

```
import folium
from folium.plugins import BeautifyIcon
import pandas as pd
```

```
from google.colab import drive
drive.mount('/content/gdrive')
```

Mounted at /content/gdrive

```
!pip install geopandas
```

```
Collecting geopandas
  Downloading https://files.pythonhosted.org/packages/d7/bf/e9cefb69d39155d122b6ddca/
  | 1.0MB 4.0MB/s
Requirement already satisfied: pandas>=0.24.0 in /usr/local/lib/python3.7/dist-packages
Collecting fiona>=1.8
  Downloading https://files.pythonhosted.org/packages/9c/fc/9807326c37a6bfb2393ae3e1c/
  | 15.4MB 232kB/s
Requirement already satisfied: shapely>=1.6 in /usr/local/lib/python3.7/dist-packages
Collecting pyproj>=2.2.0
  Downloading https://files.pythonhosted.org/packages/11/1d/1c54c672c2faf08d28fe78e1/
  | 6.6MB 31.2MB/s
Requirement already satisfied: numpy>=1.15.4 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: python-dateutil>=2.7.3 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: certifi in /usr/local/lib/python3.7/dist-packages (from fiona)
Requirement already satisfied: six>=1.7 in /usr/local/lib/python3.7/dist-packages (from fiona)
Requirement already satisfied: attrs>=17 in /usr/local/lib/python3.7/dist-packages (from fiona)
Collecting munch
  Downloading https://files.pythonhosted.org/packages/cc/ab/85d8da5c9a45e072301beb37/
Requirement already satisfied: setuptools in /usr/local/lib/python3.7/dist-packages (from munch)
Requirement already satisfied: click>=4.0 in /usr/local/lib/python3.7/dist-packages (from munch)
Collecting cligj>=0.5
  Downloading https://files.pythonhosted.org/packages/73/86/43fa9f15c5b9fb6e82620428/
Collecting click-plugins>=1.0
  Downloading https://files.pythonhosted.org/packages/e9/da/824b92d9942f4e472702488/
Installing collected packages: munch, cligj, click-plugins, fiona, pyproj, geopandas
Successfully installed click-plugins-1.1.1 cligj-0.7.2 fiona-1.8.20 geopandas-0.9.0
```

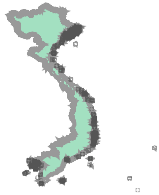
```
import geopandas as gp
```

```
geo_df = gp.read_file('Vietnam_AL2-AL2.shp',encoding='utf8')
geo_df.head()
```

	id	country	name	enname	locname	offname	boundary	adminlevel	wikid
0	10015	VNM	Vietnam	Vietnam	Vi?t	C?ng Ha X H? i Ch?	administrative	2	0

```
geo_df.loc[0,'geometry']
```

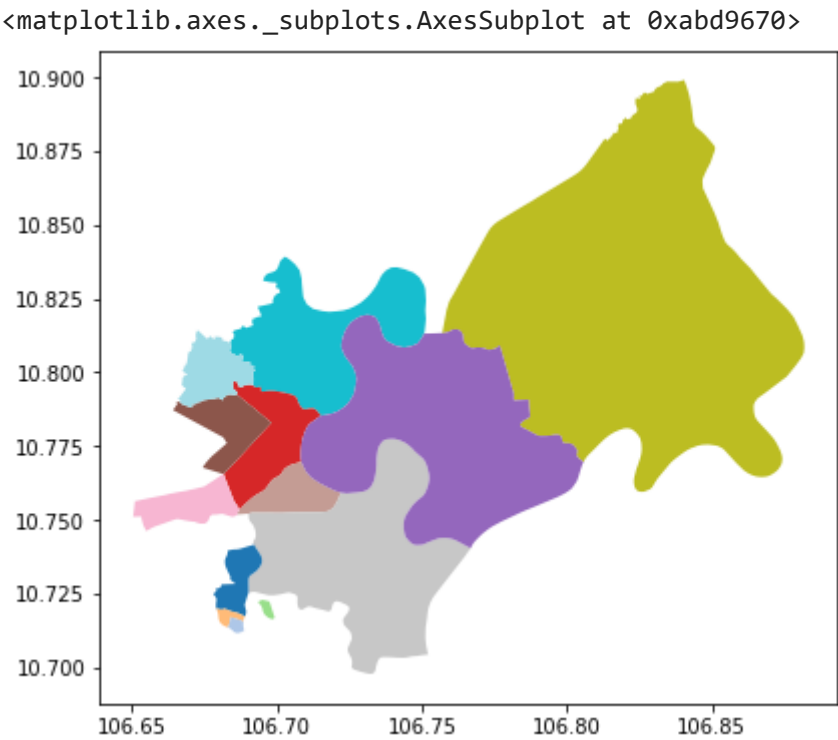




```
gdf = gp.read_file('district-boundary-hcm-city.geojson')
gdf.head()
```

	id	name	localname	timestamp	SRID	admin_level	tags
0	3850184	Saigon South	Khu đô thị Nam Sài Gòn	2016-03-18T23:05:02	4326	5	{'name': 'Khu đô thị Nam Sài Gòn', 'name:en': ...
1	3797166	Binh Thanh District	Quận Bình Thạnh	2016-03-18T23:05:02	4326	6	{'name': 'Quận Bình Thạnh', 'name:en': 'Binh T...

```
gdf.plot(column='localname', cmap='tab20', figsize=(8,6))
```



```
print(gdf.crs)

epsg:4326

gdf.geometry = gdf.geometry.to_crs(epsg = 3587)

gdf.head()
```

	id	name	localname	timestamp	SRID	admin_level	tags
0	3850184	Saigon South	Khu đô thị Nam Sài Gòn	2016-03-18T23:05:02	4326	5	{'name': 'Khu đô thị Nam Sài Gòn', 'name:en': ...}
1	3797166	Binh Thanh District	Quận Bình Thạnh	2016-03-18T23:05:02	4326	6	{'name': 'Quận Bình Thạnh', 'name:en': 'Binh T...

gdf.crs

```
<Projected CRS: EPSG:3587>
Name: NAD83(NSRS2007) / Michigan Central
Axis Info [cartesian]:
- X[east]: Easting (metre)
- Y[north]: Northing (metre)
Area of Use:
- name: USA - Michigan - SPCS - C
- bounds: (-87.06, 43.8, -82.27, 45.92)
Coordinate Operation:
- name: SPCS83 Michigan Central zone (meters)
- method: Lambert Conic Conformal (2SP)
Datum: NAD83 (National Spatial Reference System 2007)
- Ellipsoid: GRS 1980
- Prime Meridian: Greenwich
```

```
latitude = 10.7758439
longitude = 106.7017555
```

```
df = pd.read_excel('/content/gdrive/MyDrive/HCMC_location.xlsx', sheet_name='Location')
df.head()
```

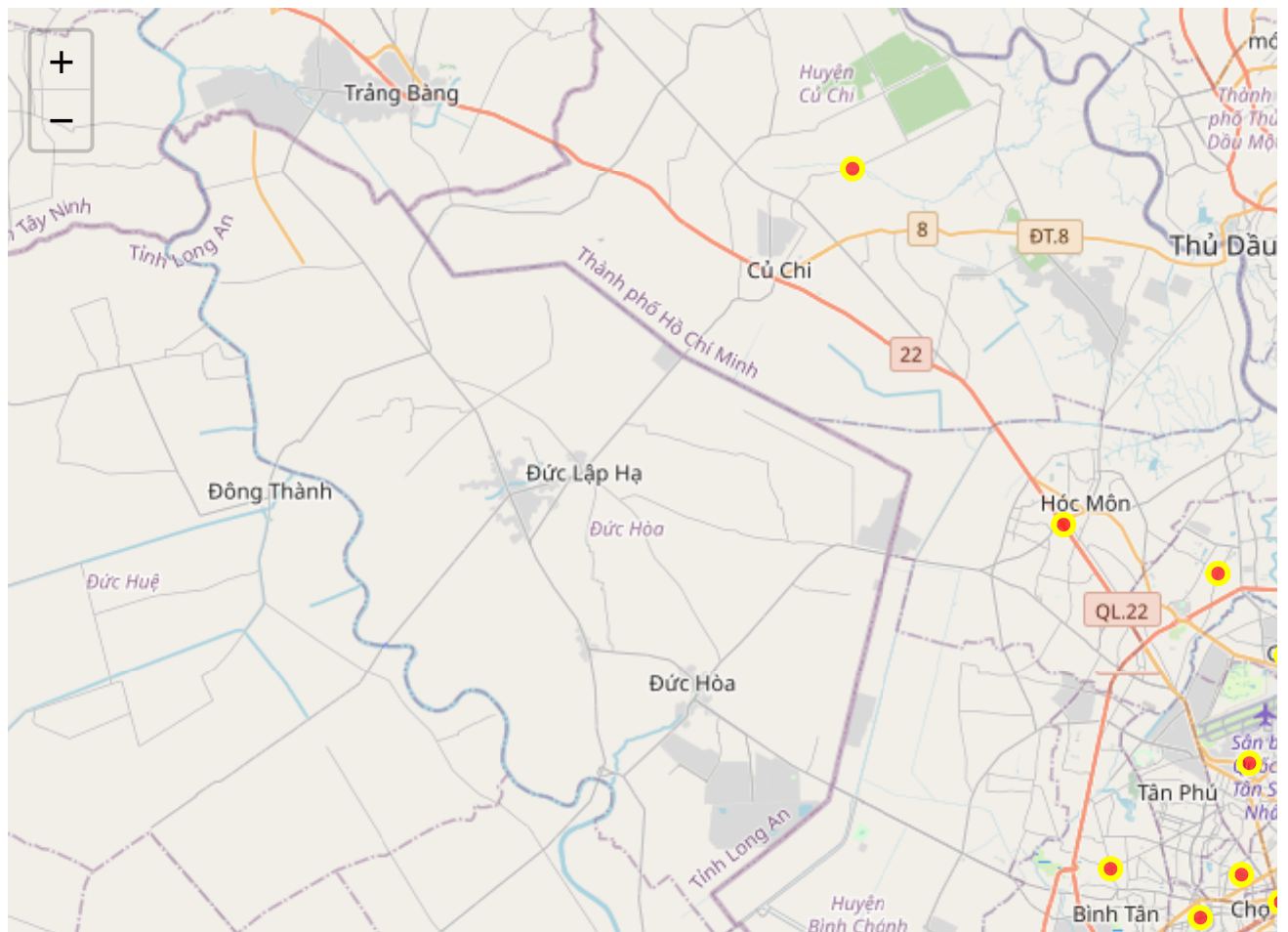
	STT	ID	Name	Bourough	Postal cost	Latitude	Longitude	Population	Population_al
0	1	760	Quận 1	Vietnam, Quan 1	NaN	10.775659	106.700424	193.632	19363
1	2	761	Quận 12	Vietnam, Quan 12	NaN	10.867153	106.641332	510.326	51032
2	3	762	Quận Thủ Đức	Vietnam, Thu Duc	NaN	10.849409	106.753705	528.413	52841

```
# create map of Toronto using latitude and longitude values
map_hcm = folium.Map(location=[latitude, longitude], zoom_start=11)
```

```
# add markers to map
for lat, lng, label in zip(df['Latitude'], df['Longitude'], df['Name']):
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='yellow',
        fill=True,
```

```
fill_color='red',  
tooltip=label,  
fill_opacity=0.7).add_to(map_hcm)
```

map_hcm



```
# create map of Toronto using latitude and longitude values  
map_hcm = folium.Map(location=[latitude, longitude], zoom_start=11)
```

```
# add markers to map
for lat, lng, label in zip(df['Latitude'], df['Longitude'], df['Name']):
    icon_star = folium.Icon(
        prefix='fa',
        icon='fa-apple',
        icon_color='red',
    )
    folium.Marker([lat, lng], icon=icon_star, tooltip=label).add_to(map_hcm)

map_hcm
```



```
# Make an empty map
m = folium.Map(location=[15, 0], tiles="OpenStreetMap", zoom_start=2)

# square marker
icon_square = BeautifyIcon(
    icon_shape='rectangle-dot',
    border_color='red',
    border_width=10,
)
folium.Marker([50, -70], tooltip='square', icon=icon_square).add_to(m)

# circle marker
icon_circle = BeautifyIcon(
    icon_shape='ambulance',
    border_color='green',
    border_width=10,
)
folium.Marker([-20, 25], tooltip='circle', icon=icon_circle).add_to(m)

# star marker
icon_star = BeautifyIcon(
    icon_shape='star',
    border_color='green',
    border_width=10,
)
folium.Marker([60, 125], tooltip='star', icon=icon_star).add_to(m)
m
```



▼ Demo Geolocation

- <https://latitudelongitude.org/vn/>

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import geopandas as gpd
```

```
# Câu 1: Đọc file dữ liệu province_data.geojson (ranh giới các tỉnh thành ở VN) và quan sát dữ liệu
gdf = gpd.read_file('province_data.geojson')
gdf.head()
```

	gid	code	ten_tinh	geometry
0	1	AD01	An Giang	MULTIPOLYGON (((105.11524 10.95566, 105.11463 ...
1	2	AD01	Bà Rịa -Vũng Tàu	MULTIPOLYGON (((106.08110 8.57754, 106.08069 8...
2	3	AD01	Bắc Giang	MULTIPOLYGON (((106.16542 21.62022, 106.16925 ...
3	4	AD01	Bắc Kạn	MULTIPOLYGON (((105.74420 22.73519, 105.74624 ...
4	5	AD01	Bạc Liêu	MULTIPOLYGON (((105.32591 9.60004, 105.32755 9...

```
gdf.shape
```

```
(63, 4)
```

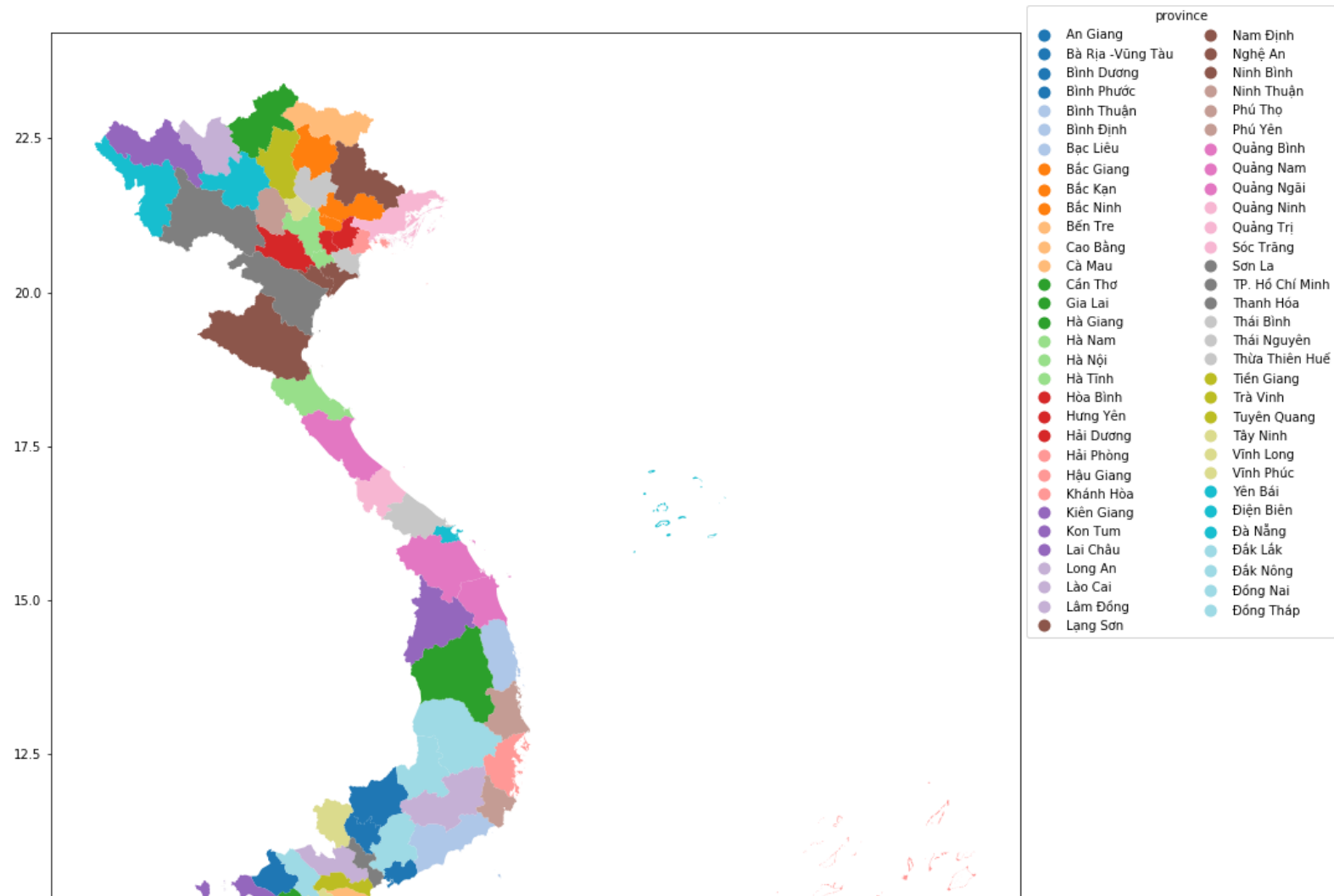
```
# Đọc tập tin dữ liệu province_data.xlsx cho biết dân số các tỉnh thành, khu vực
data = pd.read_excel('province_data.xlsx')
data.head()
```


	province	id	value	area	pop	pop.area	lat	long
0	An Giang	1	29.757870	3536.7	2155.3	609	NaN	NaN
1	Bạc Liêu	2	57.377857	2468.7	876.8	355	9.29414	105.72776
2	Bắc Giang	3	53.084348	3849.7	1593.2	414	21.27307	106.19460
3	Bắc Kạn	4	23.989343	4859.4	303.1	62	22.14701	105.83481
4	Bắc Ninh	5	24.026561	822.7	1114.0	1354	21.18608	106.07631

Hiển thị bản đồ Việt Nam

```
lgnd_kwds = {'title':'province','loc':'upper left','bbox_to_anchor':(1,1.03),'ncol':2}
gdf.plot(column='ten_tinh',figsize=(14,24),cmap='tab20',legend_kwds=lgnd_kwds,legend=True)
```

<matplotlib.axes._subplots.AxesSubplot at 0x5a86f90>



```
# Tạo dataframe df chứa dữ liệu của province và kết hợp thêm dữ liệu pop của data
df1 = pd.DataFrame(gdf.iloc[:,:].values, columns = list(gdf.columns.values)[:])
df1.head()
```

	gid	code	ten_tinh	geometry
0	1	AD01	An Giang	(POLYGON (((105.115241874 10.955660896000002, 10...
1	2	AD01	Bà Rịa -Vũng Tàu	(POLYGON (((106.081096978 8.5775360490000043, 10...
2	3	AD01	Bắc Giang	(POLYGON (((106.165424121 21.620223499000008, 10...

```
df2 = data[['province','pop']]
df2.head()
```

	province	pop
0	An Giang	2155.3
1	Bạc Liêu	876.8
2	Bắc Giang	1593.2
3	Bắc Kạn	303.1
4	Bắc Ninh	1114.0

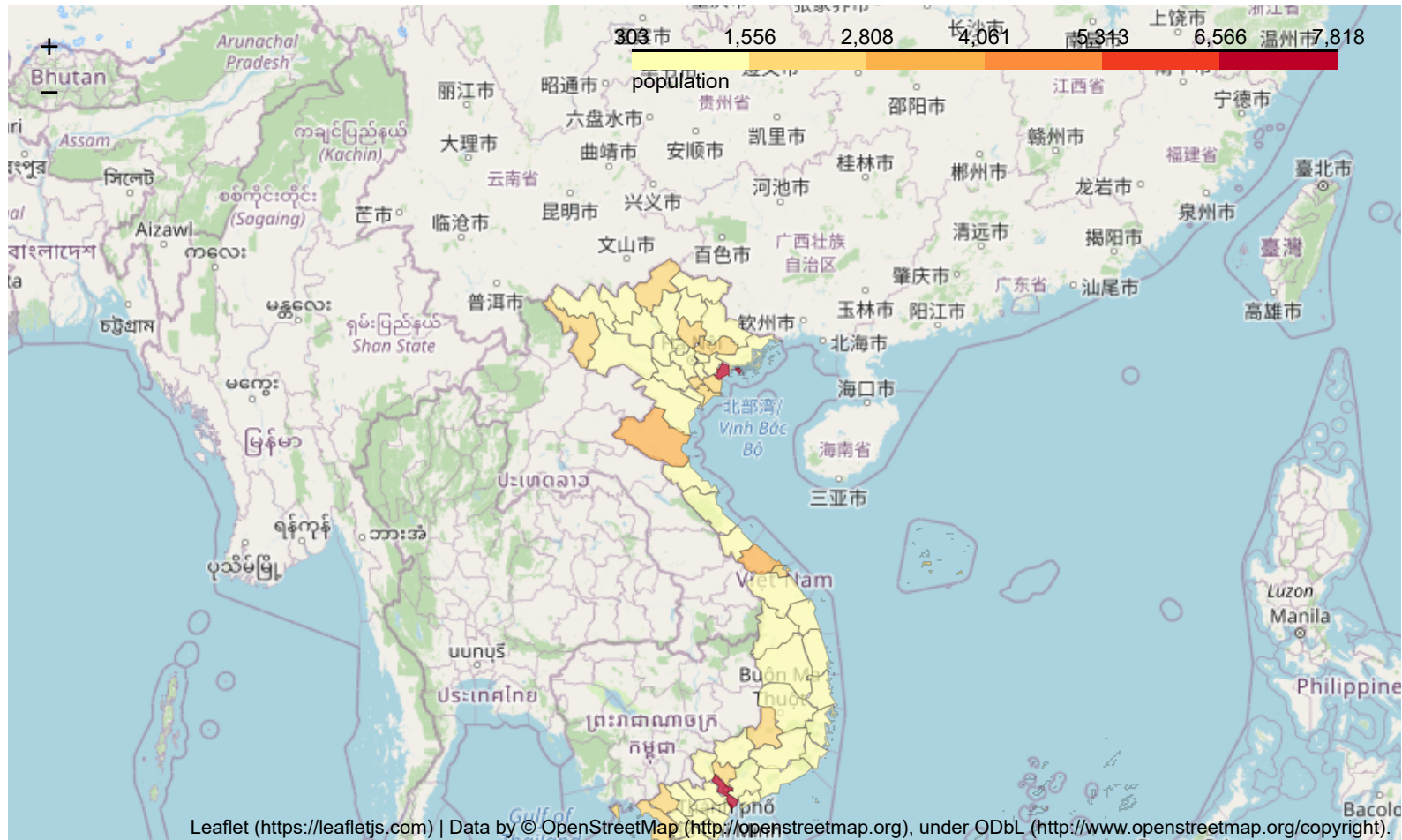
```
df = pd.concat([df1,df2],axis=1,join='inner')
df.head()
```

	gid	code	ten_tinh	geometry	province	pop
0	1	AD01	An Giang	(POLYGON (((105.115241874 10.955660896000002, 10...	An Giang	2155.3
1	2	AD01	Bà Rịa -Vũng Tàu	(POLYGON (((106.081096978 8.5775360490000043, 10...	Bạc Liêu	876.8
2	3	AD01	Bắc Giang	(POLYGON (((106.165424121 21.620223499000008, 10...	Bắc Giang	1593.2
3	4	AD01	Bắc Kạn	(POLYGON (((105.744201095 22.735194665000007, 10...	Bắc Kạn	303.1
4	5	AD01	Bạc Liêu	(POLYGON (((105.3259085210001 9.6000394860000076...	Bắc Ninh	1114.0

```
import folium
```

```
#vn_geo = r'province_data.geojson'
vn_map = folium.Map(location=[13.2904027, 108.4265113], zoom_start=6)
# Hiển thị biểu đồ dân số của Việt Nam
folium.Choropleth(
    geo_data=gdf,
    data=df,
    columns=['ten_tinh', 'pop'],
    key_on='feature.properties.ten_tinh',
    fill_color='YlOrRd',
    fill_opacity=0.7,
    line_opacity=0.2,
    legend_name='population'
).add_to(vn_map)

vn_map
```



```
gdf['province'] = df['province']
gdf['pop'] = df['pop']
gdf.head()
```

	gid	code	ten_tinh	geometry	province	pop
0	1	AD01	An Giang	MULTIPOLYGON (((105.11524 10.95566, 105.11463 ...	An Giang	2155.3
1	2	AD01	Bà Rịa -Vũng Tàu	MULTIPOLYGON (((106.08110 8.57754, 106.08069 8...	Bạc Liêu	876.8
2	3	AD01	Bắc Giang	MULTIPOLYGON (((106.16542 21.62022, 106.16925 ...	Bắc Giang	1593.2
3	4	AD01	Bắc Kạn	MULTIPOLYGON (((105.74420 22.73519, 105.74624 ...	Bắc Kạn	303.1
4	5	AD01	Bạc Liêu	MULTIPOLYGON (((105.32591 9.60004, 105.32755 9...	Bắc Ninh	1114.0

STT	ID	Name	Bourough	Postal cost	Latitude
1		760 Quận 1	Vietnam, Quan 1		10.7756587
2		761 Quận 12	Vietnam, Quan 12		10.8671531
3		762 Quận Thủ Đức	Vietnam, Thu Duc		10.8494094
4		763 Quận 9	Vietnam, Quan 9		10.8428402
5		764 Quận Gò Vấp	Vietnam, Go Vap		10.8386779
6		765 Quận Bình Thạnh	Vietnam, Binh Thanh		10.8105831
7		766 Quận Tân Bình	Vietnam, Tan Binh		10.8014659
8		767 Quận Tân Phú	Vietnam, Tan Phu		11.4275308
9		768 Quận Phú Nhuận	Vietnam, Phu Nhuan		10.7991944
10		769 Quận 2	Vietnam, Quan 2		10.7872729
11		770 Quận 3	Vietnam, Quan 3		10.7843695
12		771 Quận 10	Vietnam, Quan 10		10.7745965
13		772 Quận 11	Vietnam, Quan 11		10.7629739
14		773 Quận 4	Vietnam, Quan 4		10.7578263
15		774 Quận 5	Vietnam, Quan 5		10.7540279
16		775 Quận 6	Vietnam, Quan 6		10.7480929
17		776 Quận 8	Vietnam, Quan 8		10.7240878
18		777 Quận Bình Tân	Vietnam, Binh Tan		10.7652581
19		778 Quận 7	Vietnam, Quan 7		10.7340344
20		783 Huyện Củ Chi	Vietnam, Cu Chi		11.0066683
21		784 Huyện Hóc Môn	Vietnam, Hoc Mon		10.8839675
22		785 Huyện Bình Chánh	Vietnam, Binh Chanh		10.687392
23		786 Huyện Nhà Bè	Vietnam, Nha Be		10.6952642
24		787 Huyện Cần Giờ	Vietnam, Can Gio		10.5083266

Longitude	Population	Population_all	Avg_land_price
106.7004238	193.632	193632	59852096
106.6413322	510.326	510326	3505942
106.7537055	528.413	528413	5249286
106.8286851	290.62	290620	3337584
106.6652904	634.146	634146	9873267
106.7091422	487.985	487985	19844762
106.6525974	459.029	459029	14439409
107.36123	464.493	464493	8490438
106.6802639	182.477	182477	21845588
106.7498105	147.168	147168	9269650
106.6844089	196.333	196333	45158065
106.6679542	238.558	238558	27244615
106.650084	230.596	230596	19514337
106.7012968	186.727	186727	17400000
106.6633746	178.615	178615	31355462
106.6352362	258.945	258945	16491954
106.6286259	431.969	431969	9407143
106.6038535	686.474	686474	4534629
106.7215787	310.178	310178	11113939
106.5131967	403.038	403038	762925
106.5870611	422.471	422471	1074292
106.5938538	591.451	591451	3921026
106.704874	139.225	139225	3379524
106.8635004	74.96	74960	762154


```

1  {
2    "type" : "FeatureCollection",
3    "features" : [ {
4      "type" : "Feature",
5      "id" : 3850184,
6      "timestamp" : "2016-03-18 23:05:02+01",
7      "rpath" : [ "3850184", "1973756", "49915", "0" ],
8      "properties" : {
9        "id" : 3850184,
10       "name" : "Saigon South",
11       "localname" : "Khu đô thị Nam Sài Gòn",
12       "timestamp" : "2016-03-18 23:05:02+01",
13       "SRID" : "4326",
14       "admin_level" : 5,
15       "rpath" : [ "3850184", "1973756", "49915", "0" ],
16       "tags" : {
17         "name" : "Khu đô thị Nam Sài Gòn",
18         "name:en" : "Saigon South",
19         "name:vi" : "Khu Nam Sài Gòn",
20         "boundary" : "administrative",
21         "admin_level" : "5"
22       }
23     },
24     "geometry" : {
25       "type" : "MultiPolygon",
26       "coordinates" : [ [ [ [ 106.6934435, 10.7221295 ], [ 106.694747, 10.7227936 ], [
106.6949401, 10.7228568 ], [ 106.6951118, 10.722841 ], [ 106.6972254, 10.7223666
], [ 106.6973863, 10.7222823 ], [ 106.6974936, 10.7221136 ], [ 106.6992424,
10.7168165 ], [ 106.6988615, 10.7164739 ], [ 106.6985021, 10.7162841 ], [
106.6981159, 10.7163948 ], [ 106.6975955, 10.7165529 ], [ 106.6970913, 10.7168218
], [ 106.6963993, 10.7173119 ], [ 106.6959004, 10.71776 ], [ 106.6956161,
10.7181816 ], [ 106.6954068, 10.7185506 ], [ 106.6951869, 10.7190197 ], [
106.6951011, 10.7196153 ], [ 106.6949938, 10.7199684 ], [ 106.694865, 10.7203268
], [ 106.6946451, 10.7207959 ], [ 106.694275, 10.7212756 ], [ 106.6939102,
10.7216814 ], [ 106.6935776, 10.7219977 ], [ 106.6934435, 10.7221295 ] ] ]
27   ]
28   ]
29   }
30   }, {
31     "type" : "Feature",
32     "id" : 3797166,
33     "timestamp" : "2016-03-18 23:05:02+01",
34     "rpath" : [ "3797166", "1973756", "49915", "0" ],
35     "properties" : {
36       "id" : 3797166,
37       "name" : "Bình Thạnh District",
38       "localname" : "Quận Bình Thạnh",
39       "timestamp" : "2016-03-18 23:05:02+01",
40       "SRID" : "4326",
41       "admin_level" : 6,
42       "rpath" : [ "3797166", "1973756", "49915", "0" ],
43       "tags" : {
44         "name" : "Quận Bình Thạnh",
45         "name:en" : "Bình Thạnh District",
46         "name:vi" : "Quận Bình Thạnh",
47         "boundary" : "administrative",
48         "admin_level" : "6"
49       }
50     },
51     "geometry" : {
52       "type" : "MultiPolygon",
53       "coordinates" : [ [ [ [ 106.6838586, 10.8071124 ], [ 106.6838762, 10.8073245 ], [
106.6839311, 10.8076913 ], [ 106.684101, 10.8081502 ], [ 106.6841849, 10.8085424
], [ 106.6841826, 10.8086846 ], [ 106.6841795, 10.8088836 ], [ 106.6841463,
10.8091955 ], [ 106.6840003, 10.8094525 ], [ 106.6839697, 10.8099393 ], [
106.6841205, 10.8105078 ], [ 106.684228, 10.8108681 ], [ 106.6843665, 10.8109725
], [ 106.6845424, 10.8111052 ], [ 106.6848003, 10.811273 ], [ 106.6851743,
10.8115165 ], [ 106.685226, 10.8122181 ], [ 106.6852722, 10.8124058 ], [
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