Data Science & ML Course

Lesson #12 Exploratory Data Analysis VII

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Agenda

- Case study: IBGE
- Geojson
- Importing files
- Creating maps
- Choropleths maps

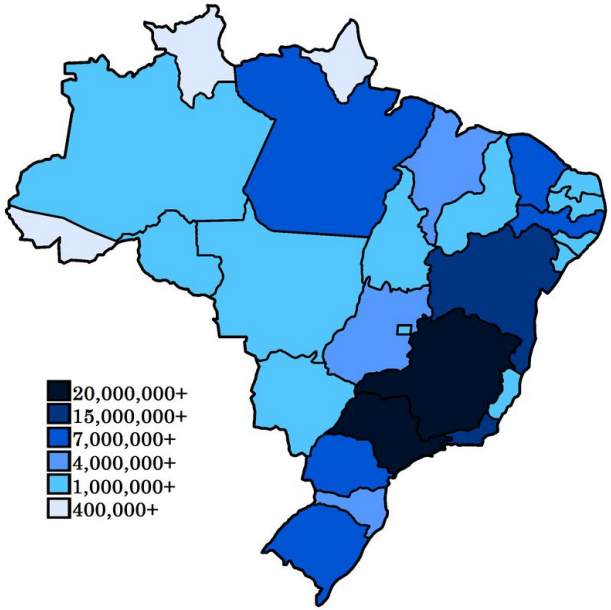
Update from repository

```
git clone https://github.com/ivanovitchm/datascience2machinelearning.git
```

Or ....

```
git pull
```

Motivation



https://en.wikipedia.org/wiki/Choropleth_map

IBGE
Instituto Brasileiro de Geografia e Estatística

https://downloads.ibge.gov.br/downloads_estatisticas.htm

BRASIL
dados.gov.br
PORTAL BRASILEIRO DE DADOS ABERTOS

DADOS ABERTOS
BETA

https://dadosabertos.camara.leg.br/

Introduction to dataset (IBGE)

Estimated population (2017)

	UF	COD._UF	COD._MUNIC	NOME_DO_MUNICÍPIO	POPULAÇÃO_ESTIMADA
1075	RN	24.0	109.0	Acari	11333.0
1077	RN	24.0	307.0	Afonso Bezerra	11211.0
1079	RN	24.0	505.0	Alexandria	13827.0
1080	RN	24.0	604.0	Almino Afonso	4854.0
1081	RN	24.0	703.0	Alto do Rodrigues	14365.0

Geojson

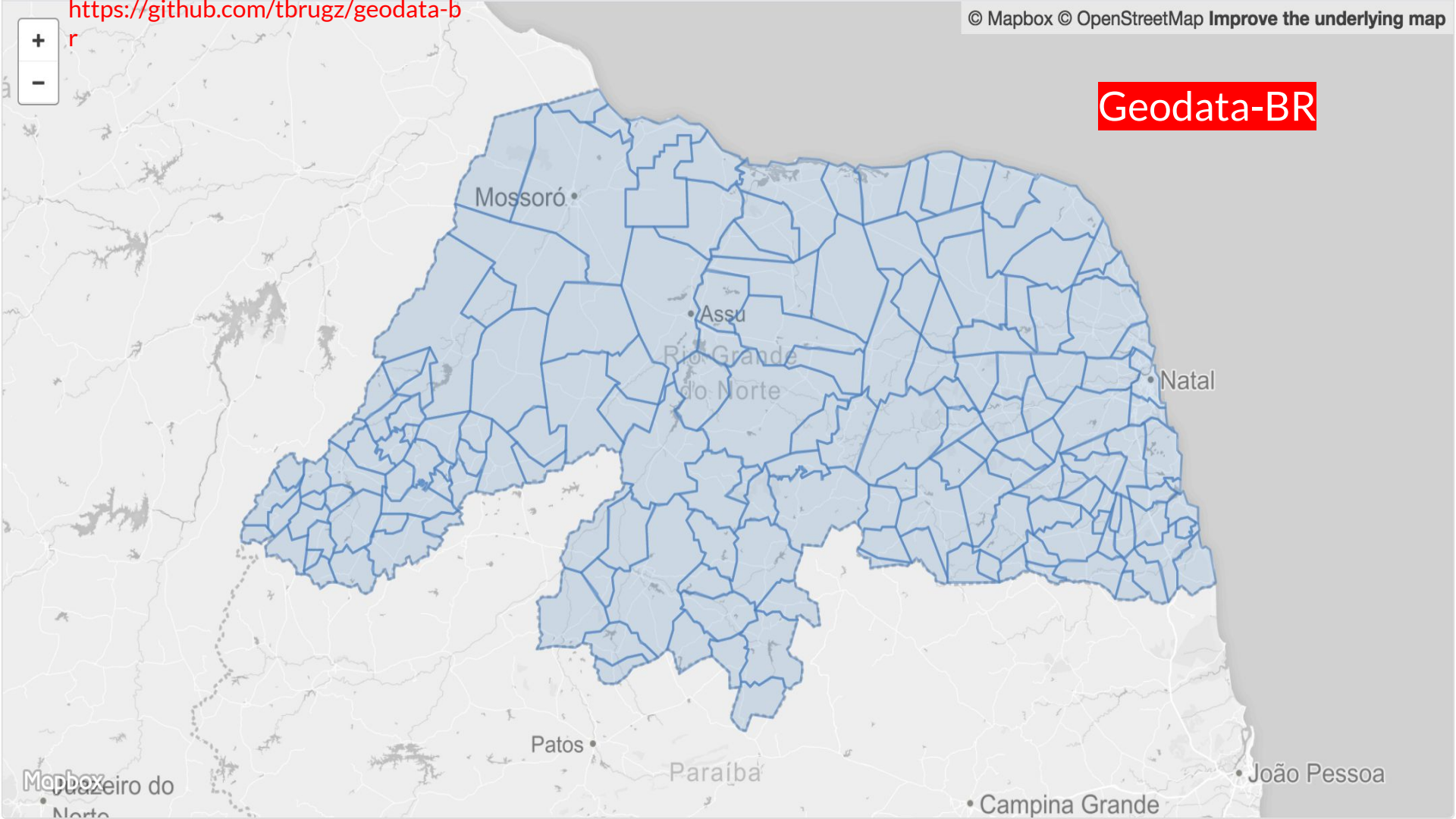
GeoJSON is a format for encoding a variety of geographic data structures.

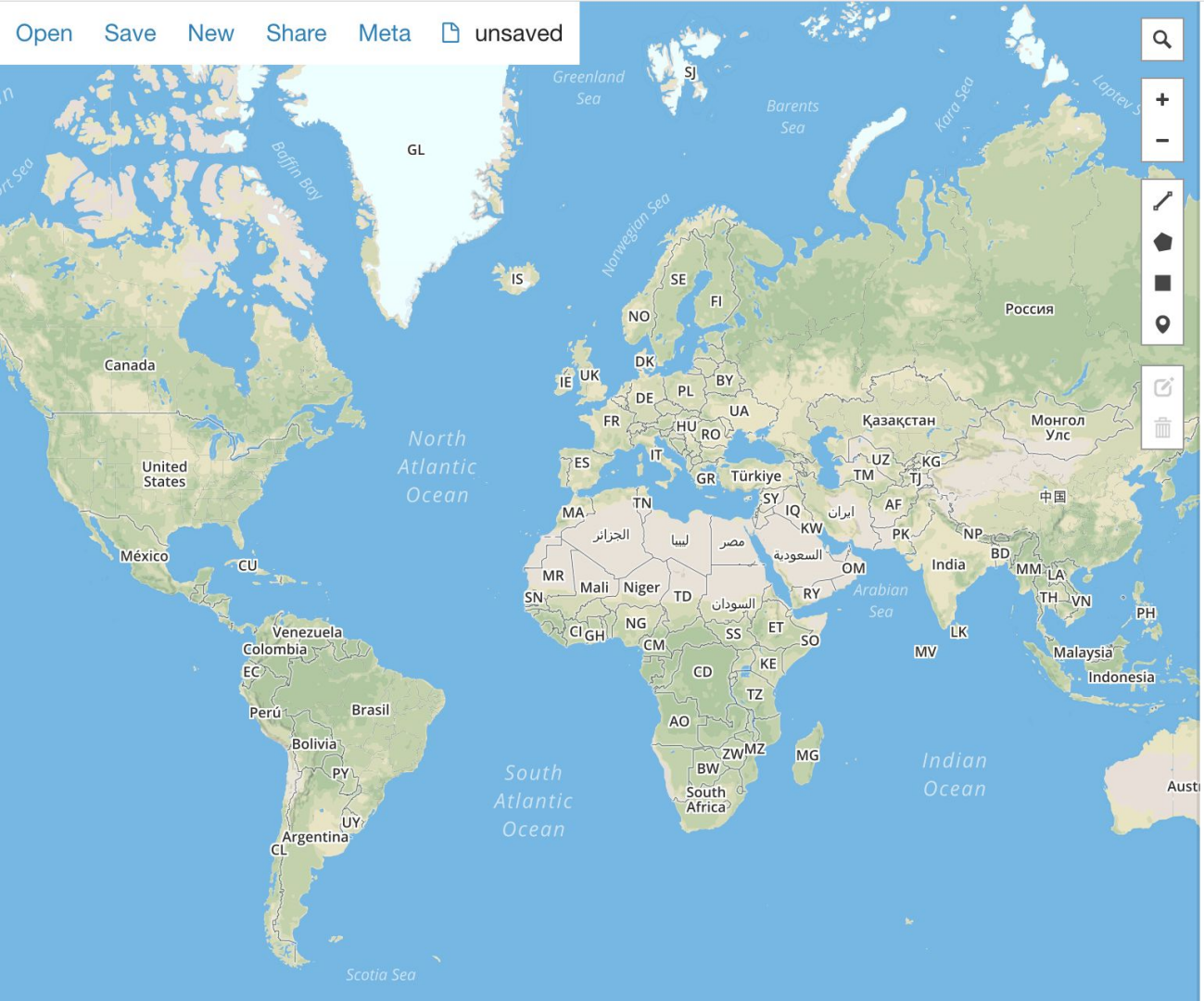
```
{
  "type": "Feature",
  "geometry": {
    "type": "Point",
    "coordinates": [125.6, 10.1]
  },
  "properties": {
    "name": "Dinagat Islands"
  }
}
```

http://geojson.org/

GeoJSON supports the following geometry types:

- Point
- LineString
- Polygon
- MultiPoint
- MultiLineString
- MultiPolygon


https://github.com/tbrugz/geodata-br
© Mapbox © OpenStreetMap Improve the underlying map
Geodata-BR
Mossoró
Assu
Rio Grande do Norte
Natal
Patos
Paraíba
João Pessoa
Campina Grande
Mapbox



</> JSON | Table | ? Help

```
{
  "type": "FeatureCollection",
  "features": []
}
```

geojson.io

Importing geojson files

```
# searching the files in geojson/geojs-xx-mun.json
br_states = os.path.join('geojson', 'geojs-24-mun.json')

# load the data and use 'latin-1'encoding because the accent
geo_json_data = json.load(open(br_states,encoding='latin-1'))
```

Importing geojson files


```
{'features': [{'geometry': {'coordinates': [[[-36.6752824479, -6.2695704427],
      [-36.6721661976, -6.2748710057],
      [-36.6621971359, -6.2781206182],
      [-36.6544080838, -6.2718175581],
      [-36.6302770363, -6.2681148661],
                  . . .
      [-36.6892626008, -6.2741768473],
      [-36.68125826, -6.2694071238],
      [-36.6752824479, -6.2695704427]]],
    'type': 'Polygon'},
   'properties': {'description': 'Acari', 'id': '2400109', 'name': 'Acari'},
   'type': 'Feature'},
  {'geometry': {'coordinates': [[[-37.0150184398, -5.8704516715],
      [-37.0352362699, -5.8906742235],
      [-37.0354495717, -5.8906136983],
                  . . .
```


City

Coordinates: long, lat

Cleaning & EDA

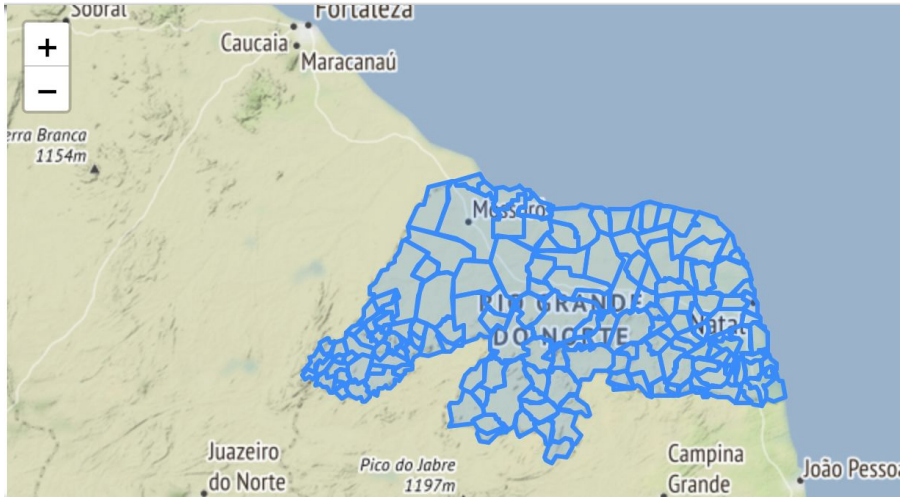
```
# http://cidades.ibge.gov.br/painel/historico.php?codmun=241030
# Presidente Juscelino city changes your name to Serra Caiada
geo_json_data['features'][112]['properties']['description'] = 'Serra Caiada'
geo_json_data['features'][112]['properties']['name'] = 'Serra Caiada'
```

```
cities = []
# list all cities in the state
for city in geo_json_data['features']:
        cities.append(city['properties']['description'])
cities
```

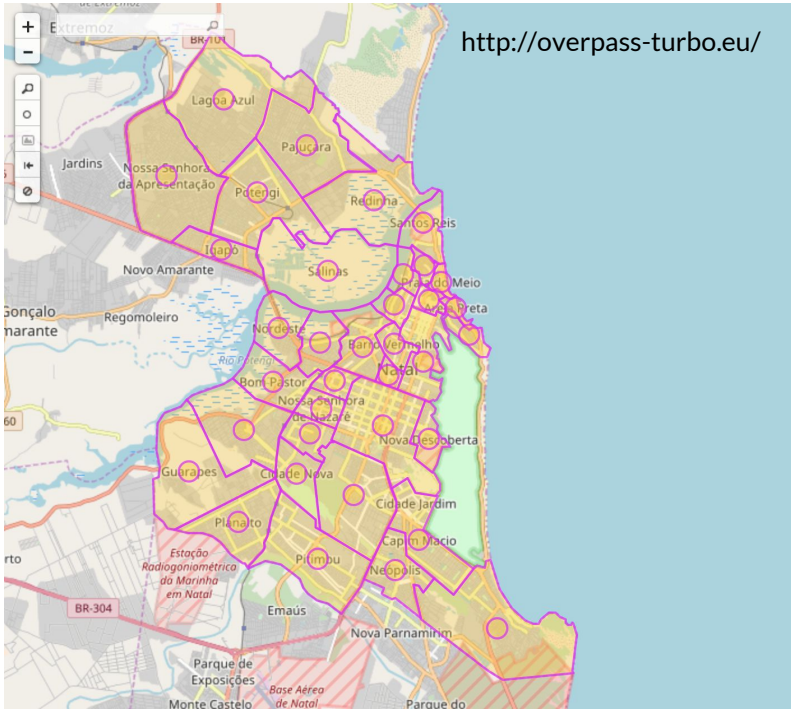
EDA - Creating a map

```
# Create a map object
m = folium.Map(
    location=[-5.826592, -35.212558],
    zoom_start=7,
    tiles='Stamen Terrain'
)

# Configure geojson layer
folium.GeoJson(geo_json_data).add_to(m)
```



Importing geojson files from other sources



A web based data mining tool for OpenStreetMap using Overpass API

https://github.com/tyrasd/overpass-turbo

```
[out:json][timeout:25];
{{geocodeArea:Natal RN Brasil}}->.searchArea;
(
  relation["admin_level"="10"](area.searchArea);
);
out body;
>;
out skel qt;
```

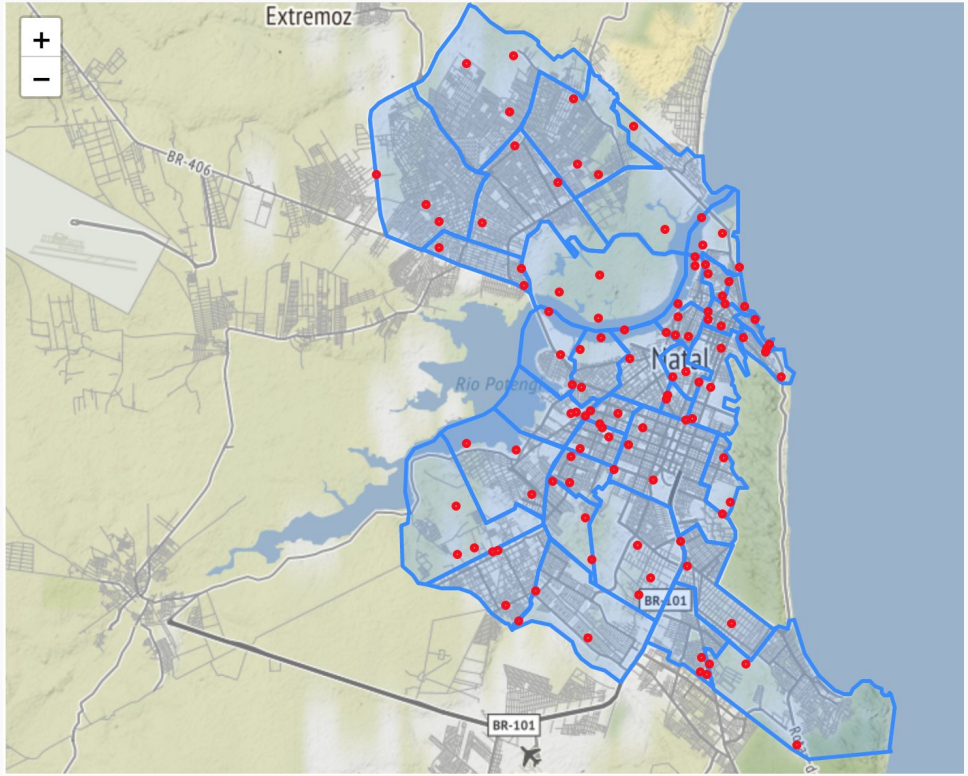
Case study: neighborhoods of Natal-RN

```
# import geojson file about natal neighborhood
natal_neigh = os.path.join('geojson', 'natal.geojson')

# load the data and use 'UTF-8'encoding
geo_json_natal = json.load(open(natal_neigh,encoding='UTF-8'))
```

```
neighborhood = []
# list all neighborhoods
for neigh in geo_json_natal['features']:
        neighborhood.append(neigh['properties']['name'])
neighborhood
```

Neighborhoods as a polygon



Problem:
spread X points using a uniform distribution within the limits of neighborhoods

Spread X points within in polygon

```
from shapely.geometry import Polygon
from shapely.geometry import Point
```

```
# return a number of points inside the polygon
def generate_random(number, polygon, neighborhood):
    list_of_points = []
    minx, miny, maxx, maxy = polygon.bounds
    counter = 0
    while counter < number:
        x = random.uniform(minx, maxx)
        y = random.uniform(miny, maxy)
        pnt = Point(x, y)
        if polygon.contains(pnt):
            list_of_points.append([x,y,neighborhood])
            counter += 1
    return list_of_points
```

```
number_of_points = 3

# search all features
for feature in geo_json_natal['features']:
    # get the name of neighborhood
    neighborhood = feature['properties']['name']
    # take the coordinates (lat,log) of neighborhood
    geom = feature['geometry']['coordinates']
    # create a polygon using all coordinates
    polygon = Polygon(geom[0])
    # return number_of_points by neighborhood as a list [[log,lat],....]
    points = generate_random(number_of_points,polygon, neighborhood)
    # iterate over all points and print in the map
    for i,value in enumerate(points):
        log, lat, name = value
        # Draw a small circle
        folium.CircleMarker([lat,log],
                            radius=2,
                            popup='%s %s%d' % (name, '#', i),
                           color='red').add_to(m)
m
```

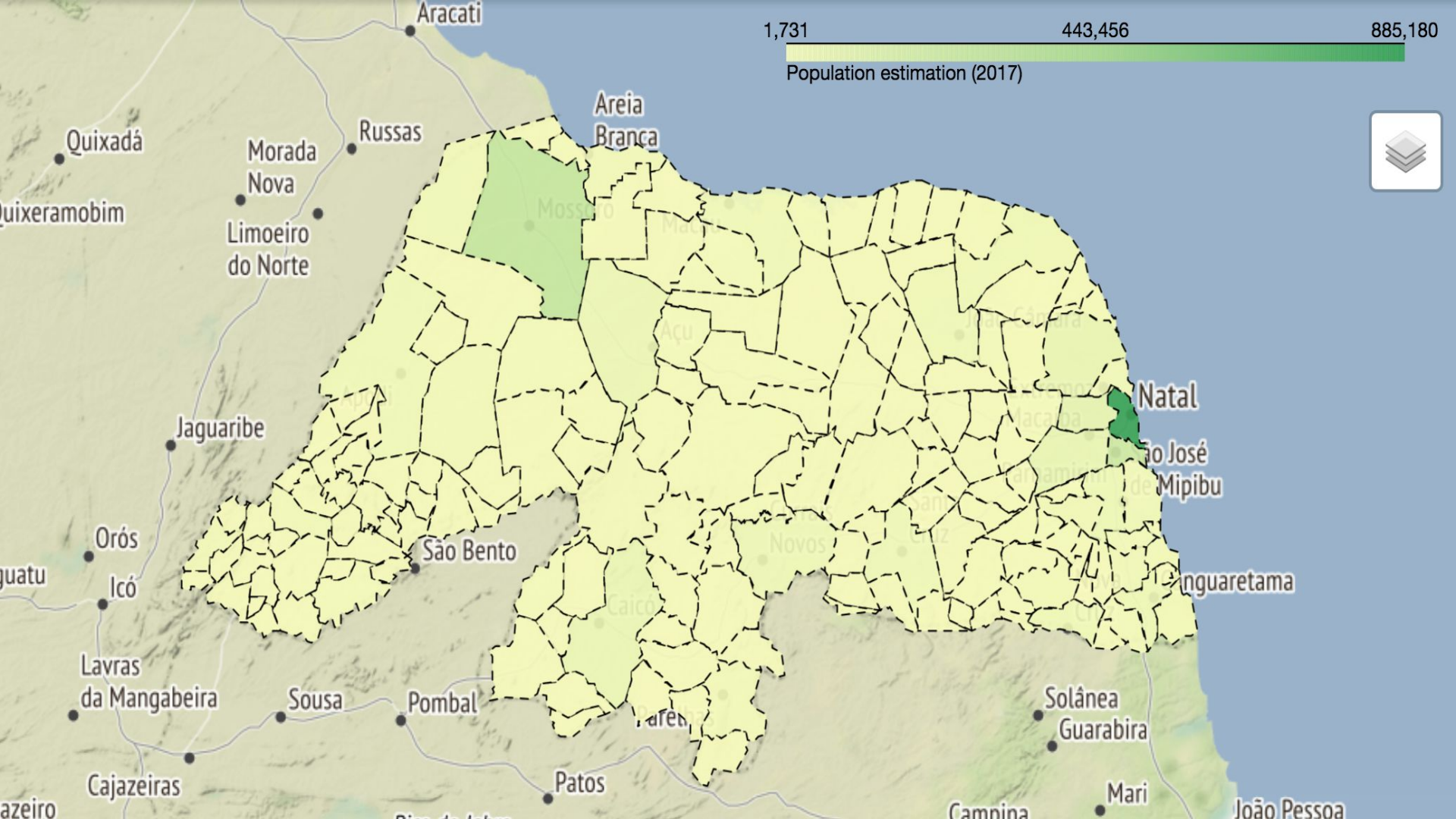
Drawing a choropleth map (colormap)

```
# colormap yellow and green (YlGn)
colormap = linear.YlGn_03.scale(
    dataRN.POPULAÇÃO_ESTIMADA.min(),
    dataRN.POPULAÇÃO_ESTIMADA.max())

print(colormap(5000.0))

colormap
```

NOME_DO_MUNICÍPIO	POPULAÇÃO_ESTIMADA
Acari	11333.0
Afonso Bezerra	11211.0
Alexandria	13827.0
Almino Afonso	4854.0
Alto do Rodrigues	14365.0


1,731
443,456
885,180
Population estimation (2017)
Aracati
Areia Branca
Quixadá
Morada Nova
Russas
Quixeramobim
Limoeiro do Norte
Natal
Jaguaribe
São José Mipibu
Orós
São Bento
Icó
Lavras da Mangabeira
Sousa
Pombal
Solânea
Guarabira
Cajazeiras
Patos
Mari
João Pessoa

Drawing a choropleth map (option #1)

Preparing the data

```
population_dict = dataRN.set_index('NOME_DO_MUNICÍPIO')['POPULAÇÃO_ESTIMADA']
```

Drawing a choropleth map (option #1)

```
# Configure geojson layer
folium.GeoJson(
    geo_json_data,
    name='Population estimation of RN State in 2017',
    style_function=lambda feature: {
        'fillColor': colormap(population_dict[feature['properties']['description']]),
        'color': 'black',
        'weight': 1,
        'dashArray': '5, 5',
        'fillOpacity': 0.9,
    }
).add_to(m)

colormap.caption = 'Population estimation (2017)'
colormap.add_to(m)

folium.LayerControl().add_to(m)
```

Drawing a choropleth map (option #2)

```
# create a threshold of legend
threshold_scale = np.linspace(dataRN['POPULAÇÃO_ESTIMADA'].min(),
                              dataRN['POPULAÇÃO_ESTIMADA'].max(), 6, dtype=int).tolist()


m.choropleth(
    geo_data=geo_json_data,
    data=dataRN,
    columns=['NOME_DO_MUNICÍPIO', 'POPULAÇÃO_ESTIMADA'],
    key_on='feature.properties.description',
    fill_color='YlGn',
    legend_name='Population estimation (2017)',
    highlight=True,
    threshold_scale = threshold_scale
)
```

Exercise

1. Estimated population to Northeast Region
2. Other metrics

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https://dadosabertos.camara.leg.br/