How to: Mapping with Python

**Intro to GIS:**

Geographic Information Systems (GIS) is a powerful and versatile technology that is used to capture, analyze and visualize geospatial data. It integrates various forms of information, such as maps, satellite imagery, and numerical or categorical data layers, to provide a comprehensive understanding of geography and the related attributes. GIS plays a crucial role across diverse fields, including urban planning, environmental management, disaster response, agriculture, transportation, and epidemiology. Its utility stems from its ability to uncover patterns, relationships, and trends in spatial data, allowing decision makers to make informed choices, optimize resource allocation, and develop effective strategies. By facilitating the creation of interactive maps, conducting spatial analyses, and fostering data-driven insights, GIS enhances our ability to address complex challenges, make informed decisions, and foster sustainable development in an increasingly interconnected world.

The program that is most commonly used for this type of geospatial analysis is ArcGIS, a product created by the software company ESRI. However, it is possible to do some of the functions of GIS in Python using Pandas.

In this article, I will go through one method for creating an interactive map in Python. Plotly.express is a package in Python that can be used to visualize data. The results are interactive and can be embedded into web applications and notebooks. Plotly.express allows you to create interactive maps that are complex with relatively short amounts of code and makes it easy to import data into its format. However, it still allows for a lot of customization of your data, you can modify colors, markers, labels, titles, axis properties, legends, and more using function arguments. The interactive component allows you to zoom into maps, rather than them being static, and hover over points on the maps to view more information.

In the Jupyter notebook that can be found at this link, I wrote a simple code to visualize 40 countries with some of the largest population sizes globally. First, I read an excel file with all of my data into python using pandas. The columns in this file are City, Country, Latitude, Longitude, Population, and Population Density; the latitude and longitude are used to locate the points on the map with plotly.express.

To create a basic global map with the points from this data, you can follow this code:

import plotly.express as px

# Create a scatter\_geo plot

fig = px.scatter\_geo(city\_pops, lat='Latitude', lon='Longitude', text='City', size='Population', color=’Population\_Density’)

# Customize the layout

fig.update\_geos(projection\_type="mercator", showcoastlines=True)

fig.update\_layout(coloraxis\_colorbar\_title="Population Density (per sq. km)", title="Population Sizes of Major Global Cities") # Customize the color scale legend title

# Show the plot

fig.show()

Key points in the code:

* px.scatter\_geo – this creates a scatterplot, which is great for visualizing the locations of cities, but another option might be preferred for other geography such as regions, water bodies, or roads that can’t be defined using a point on a map.
* size=’Population’ – this customizes the points on the map by setting the size of the points to represent the relative population size. Using this customization creates a quick way for someone viewing the map to identify which are the largest cities even when the map is zoomed out.
* color=’Population\_Density’ – this customizes the points on the map by setting the color of the points to reflect the population density of the city.
* fig.update\_geos(projection\_type="mercator", showcoastlines=True)
  + fig.update\_geos() - This method is used to update the properties related to the geographical aspect of the plot, such as the map projection, coastlines, and other geographic features.
  + projection\_type="mercator" – this specifies the map projection to be used for the geographic plot. In this case, "mercator" refers to the Mercator projection, which is a cylindrical map projection commonly used for world maps. The Mercator projection preserves straight lines and angles, making it useful for navigation, but it distorts the size of land masses at higher latitudes. If you are mapping regions, individual countries, or cities, I would recommend that you use a projection that is more specific to the area you are mapping to give a much more accurate projection of the shape and space.
  + showcoastlines=True - When you set showcoastlines=True, it means that the coastlines of land masses will be visible as lines on the map.