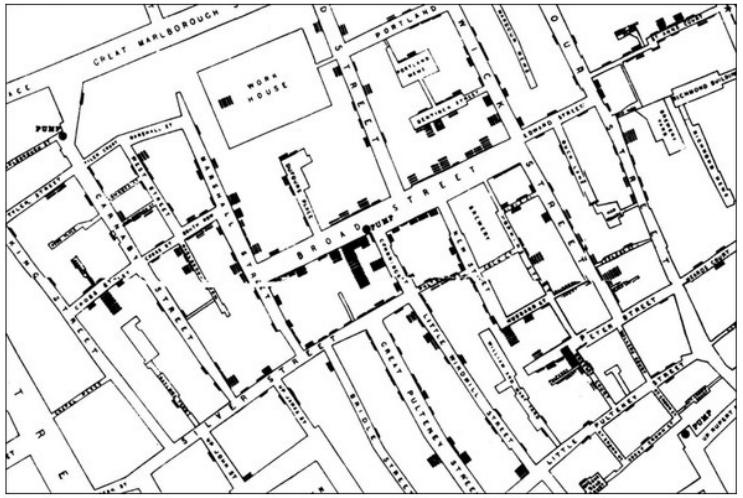
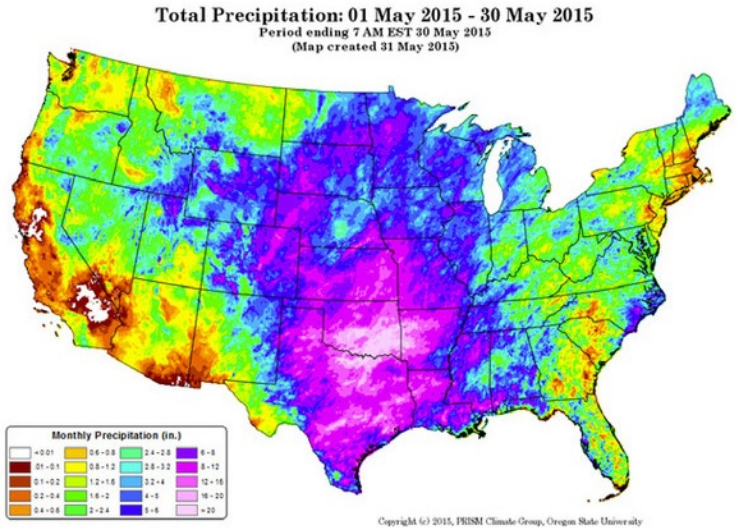
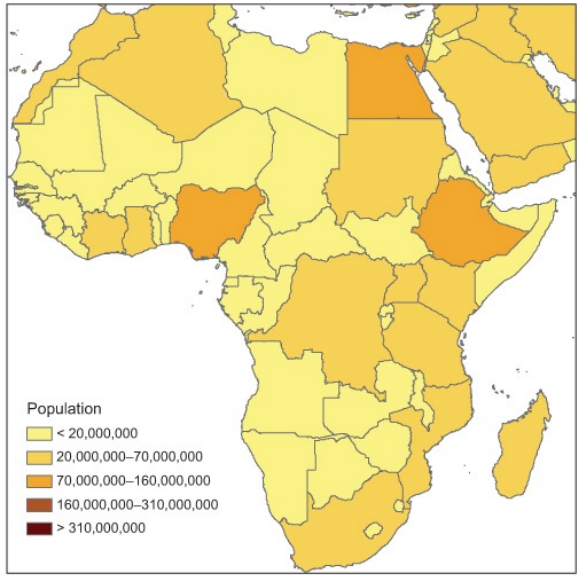
Introduction to GIS Programming

History of Geoprocessing and GIS







John Snow,
Soho cholera outbreak of 1854

Desktop-based
Geographic Information System

Drawbacks of desktop-based GIS

- Expensive; commercial GIS software such as Esri ArcMap and ArcGIS Pro
- Predefined toolsets; not able to modify things in ‘black box’
- Tedious mouse clicks
- Hard to save several tasks

Benefits of programming

- Free and open-source languages
- Being able to investigate logics inside of the ‘black box’
- Automation; no more clicking mouse
- Reproducibility; redo the task easily as long as you haver your code

Types of Programming (Platform)

- Desktop
  - Things that show up in your start menu
- Web
  - Things you can get to from a web browser
- Scripts
  - Things that you run from your computer but are not in your start menu
- High Performance Computing (HPC)
  - Things that you would run on a supercomputer
- Apps
  - Things that you run on your cell phone

Kinds of programming languages

- **C#**; primarily for Windows
- **VBA**; primarily for Windows
- **C** & **C++**; most powerful fundamental language but hard to learn
- **Java**; works on any platform; was popular (some desktop apps that out of style)
- **HTML**; web development and often combined with **CSS** and **JavaScript**
- **R**; specialized in statistics but also popular in GIS
- **PYTHON**; the focus langauge of our course

What is Python and why popular?

- History
  - Conceived in late 1980s by Guido van Rossum
  - Python 2 released in 2000 and depreciated in 2020
  - Python 3 announced in 2008 (active)

- Strengths:
  - Intuitive language; pretty easy to learn
  - High-level language, can do a lot with relatively little code
  - Fairly popular among high-level languages
  - Robust support for object-oriented programing
  - Support for integration with other languages (e.g., GDAL binding)

Python dev environment

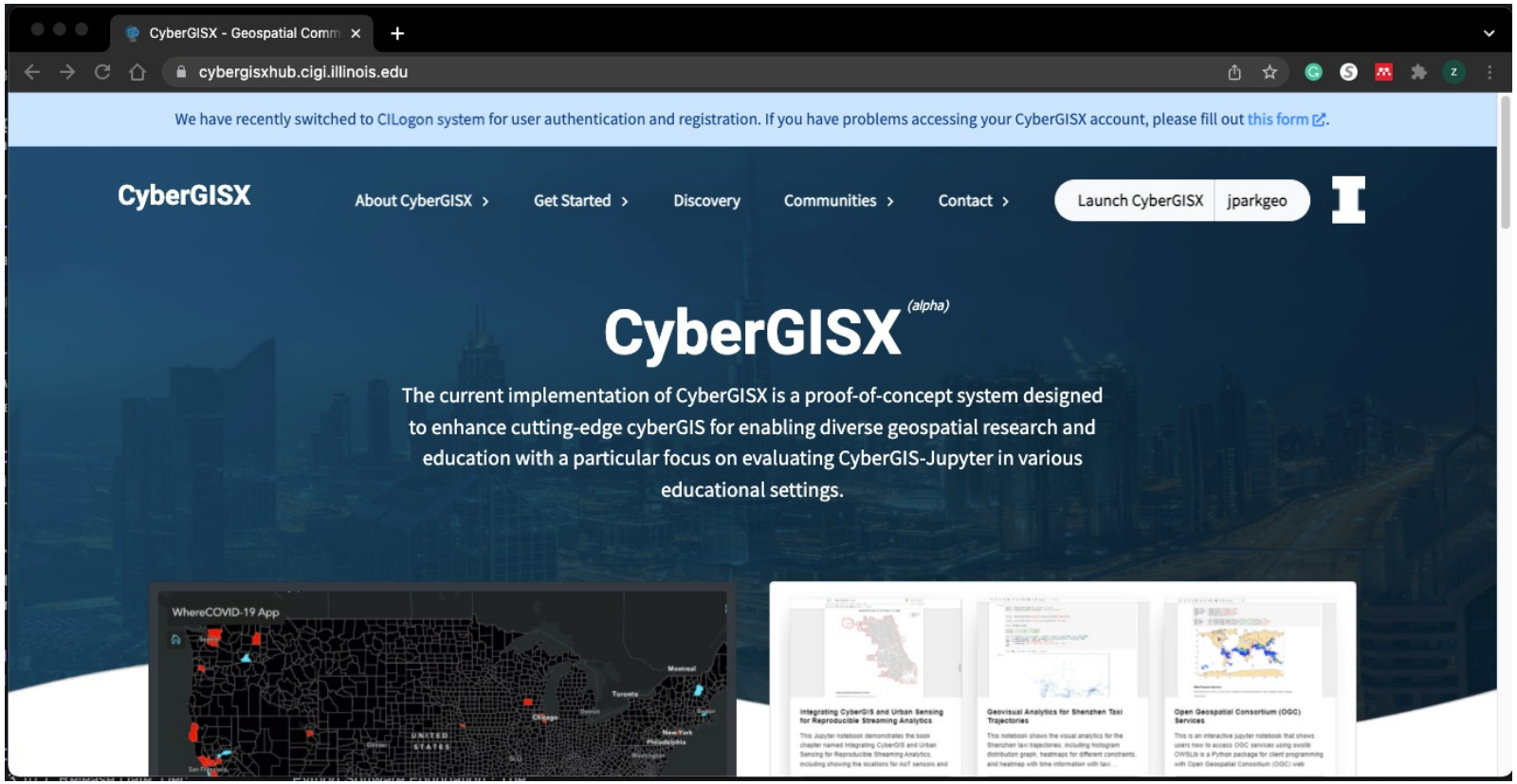
- Python file (*.py) with code editor (e.g., PyCharm and Atom)
  - Local; only can run an entire python file

- IDLE (Integrated Development and Learning Environment)
  - Local; interactive interface; instant output
  - Run a line at a time

- Jupyter Notebook
  - Web application; internet may be required
  - Can run code partially or entirely as needed

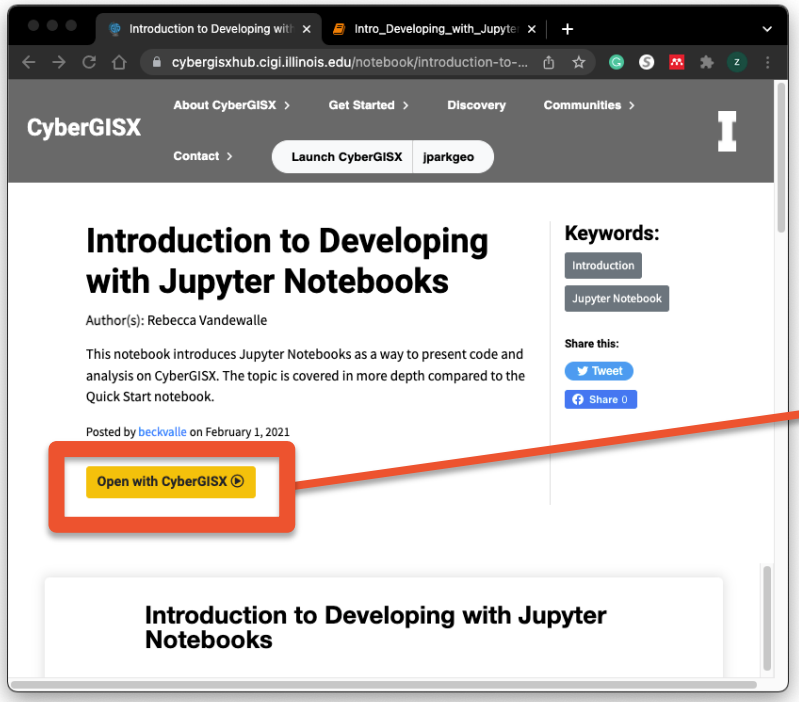
Set up your Jupyter notebook

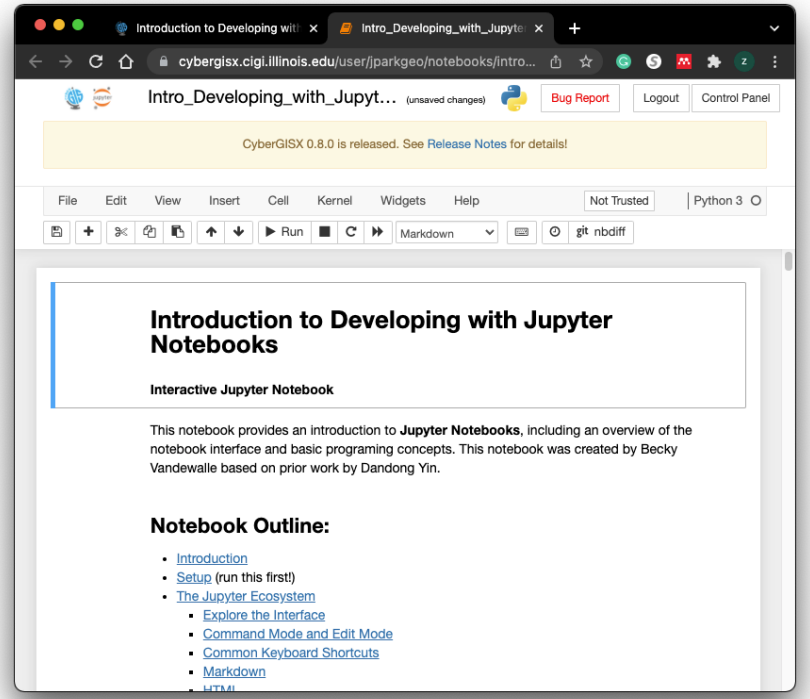
- https://cybergisxhub.cigi.illinois.edu/get-started/



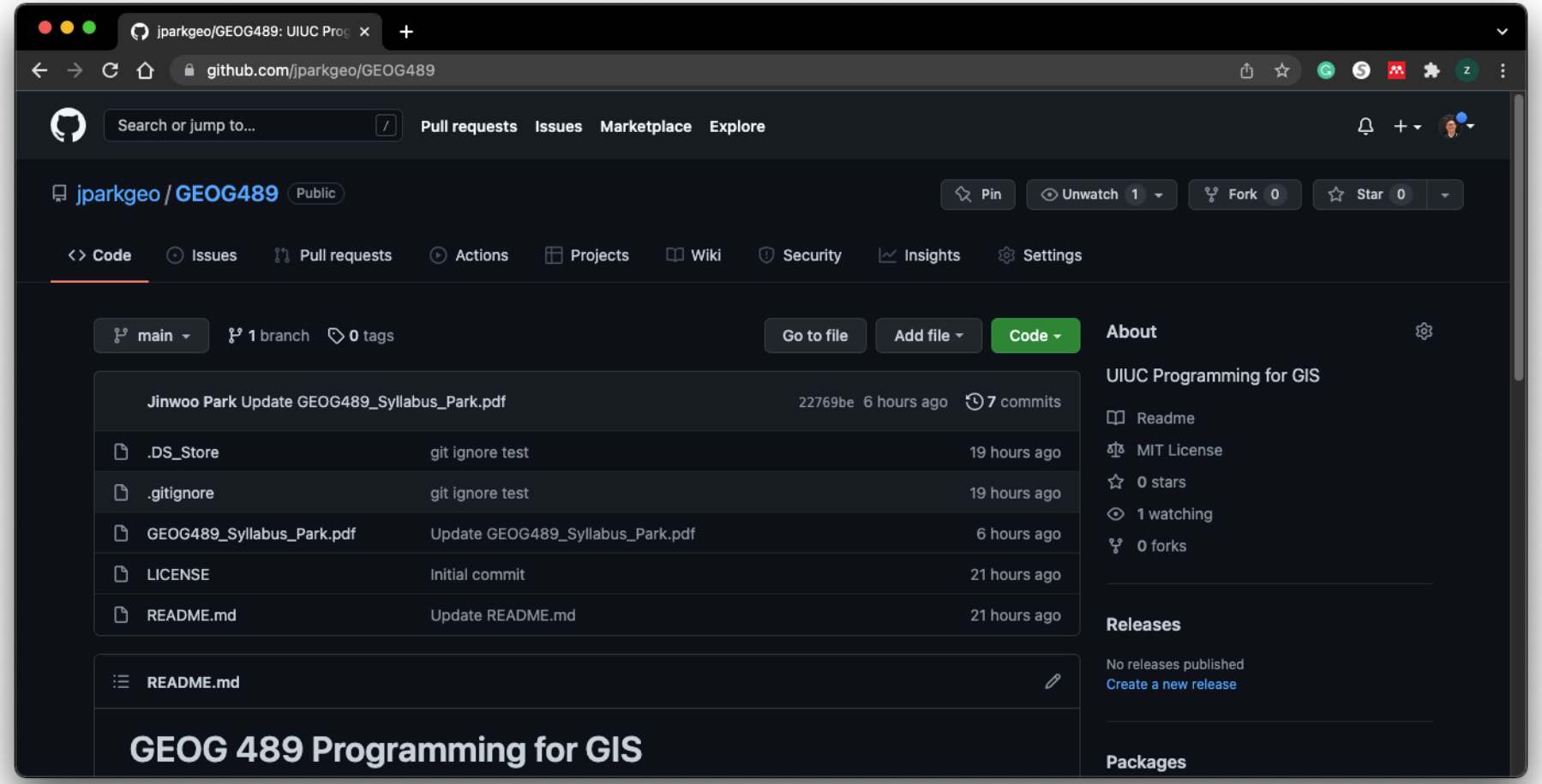
Intro to Jupyter notebook

- https://cybergisxhub.cigi.illinois.edu/notebook/introduction-to-developing-with-jupyter-notebooks/
- https://cybergisxhub.cigi.illinois.edu/notebook/jupyter-notebooks-quick-start-2/





GitHub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Packages

Helpful resources

- Official Python Tutorial:
  - https://docs.python.org/3/tutorial/index.html
- Stack Overflow (Q&A Forum):
  - https://stackoverflow.com/
- W3schools:
  - https://www.w3schools.com/python/default.asp
- GeeksforGeeks:
  - https://www.geeksforgeeks.org/python-programming-language/?ref=shm

Next class

- Python basics
  - Data types: Binary, Integer, Float, Boolean, etc.
  - Data containers: List, Dictionary, Tuple, Set
  - Basic functions: Type(), Range()

- Reading (recommended)
  - Geoprocessing with Python, Chapter 2

Q&A

Jinwoo Park
jparkgeo@illinois.edu