VISUALIZING GEOSPATIAL DATA IN PYTHON

Plotting with GeoJSON

Mary van Valkenburg
Data Science Program Manager, Nashville Software School

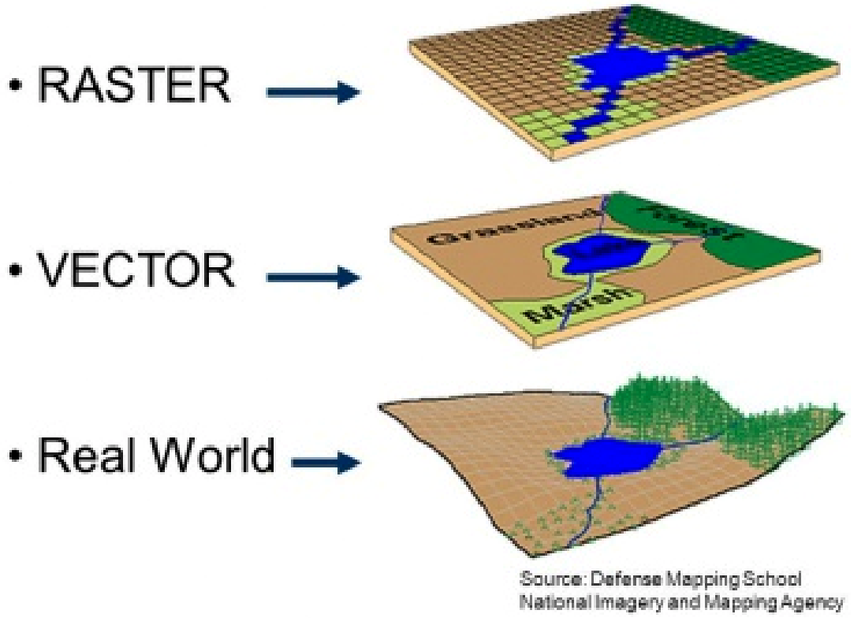
Neighborhoods GeoJSON

```
{
  "type": "FeatureCollection",
  "features": [
    {
      "type":"Feature",
      "properties":{
    "name":"Historic Buena Vista"
    },"geometry":{
        "type":"MultiPolygon","coordinates":[[[[-86.79511056795417,36.17575
        964963348],[-86.79403325521203,36.176723819622765],[-86.79395847673
        587,36.176734201205555],[-86.79373059621346,36.17641850227536],
```

```
neighborhoods = gpd.read_file('./data/neighborhood_boundaries.geojson')
neighborhoods.head(1)
```

```
        name                geometry
Historic Buena Vista    (POLYGON ((-86.79511056795417 36.17575964963348)))
```

Geopandas dependencies

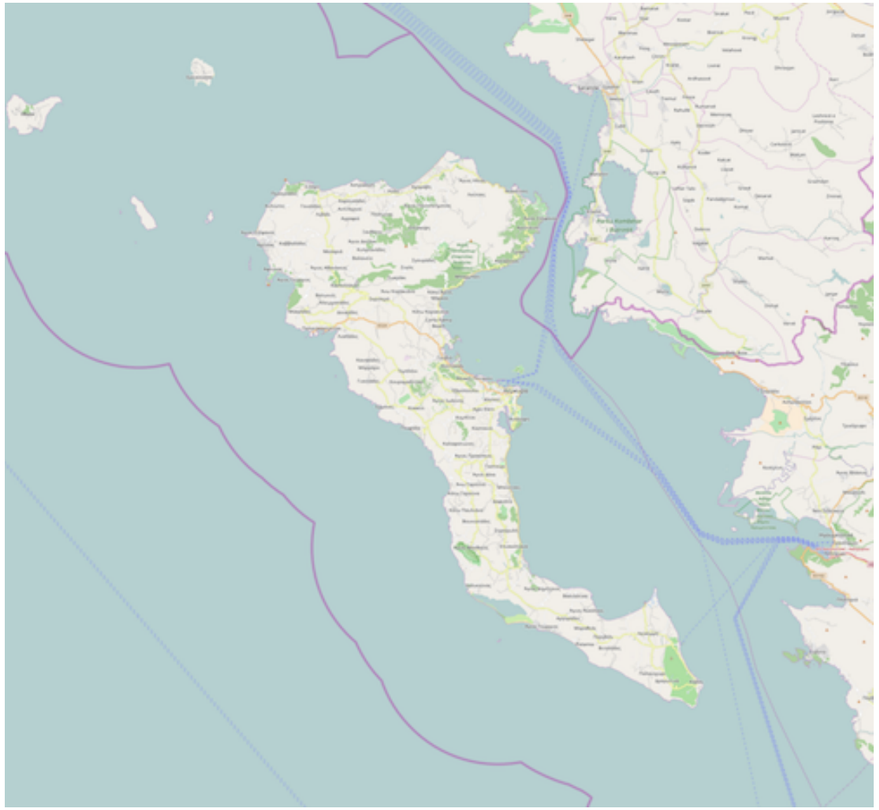


- Fiona
  - provides an python API for OGR
- GDAL/OGR
  - GDAL for translating raster data
  - OGR for translating vector data

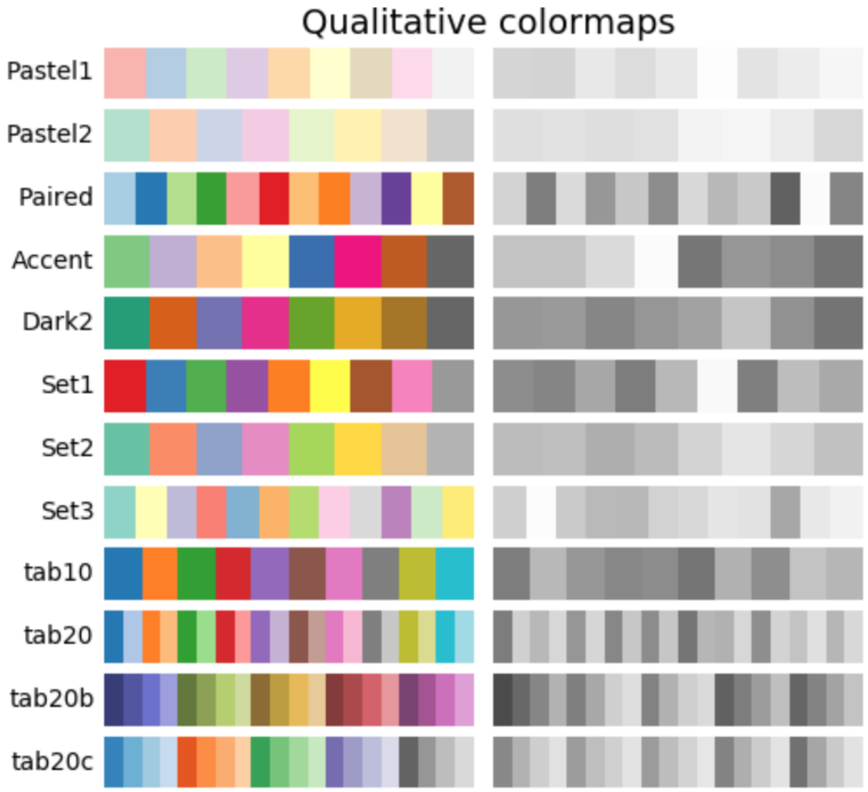
Comparing raster and vector graphics

raster image of Corfu

vector image of Corfu



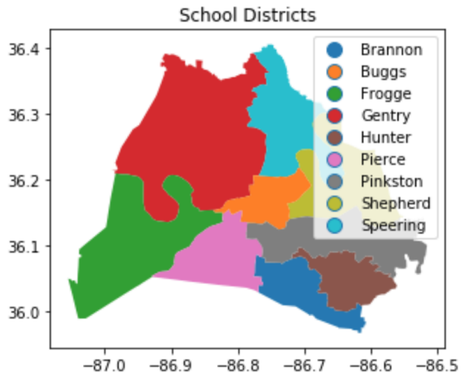
Colormaps

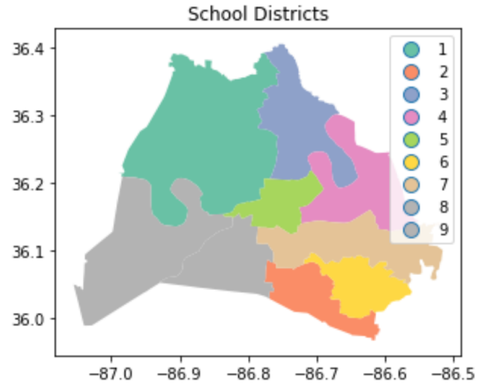


https://matplotlib.org/users/colormaps.html

Plotting with color

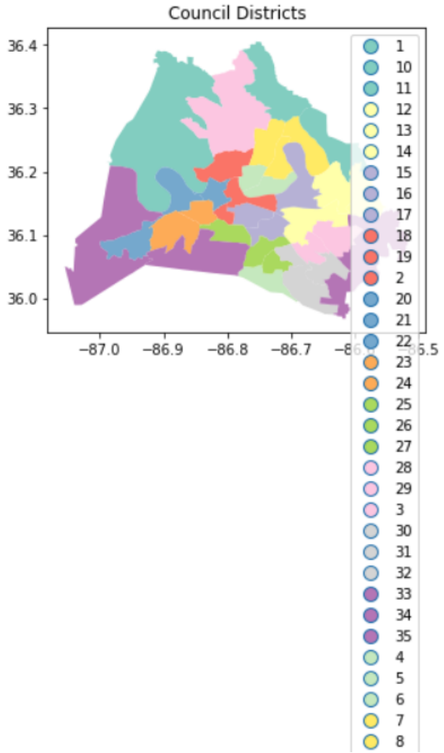
```
school_districts.head(3)

first_name      last_name     position     district      geometry
Sharon          Gentry        Member        1     (POLYGON ((-86.771 36.383)))
Jill            Speering      Vice-Chair    3     (POLYGON ((-86.753 36.404)))
Jo Ann          Brannon       Member        2     (POLYGON ((-86.766 36.083)))
```



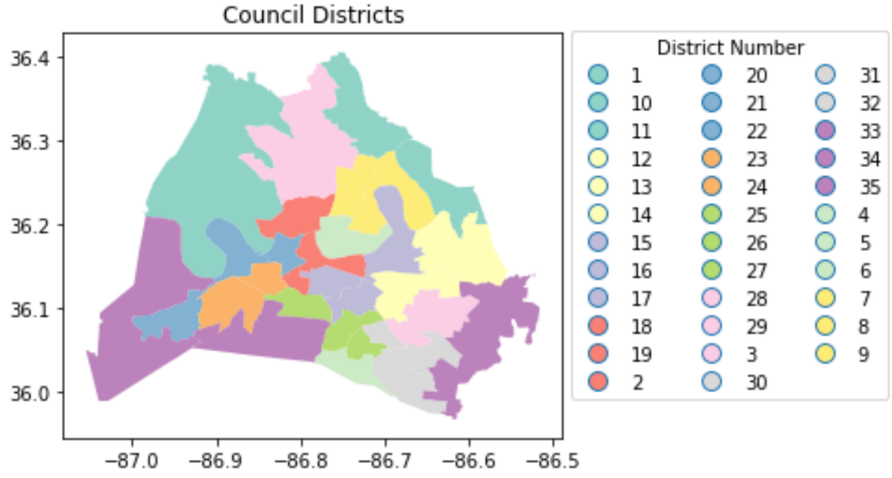


The legend_kwds argument to .plot()

```
council_dists.plot(
                    column='district',
                    cmap='Set3',
                    legend=True)
plt.title('Council Districts')
plt.show();
```




```
leg_kwds={'title':'District Number',
          'loc': 'upper left',
          'bbox_to_anchor':(1, 1.03),
          'ncol':3}
council_dists.plot(column='district',
                   cmap='Set3',
                   legend=True,
              legend_kwds=leg_kwds)
plt.title('Council Districts')
plt.show();
```



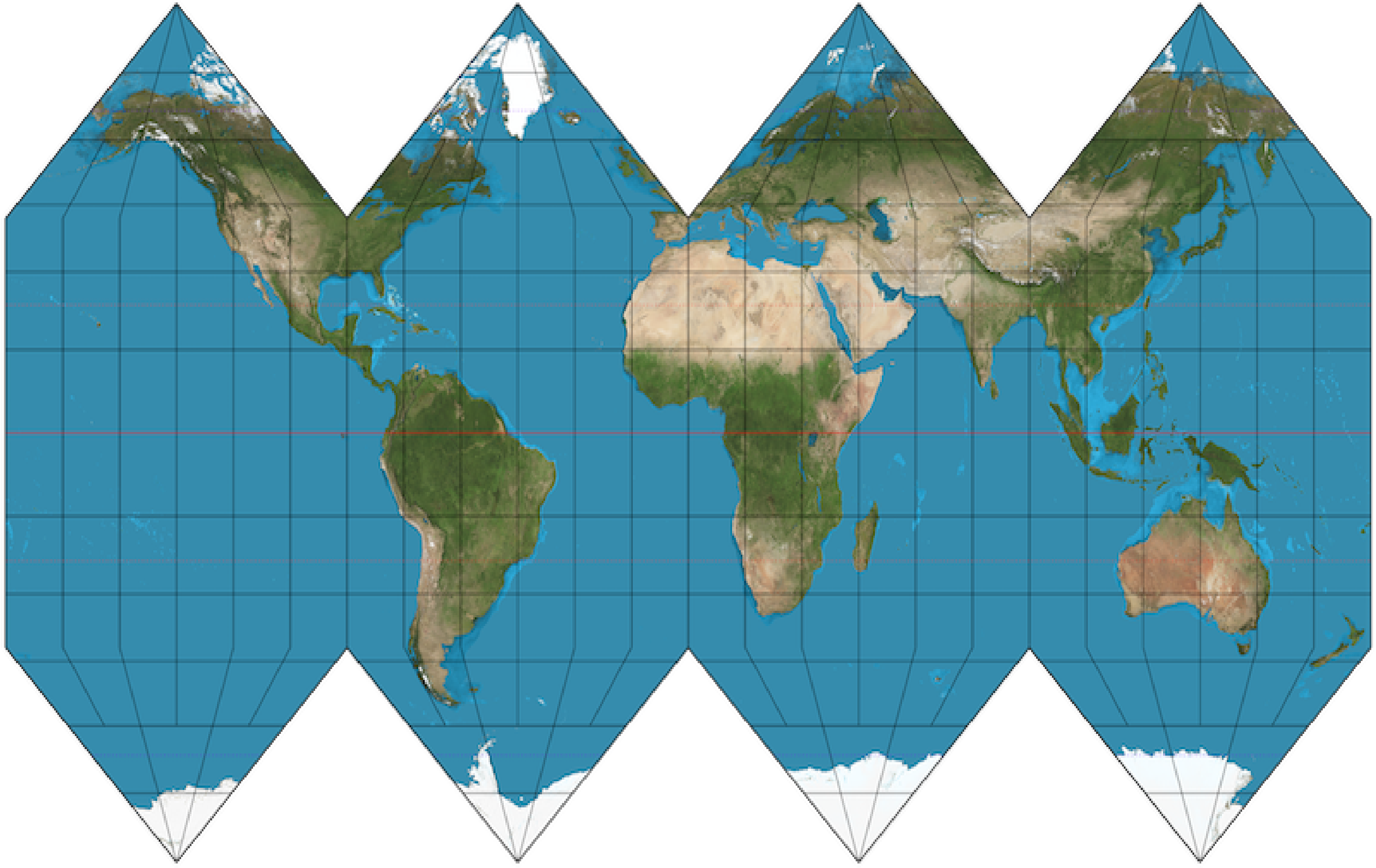
VISUALIZING GEOSPATIAL DATA IN PYTHON

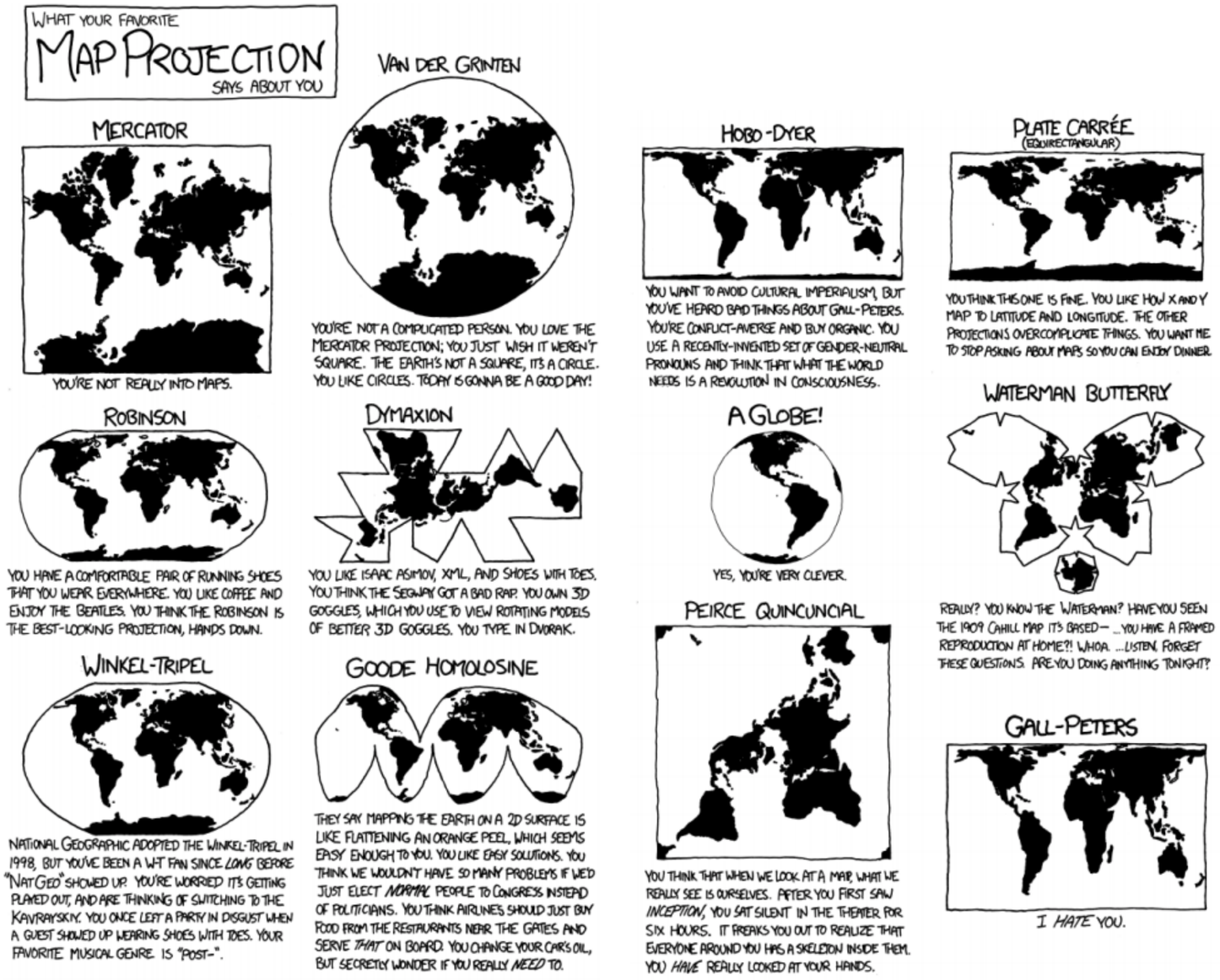
Let's practice!

VISUALIZING GEOSPATIAL DATA IN PYTHON

Projections and Coordinate Reference Systems

Mary van Valkenburg
Data Science Program Manager, Nashville Software School





*What's that? You think I don't like the Peters map because I'm uncomfortable with having my cultural assumptions challenged? Are you sure you're not... ::puts on sunglasses:: ... **projecting**?* http://xkcd.com/977/ - http://bit.ly/explainxkcd-977

Coordinate Reference Systems

EPSG:4326

- used by Google Earth
- units are decimal degrees

EPSG:3857

- used by Google Maps, Bing Maps, Open Street Maps
- units are meters

Creating a geometry column

```
School Name                Latitude     Longitude
A. Z. Kelley Elementary    36.021       -86.658
Alex Green Elementary      36.252       -86.832
Amqui Elementary           36.273       -86.703
Andrew Jackson Elementary  36.231       -86.623
```

```
# create a point geometry column
from shapely.geometry import Point

schools['geometry'] = schools.apply(
    lambda x: Point((x.Longitude, x.Latitude)),
    axis = 1)

schools.head()
```

```
School Name                Latitude     Longitude     geometry
A. Z. Kelley Elementary    36.021    -86.658       POINT (-86.658 36.021)
Alex Green Elementary      36.252    -86.832       POINT (-86.832 36.252)
Amqui Elementary           36.273    -86.703       POINT (-86.703 36.273)
Andrew Jackson Elementary  36.231    -86.623       POINT (-86.623 36.231)
```

Creating a GeoDataFrame from a DataFrame

```
import geopandas as gpd

schools_crs = {'init':  'epsg:4326'}
schools_geo = gpd.GeoDataFrame(schools,
                               crs = schools_crs,
                               geometry = schools.geometry)
```

```
schools_geo.head(4)
```

```
School Name                Latitude     Longitude     geometry
A. Z. Kelley Elementary    36.021    -86.658       POINT (-86.658 36.021)
Alex Green Elementary      36.252    -86.832       POINT (-86.832 36.252)
Amqui Elementary           36.273    -86.703       POINT (-86.703 36.273)
Andrew Jackson Elementary  36.231    -86.623       POINT (-86.623 36.231)
```

Changing from one CRS to another

```
schools_geo.head(2)
```

```
School Name                Latitude     Longitude     geometry
A. Z. Kelley Elementary    36.021    -86.658        POINT (-86.658 36.021)
Alex Green Elementary      36.252    -86.832        POINT (-86.832 36.252)
```

```
# convert geometry from decimal degrees to meters
schools_geo.geometry = schools_geo.geometry.to_crs(epsg = 3857)
schools_geo.head(2)
```

```
School Name                Latitude    Longitude    geometry
A. Z. Kelley Elementary    36.021    -86.658    POINT (-9646818.8 4303623.8)
Alex Green Elementary      36.252    -86.832    POINT (-9666119.5 4335484.4)
```

VISUALIZING GEOSPATIAL DATA IN PYTHON

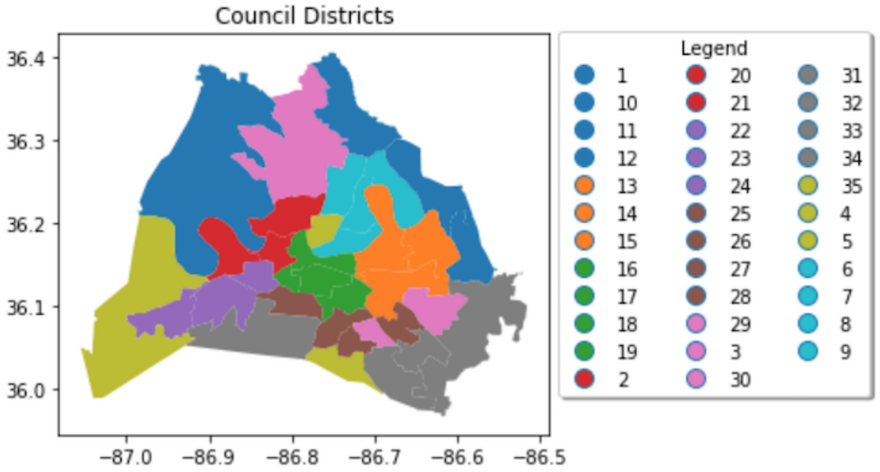
Let's practice!

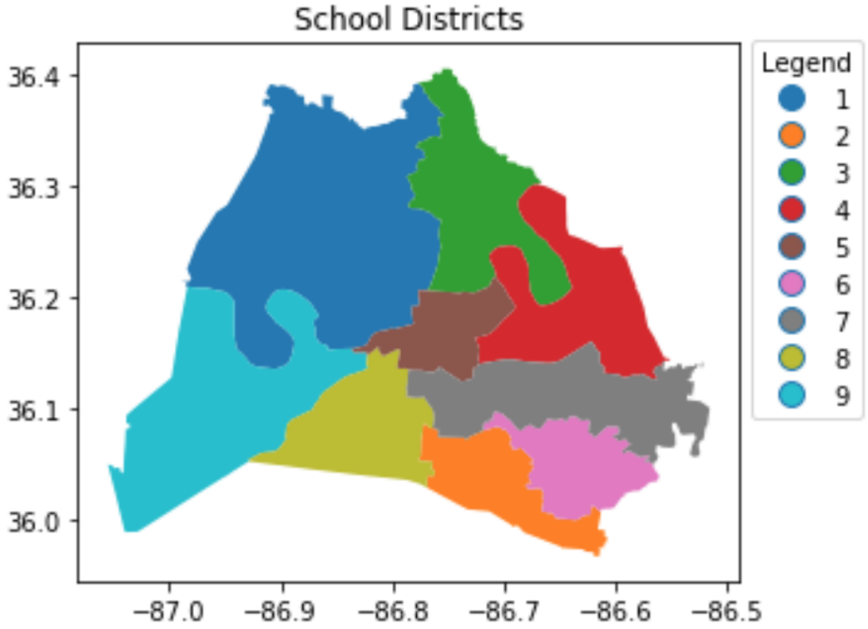
VISUALIZING GEOSPATIAL DATA IN PYTHON

Spatial joins

Mary van Valkenburg
Data Science Program Manager, Nashville Software School

Council districts and school districts



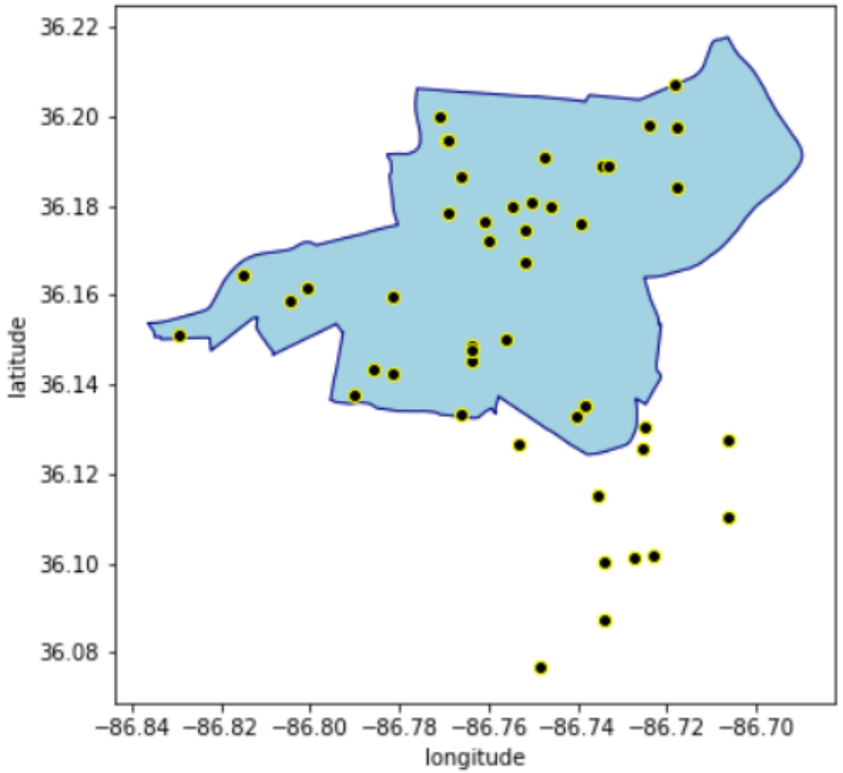


The .sjoin() op argument

```
import geopandas as gpd

gpd.sjoin(blue_region_gdf, black_point_gdf, op = <operation>)
```

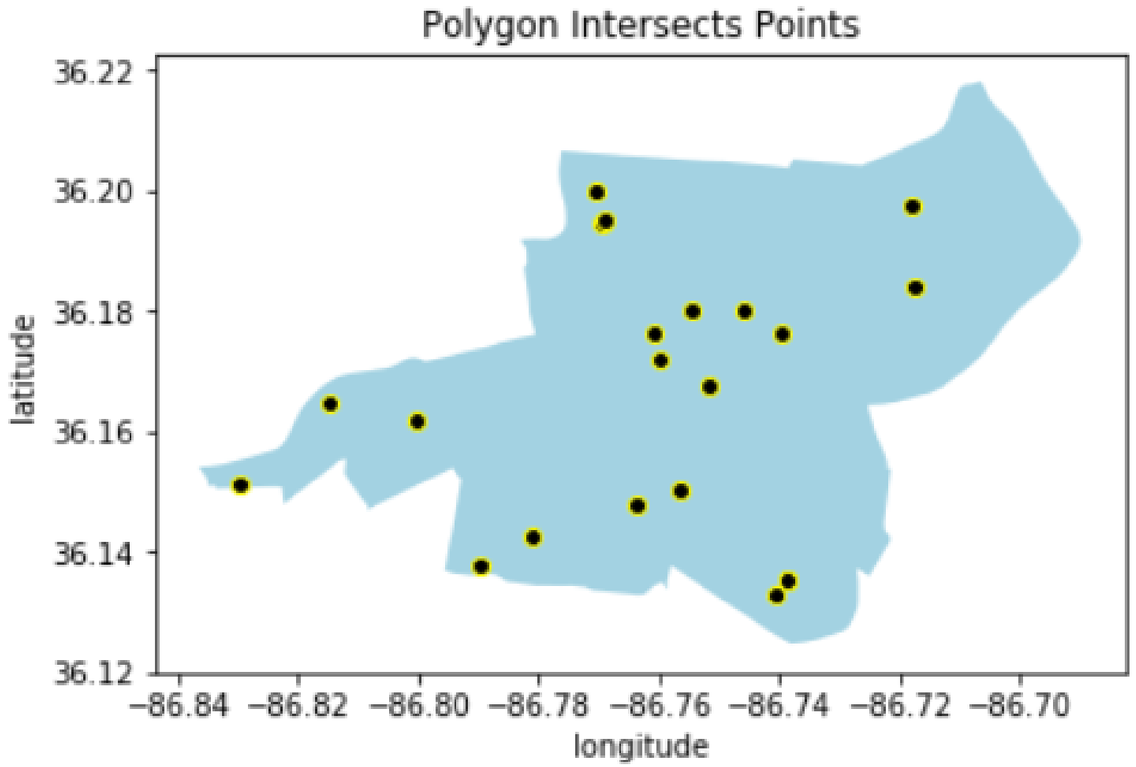
operation can be ***intersects***, ***contains***, or ***within***

Using .sjoin()


36.22
36.20
36.18
36.16
36.14
36.12
36.10
36.08
latitude
−86.84
−86.82
−86.80
−86.78
−86.76
−86.74
−86.72
−86.70
longitude

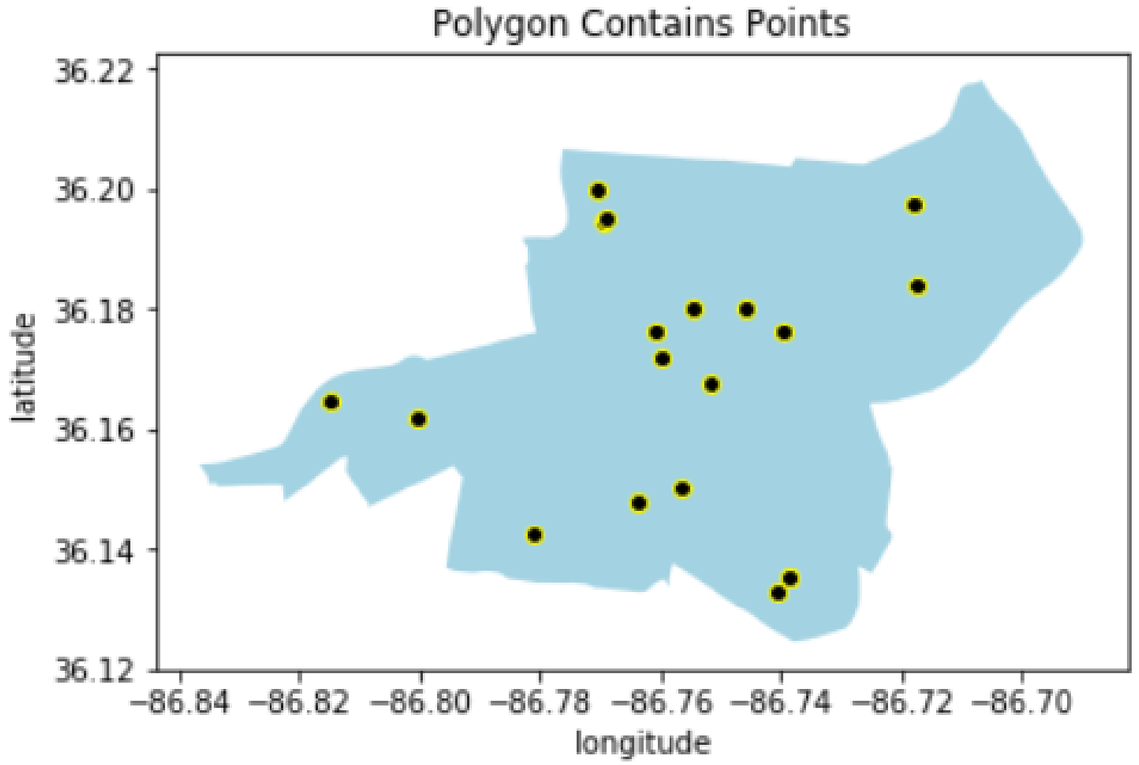
op = 'intersects'

```
gpd.sjoin(blue_region_gdf, black_point_gdf, op = 'intersects')
```



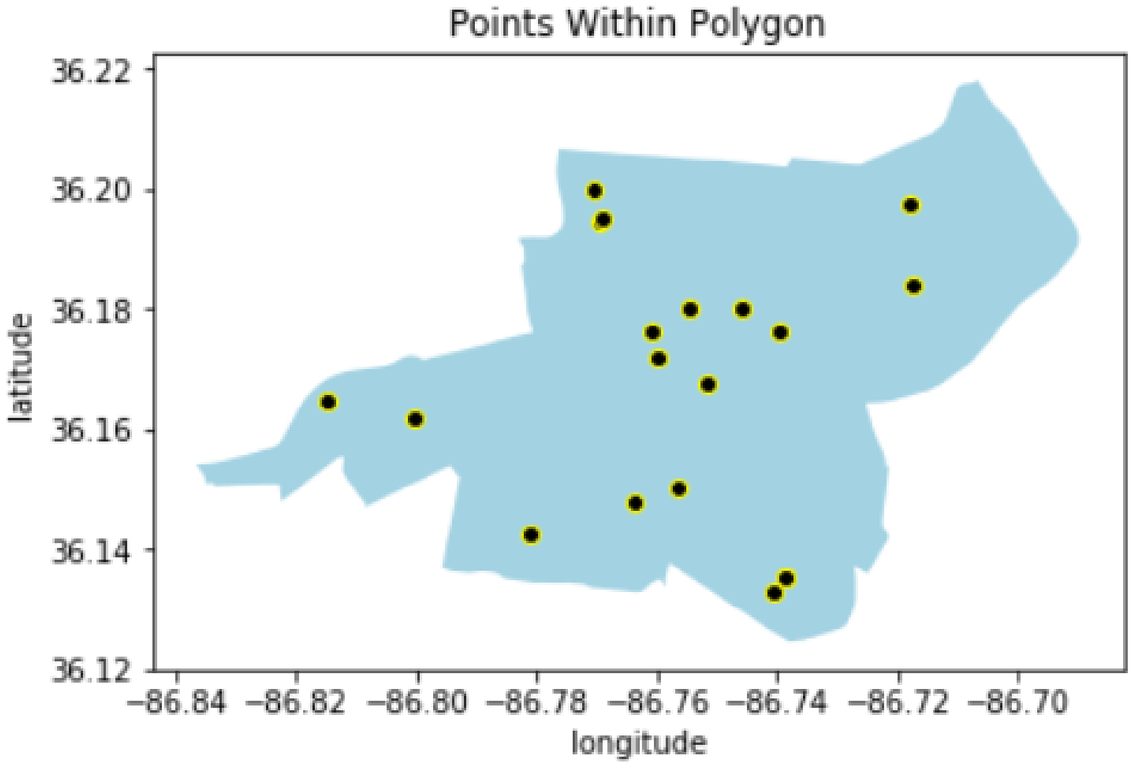
op = 'contains'

```
gpd.sjoin(blue_region_gdf, black_point_gdf, op = 'contains')
```



op = 'within'

```
gpd.sjoin(black_point_gdf, blue_region_gdf, op = 'within')
```



The sjoin.() op argument - within

```
# find council districts within school districts

within_gdf =gpd.sjoin(council_districts, school_districts, op='within')
print('council districts within school districts: ', within_gdf.shape[0])
```

```
council districts within school districts:  11
```

The sjoin.() op argument - contains

```
# find school districts that contain council districts

contains_gdf=pd.sjoin(school_districts, council_districts, op='contains')
print('school districts contain council districts: ', contains_gdf.shape[0])
```

```
school districts contain council districts:  11
```

The sjoin.() op argument - intersects

```
# find council districts that intersect with school districts

intersect_gdf=gpd.sjoin(council_districts, school_districts, op='intersects')
print('council districts intersect school districts: ', intersect.shape[0])
```

```
council districts intersect school districts:  100
```

Columns in a spatially joined GeoDataFrame

```
within_gdf=gpd.sjoin(council_districts, school_districts, op = 'within')
within_gdf.head()
```

```
  first_name_left  last_name_left district_left  index_right
0 Nick             Leonardo              1              0
1 DeCosta          Hastings              2              0
2 Nancy            VanReece              8              1
3 Bill             Pridemore             9              1
9 Doug             Pardue               10              1
```

Aggregating spatially joined data

```
# Aggregate council districts by school district
# to see how many council districts are within each school district.

# first rename district_left and district_right
within_gdf.district_left = council_district
within_gdf.district_right = school_district

within_gdf[['council_district', 'school_district']
          ].groupby('school_district'
                    ).agg('count'
                          ).sort_values('council_district', ascending = False)
```

```
                 council_district
school_district
              3                3
              1                2
              9                2
              2                1
              5                1
              6                1
              8                1
```

VISUALIZING GEOSPATIAL DATA IN PYTHON

Let's Practice!