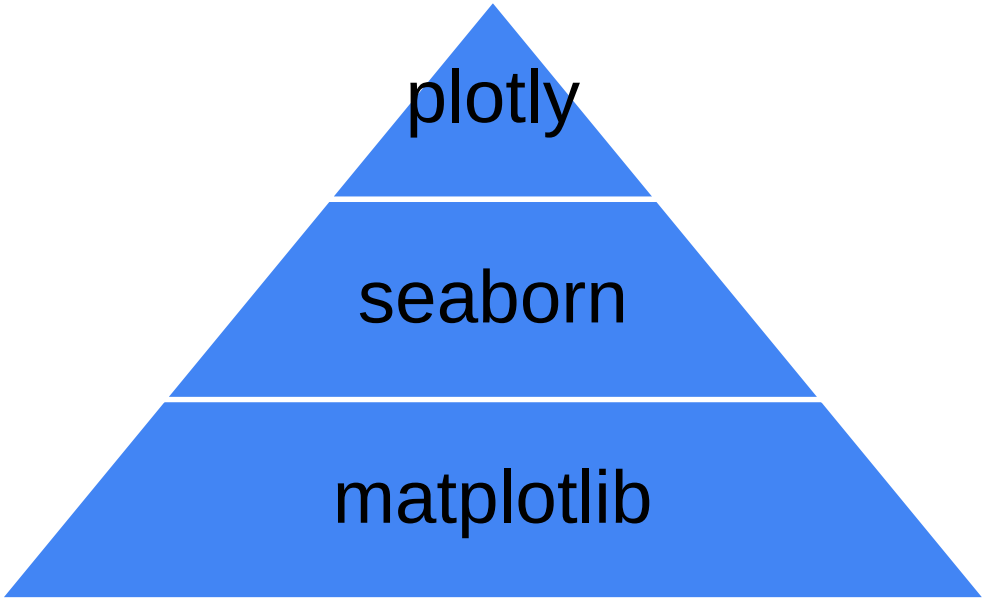
Displaying Figures



Plotly Express

Analytical Apps with Dash

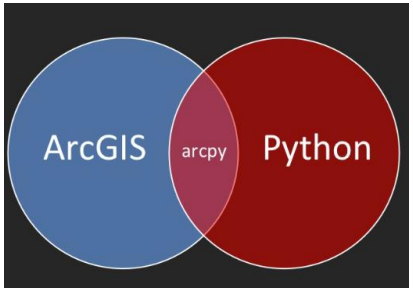
Difference among three



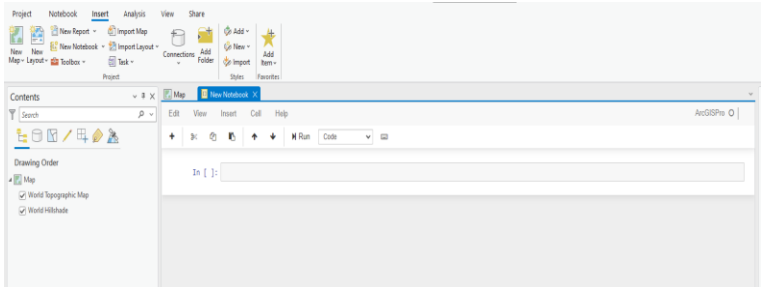
- matplotlib: Low-level library
- seaborn: built on top of matplotlib
- plotly: focused on interactive plots

Geoprocessing - Arcpy

Integration with ArcGIS Pro



Scripting & Automation



Access to Geoprocessing Tools

ArcPy → ArcGIS Pro

Interact with other Esri products

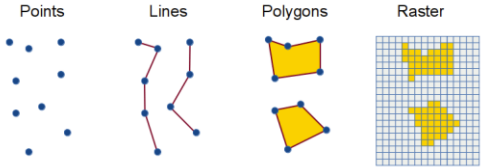
ESRI ArcGIS Online
Mapping and analysis: location intelligence for everyone

Web maps using the ArcGIS API for Python

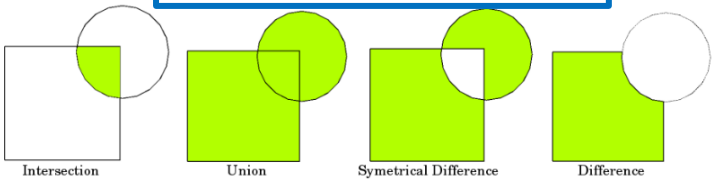
1. Esri User Document
2. Esri official Repo on GitHub

Web maps using the Open Source Spatial Libraries

Spatial Data Structure



Geometric Operation

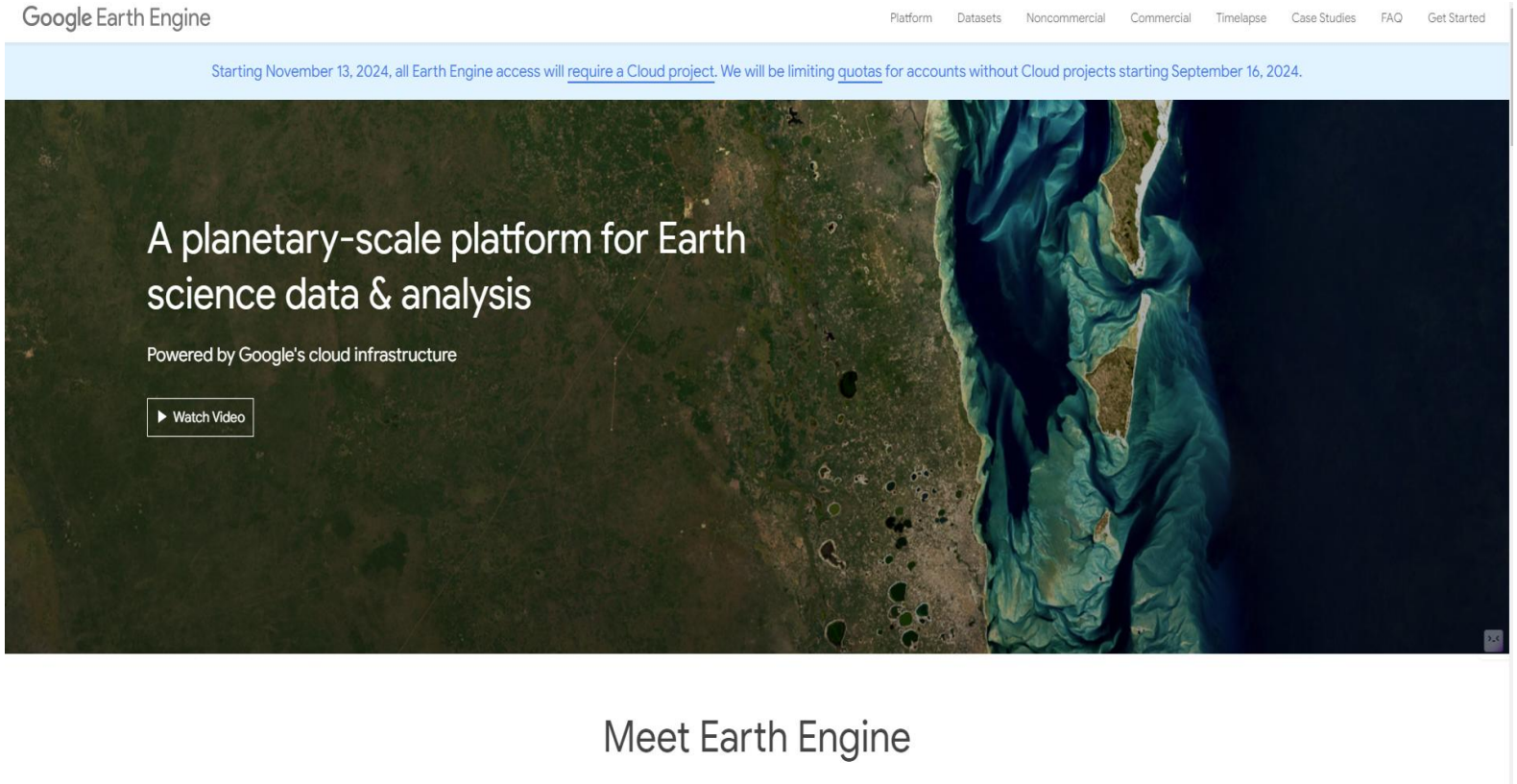


Interactive map

Open Source

- Installing with Anaconda/conda

geemap – Google Earth Engine Python API



geemap – Google Earth Engine Python API

giswqs

Type / to search

Overview | Repositories 282 | Projects | Packages | Stars 1.1k

Qiusheng Wu

giswqs

Unfollow | Sponsor

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

6k followers · 168 following

Followed by gisyaliny

University of Tennessee
Knoxville, TN
15:50 - same time
qwu18@utk.edu
https://gishub.org
https://orcid.org/0000-0001-5437-4073

giswqs / README.md

Qiusheng Wu

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visitors 131210

Dr. Qiusheng 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 | eefolium | 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

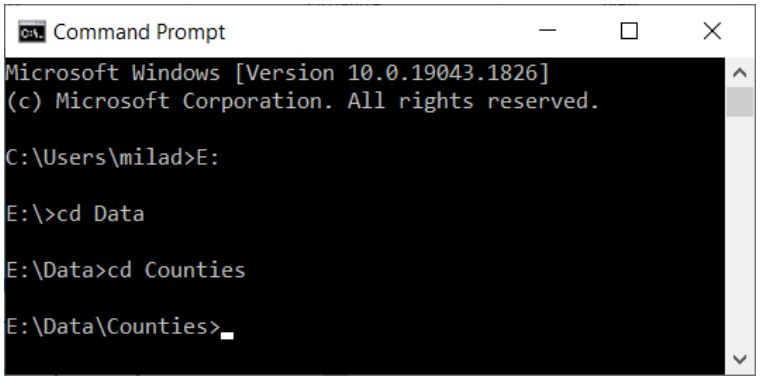
Latest Blog Posts

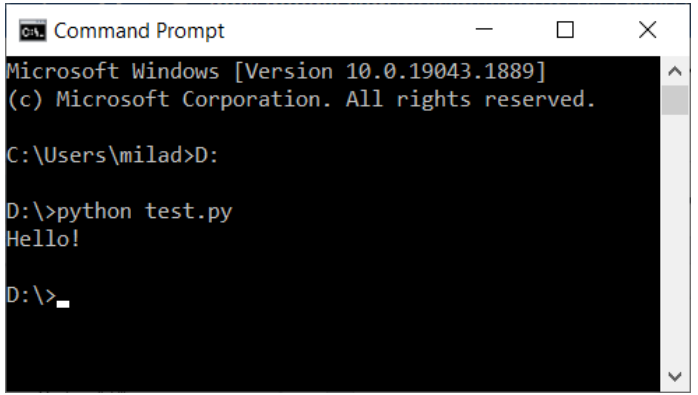
- Visualizing satellite image time series interactively
- Segment-geospatial presentation at SERVIR
- Segmenting remote sensing imagery with box prompts
- New book release: Earth Engine and Geemap
- Creating satellite timelapse with Streamlit and Earth Engine

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

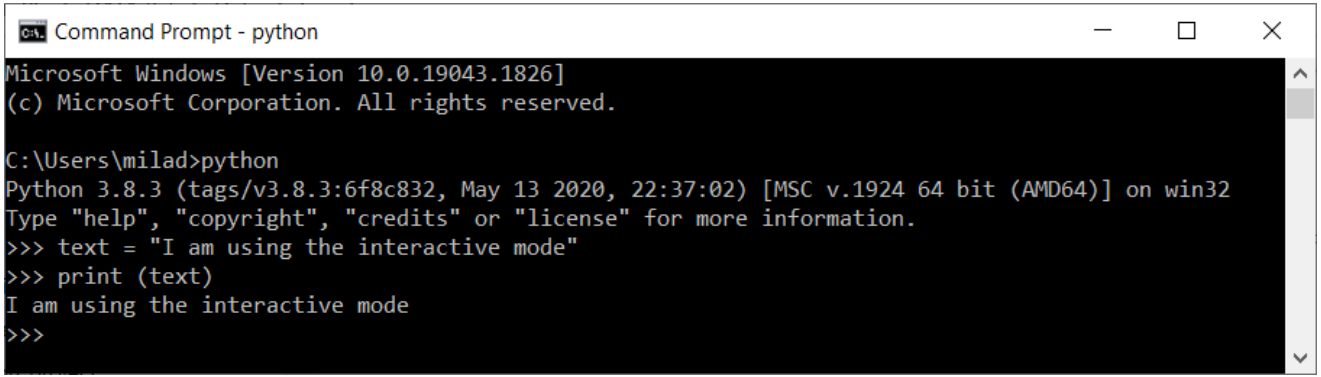




How Do I Program In Python?

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:



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