Immersive Python Workshop

August 15-16, 2024

Introduction to Python for GIS

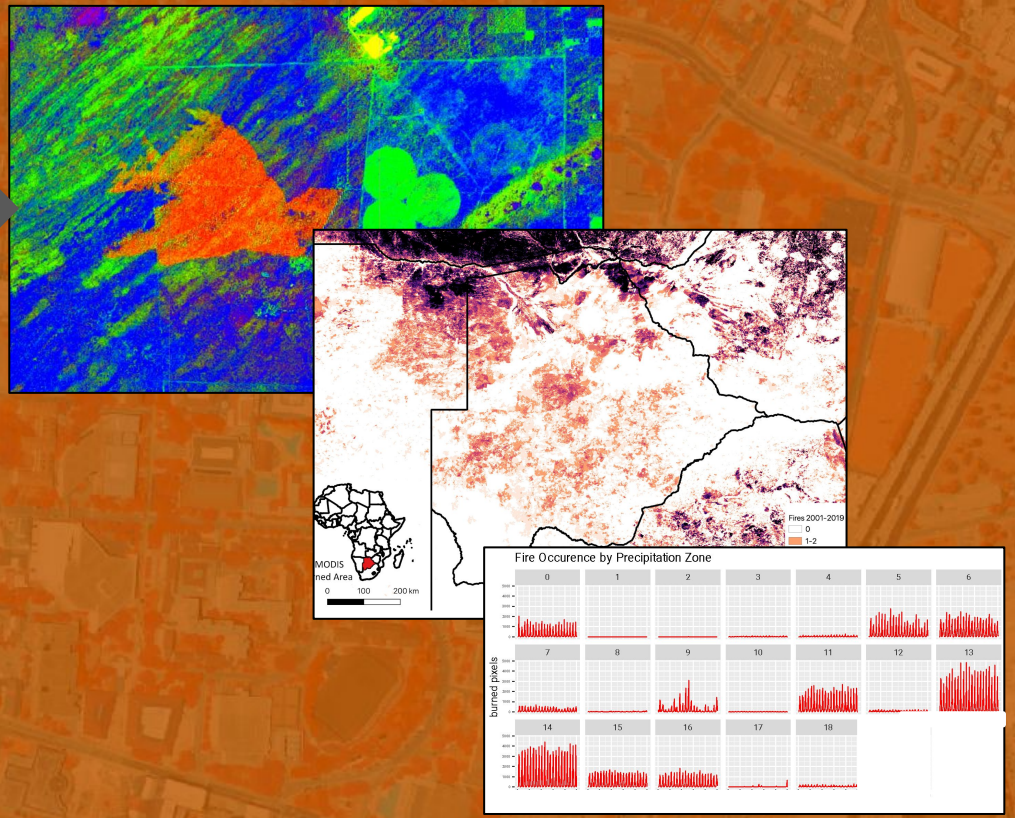
TEXAS Libraries
The University of Texas at Austin
University of Texas Libraries

Presented by the
UT Libraries &
Open Source Program Office (UT-OSPO)

UT-OSPO
UT Austin Open Source Program Office

Sloan grant number: G-2023-20944

Introduction



Goals for this Workshop

Highlight useful freestanding GIS packages on Python

Introduce workflows for Vector and Raster data

Provide sources for spatial data and explain how to access/manipulate with python

Goals for this Workshop

Highlight useful freestanding GIS packages on Python

Introduce workflows for Vector and Raster data

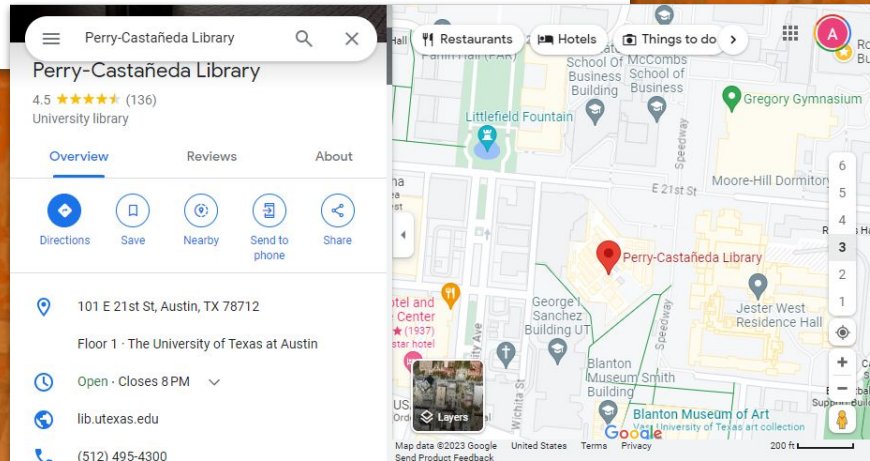
Provide sources for spatial data and explain how to access/manipulate with python

What is GIS?

Geographic – Relates to a specific location on the Earth's surface

Information – Data that has some value added

Systems – System that performs functions with geographic data



Why is GIS Important?

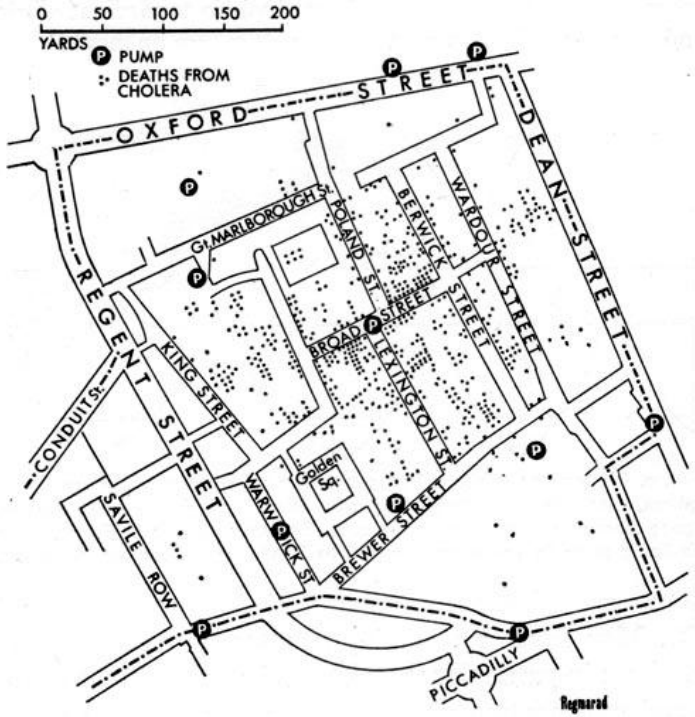
- Helps solve geographic problems
- Location is either used to help find a solution or is the solution itself

Examples: “Where did the flooding occur?”

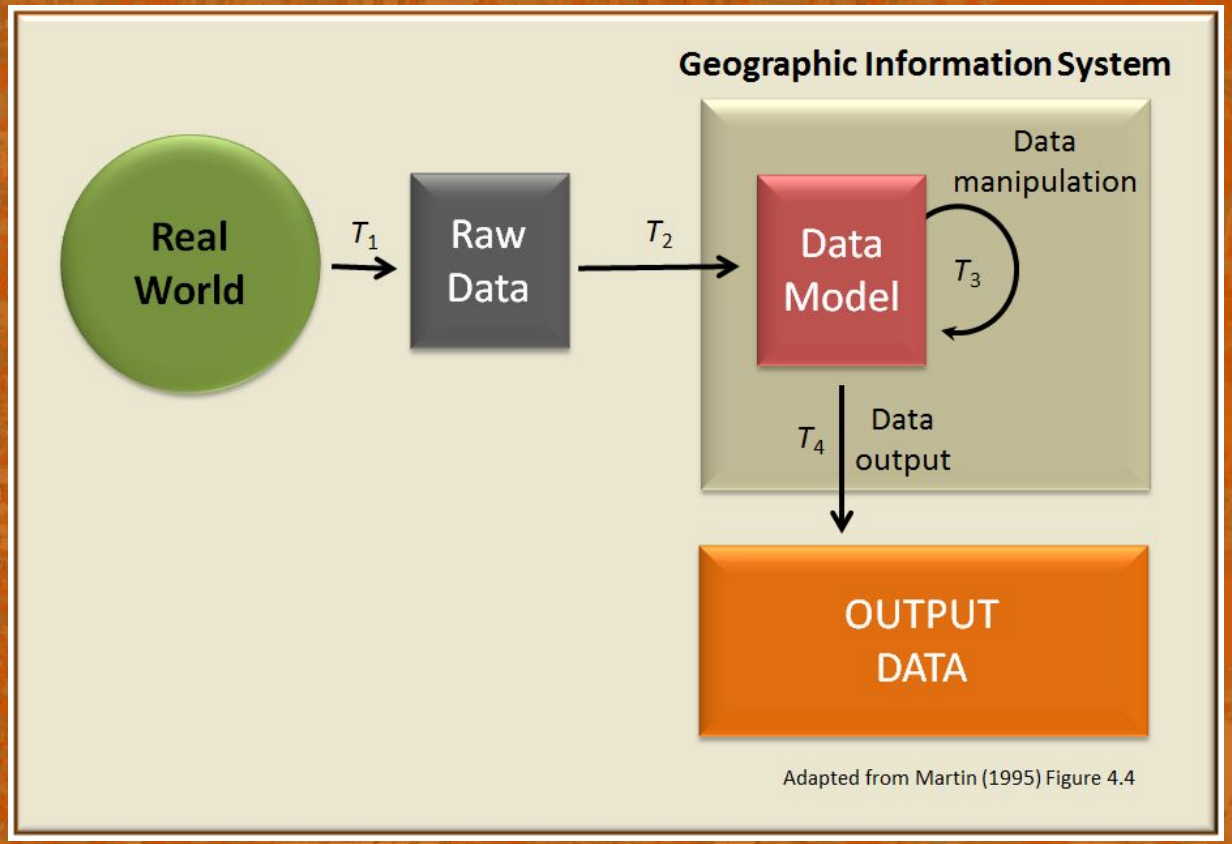
“Where should I open my business?”

“Why are cases of Cholera clustered?”

John Snow’s Cholera Map, 1854



What is GIS?


Geographic Information System
Real World
T_1
Raw Data
T_2
Data Model
Data manipulation
T_3
T_4
Data output
OUTPUT DATA
Adapted from Martin (1995) Figure 4.4

What is GIS?

Real World

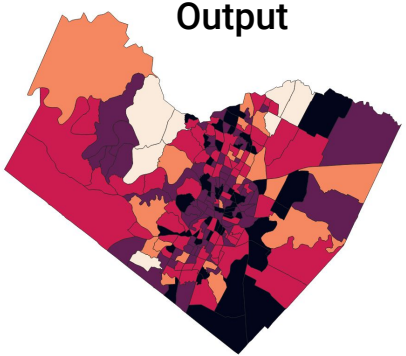
Raw Data

48453001728	CT001728, Travis County, TX	7753
48453001747	CT001747, Travis County, TX	6526
48453001748	CT001748, Travis County, TX	6198
48453001772	CT001772, Travis County, TX	5340
48453001774	CT001774, Travis County, TX	8484
48453002407	CT002407, Travis County, TX	6911
48453002421	CT002421, Travis County, TX	11874
48453002422	CT002422, Travis County, TX	6376
48453002423	CT002423, Travis County, TX	6192
48453002424	CT002424, Travis County, TX	3899
48453002425	CT002425, Travis County, TX	4590
48453002426	CT002426, Travis County, TX	9918
48453002427	CT002427, Travis County, TX	8101
48453002428	CT002428, Travis County, TX	9084
48453002429	CT002429, Travis County, TX	2159
48453002430	CT002430, Travis County, TX	2614

Data Model

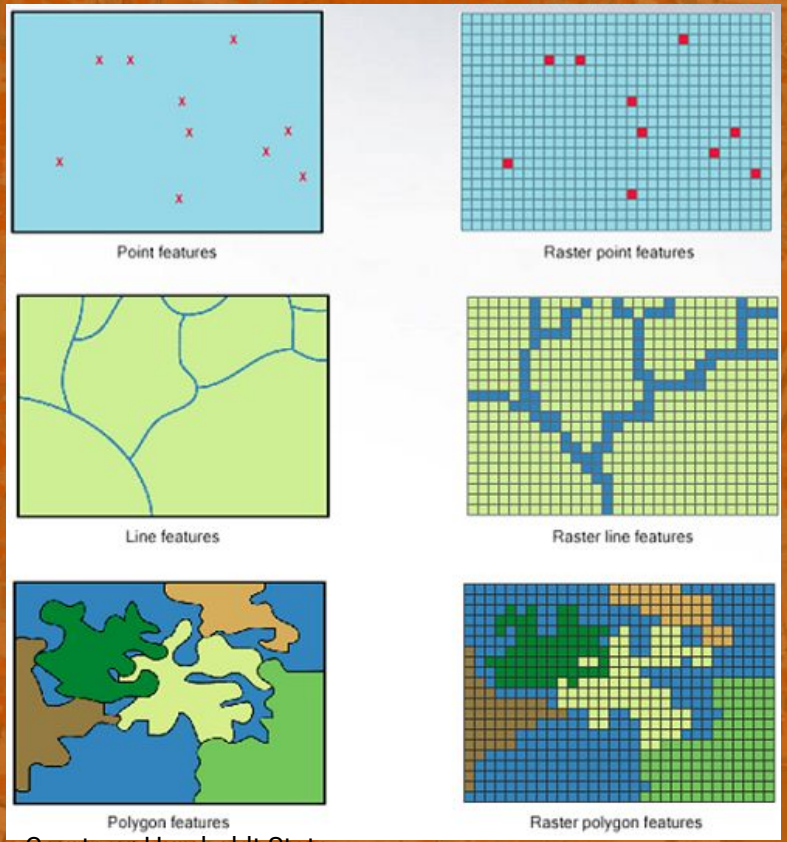
Data Manipulation

Output



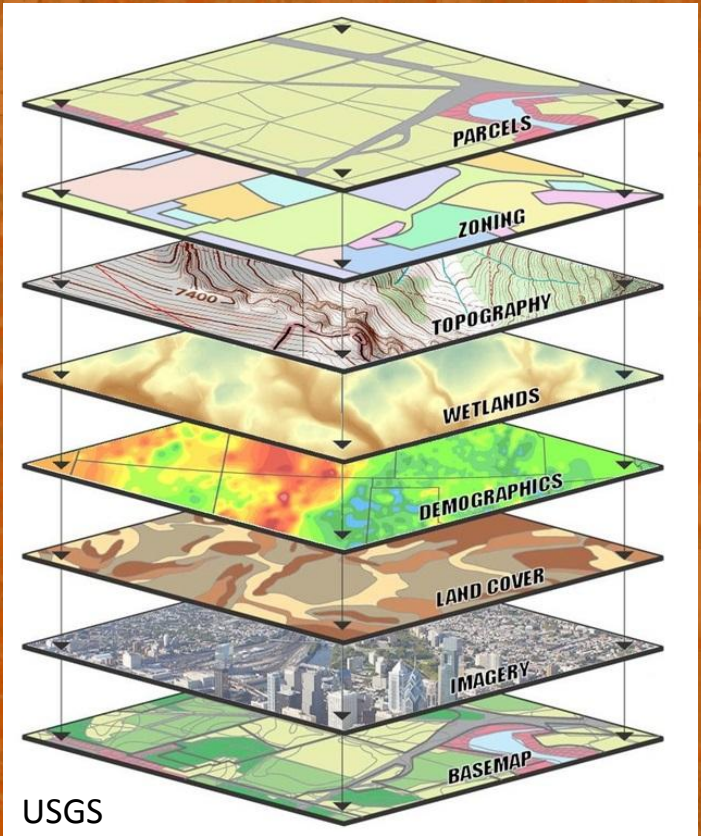
GIS Data Models

- How do we represent geographic space with data?
- Two different types of models
  - Vector
  - Raster
- Vector is normally used for discrete features
  - e.g., roads, lakes
- Raster is best for continuous features
  - e.g., elevation, land cover type`

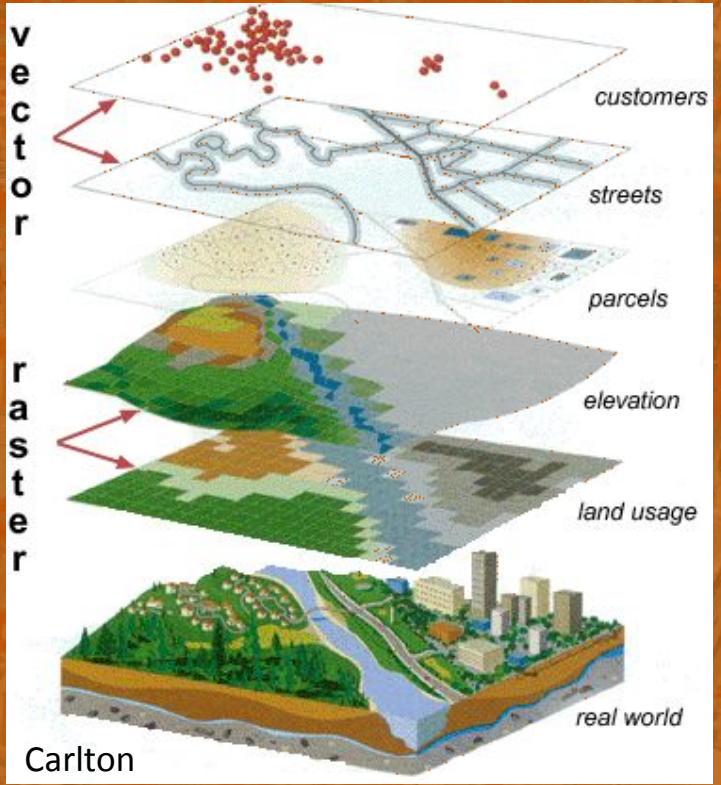


Courtesy: Humboldt State

GIS Layers



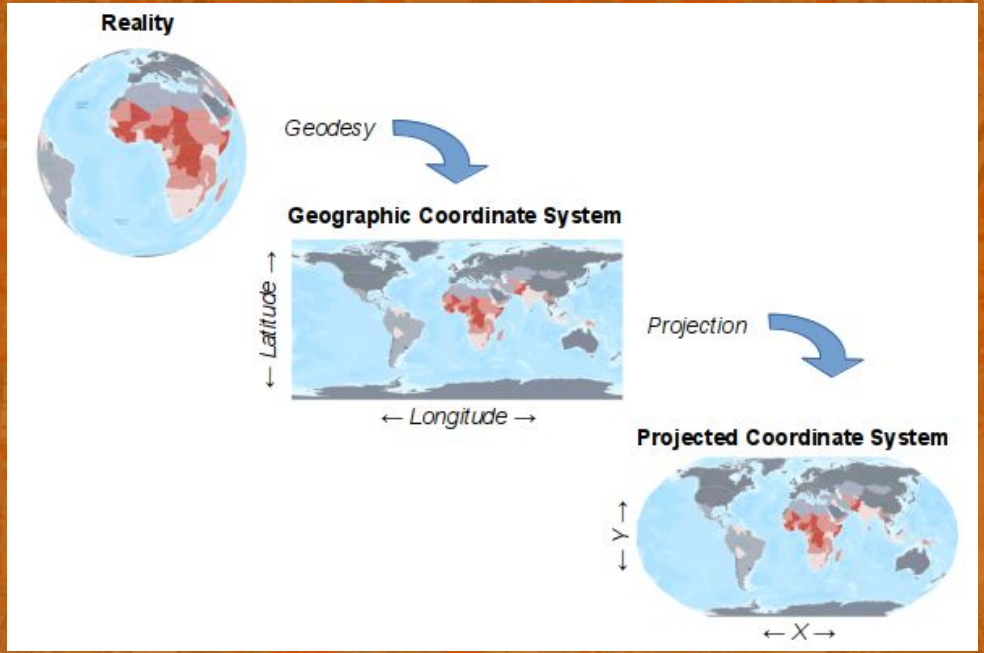
USGS



Carlton

Coordinate Systems

- To understand where something is we need uniquely defined locations for all points on earth
- A geographic coordinate system uses a three-dimensional spherical surface
    - E.g., Lat/Long = 30.282, -97.738
- A projected coordinate system employs a conversion from Lat/Long to X/Y on a planar system



Why is open source important in GIS

- Traditionally dominated by proprietary software (Esri) in the US
- It is still important to know Esri ArcGIS software for the GIS professional market in the US

However, there are great open source alternatives!

- These open source softwares are free to use and globally popular
- Analyses performed with open source software have higher reproducibility
- Unlike ArcGIS Pro, open source GIS software generally works on Macs

GIS Software

Desktop Interface

QGIS

ArcGIS Pro

Script-based

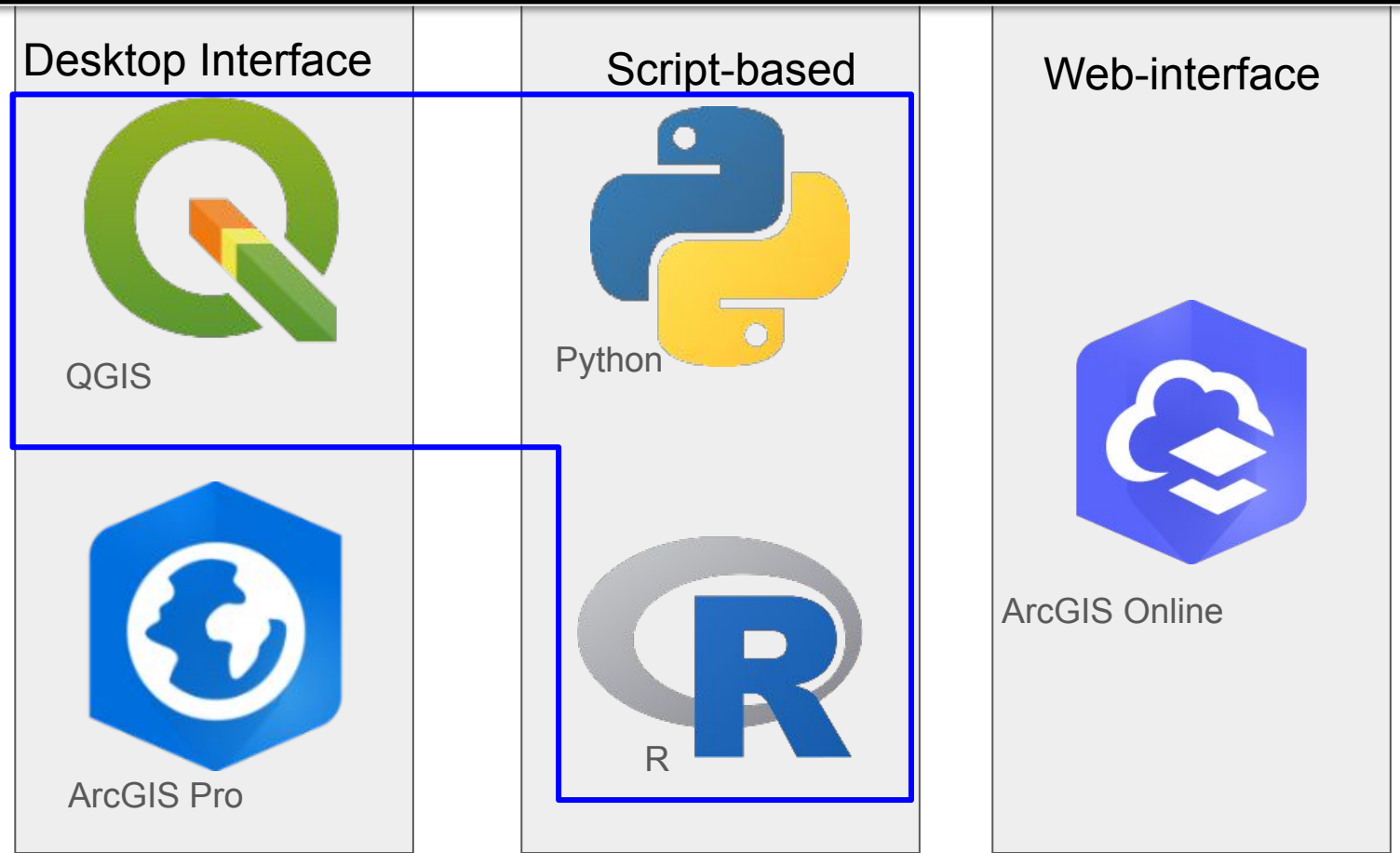
Python

R

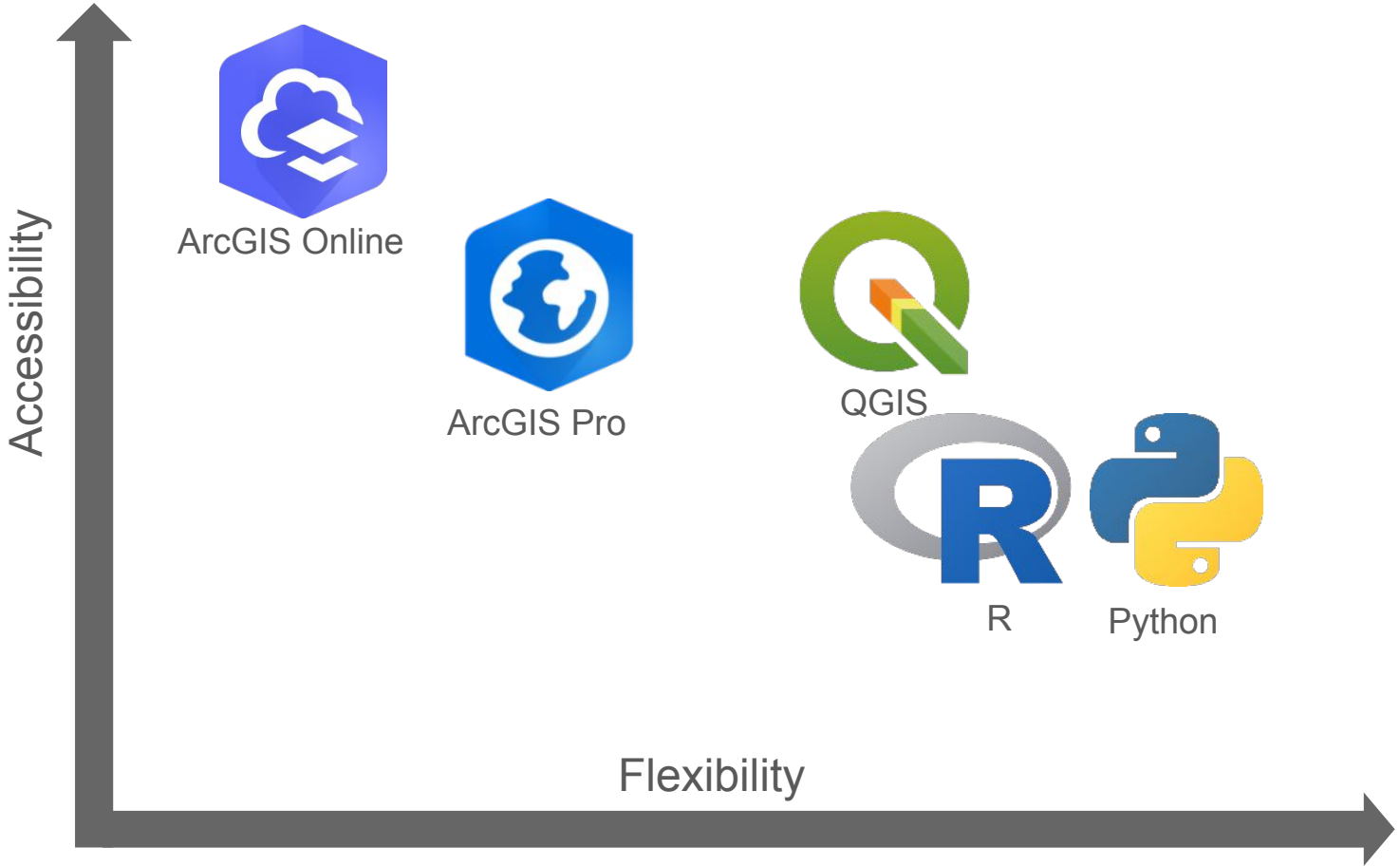
Web-interface

ArcGIS Online

What software should I recommend?



*Assuming institutional access to ArcGIS products and a non-programming background



GIS in Python

Example Python GIS Packages

GeoPandas: Important library for working with vector based geospatial data in Python

GDAL: Translator library for a wide variety of raster and vector data formats.

GeoWombat: Provides utilities to process geospatial and time series of raster data at scale. Easily process Landsat, Sentinel, Planetscope or RGB data and others.

Rasterio: Provides functionality for GeoTIFF and other formats to organize and store gridded raster datasets such as satellite imagery and terrain models.

OSMnx: Allows users to easily download, model, analyze, and visualize street networks and other geospatial features from OpenStreetMap.

GIS in Python

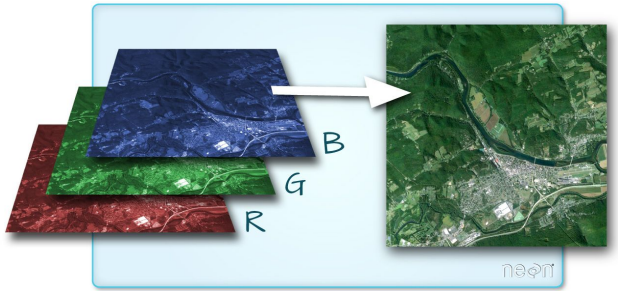
Other Packages We'll Use Today

MatPlotLib: comprehensive library for creating static, animated, and interactive visualizations.

urllib: provides several modules for working with URLs:

Important Concepts for today

- Buffering
- Openstreetmap Data
- Multiband Satellite Imagery
- NDVI



ArcGIS