Capstone Project --

Exploring similarities and dissimilarities between two cities, Taipei and Tainan, in Taiwan

1. Introduction

1.1 Background

Taiwan is one of the popular immigration countries for Hong Kong residents, given its resemblance in dining, culture and climates. Yet, there are a number of cities in Taiwan that have some similarities and dissimilarities in their neighborhoods, such that people will have to consider before they apply for an immigration, especially with the whole family.

1.2 Interest

For the sake of interest of an immigration agency, we will conduct an analysis to explore similarities and dissimilarities in city neighborhoods in Taiwan. As a result of the study, the agency would be able to provide more valuable immigration advice and recommendations to their clients.

1.3 Problem

We will explore district neighborhoods in two major cities, Taipei and Tainan, in Taiwan. For Taipei, as we consider in this study, it will include districts in both Taipei city and New Taipei city, as New Taipei is more like a region surrounding Taipei.

Using segmentation and clustering, we will compare the district neighborhoods of Taipei and Tainan, in order to determine the similarities and dissimilarities of these two cities.

2. Data

2.1 City Districts in Taiwan

This wiki page provides a list of cities and districts in Taiwan.

https://en.wikipedia.org/wiki/List_of_townships/cities_and_districts_in_Taiwan

We will parse data from html file and load data into a data frame for analysis. We will focus on data of '*Type District*' only in the table.

2.2 Coordinates Data

Theoretically, we can get latitude and longitude data for each district using geocoder in Python.

Alternatively, we can look up map coordinates from this website.

https://www.gps-coordinates.net/

2.3 Venues Data

Foursquare API will be used to obtain the most common venues in each district in Taipei and Tainan.

2.4 Sample Formatted Districts Data for Taipei and Tainan

Sample data for Taipei:

	City	District	Area	Population	Latitude	Longitude
0	New Taipei City	Banqiao District	556,276	23.14	25.009670	121.459099
1	New Taipei City	Sanchong District	386,206	16.32	25.061486	121.488102
2	New Taipei City	Zhonghe District	412,856	20.14	24.999397	121.498980
3	New Taipei City	Yonghe District	220,602	5.71	25.009235	121.520070
4	New Taipei City	Xinzhuang District	419,962	19.74	25.035772	121.450248
5	New Taipei City	Xindian District	303,288	120.23	24.928408	121.539007
6	New Taipei City	Shulin District	183,982	33.13	24.990706	121.420533
7	New Taipei City	Yingge District	86,780	21.12	24.959945	121.353771
8	New Taipei City	Sanxia District	116,338	191.45	24.934339	121.368905
9	New Taipei City	Tamsui District	177,988	70.66	25.183559	121.459954

Sample data for Tainan:

|	City	District	Area	Population	Latitude	Longitude
0	Tainan City	Xinying District	77,072	38.54	23.308698	120.316957
1	Tainan City	Yanshuei District	25,266	52.25	23.319828	120.266398
2	Tainan City	Baihe District	27,744	126.40	23.351473	120.413745
3	Tainan City	Liuying District	21,103	61.29	23.279601	120.311157
4	Tainan City	Houbi District	23,055	72.22	23.366721	120.362726
5	Tainan City	Dongshan District	20,501	124.92	23.326668	120.404059
6	Tainan City	Madou District	43,987	53.97	23.181724	120.248206
7	Tainan City	Xiaying District	23,700	33.53	23.235413	120.264484
8	Tainan City	Lioujia District	21,917	67.55	23.232901	120.352221
9	Tainan City	Guantian District	21,343	70.80	23.191997	120.316493

3. Methodology

3.1 Examine the District Dataset

Once we have retrieved the coordinates for districts in Taipei and Tainan, we can visualize the districts of these two cities in a map using the **Folium** library.

There are 40 districts in Taipei:
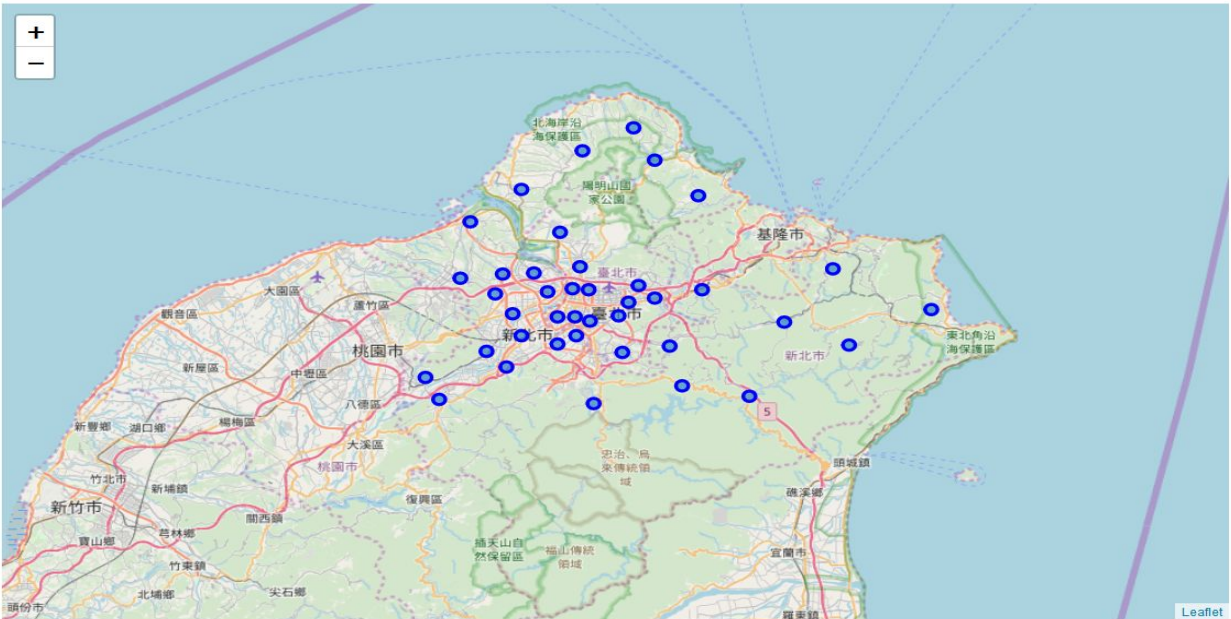
There are 37 districts in Tainan:
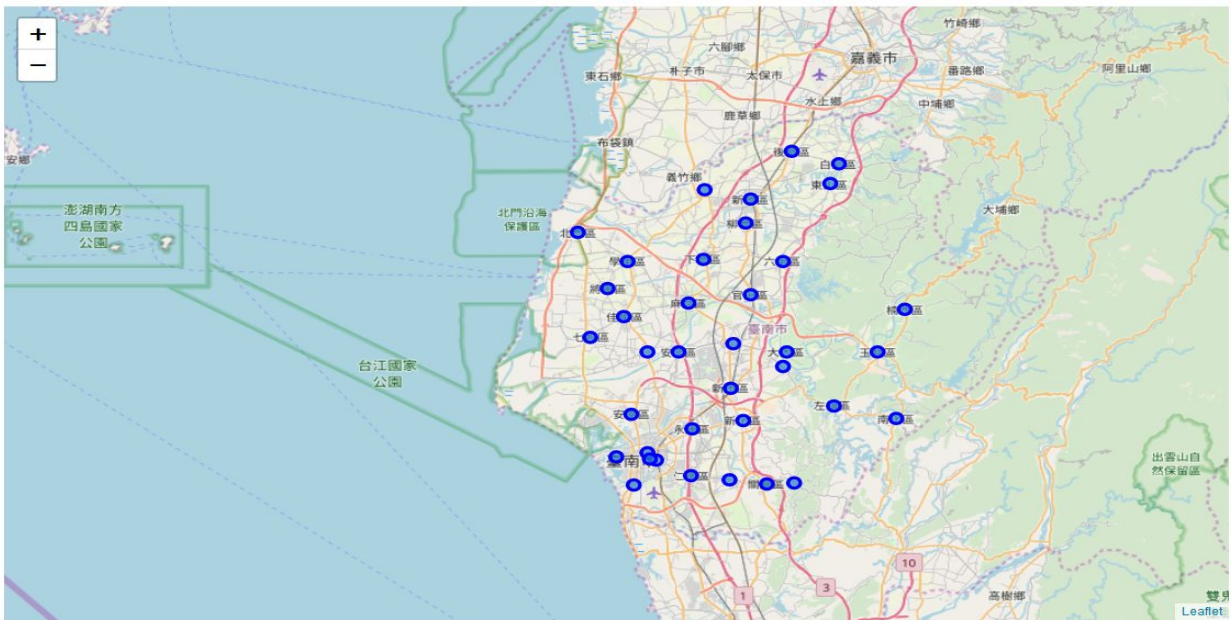
From the maps above, the districts can be identified correctly and properly in the two city maps respectively. So it looks good on the district dataset.

3.2 Examine the Venue Dataset returned from Foursquare API

Next, we use Foursquare /venues/explore API to get the most common venues for each district in Taipei and Tainan. In our case, we try to look up top 100 venues within a radius of 800 meters.

```
In [31]: ▶ taipei_venues.head()
```
Out[31]:

	City	District	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	New Taipei City	Banqiao District	25.00967	121.459099	府中15	25.009315	121.459580	Indie Movie Theater
1	New Taipei City	Banqiao District	25.00967	121.459099	馥都飯店 Grand Forward Hotel	25.007536	121.458580	Hotel
2	New Taipei City	Banqiao District	25.00967	121.459099	生炒魷魚	25.010272	121.457347	Seafood Restaurant
3	New Taipei City	Banqiao District	25.00967	121.459099	麥當勞 McDonald's	25.007962	121.460940	Fast Food Restaurant
4	New Taipei City	Banqiao District	25.00967	121.459099	六必居潮州沙鍋粥	25.009990	121.463072	Chinese Restaurant

```
In [32]: ▶ # check the size of the resulting venue dataframe
         taipei_venues.shape
```
Out[32]: (506, 8)

For Taipei, we get 506 venues, of which they can be classified into 122 unique categories.

```
In [34]: ▶ tainan_venues.head()
```
Out[34]:

	City	District	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Tainan City	Xinying District	23.308698	120.316957	美美冰果部	23.310415	120.316402	Dessert Shop
1	Tainan City	Xinying District	23.308698	120.316957	南瀛綠都心	23.309457	120.315478	Park
2	Tainan City	Xinying District	23.308698	120.316957	華味香鴨肉羹	23.310876	120.317258	Food
3	Tainan City	Xinying District	23.308698	120.316957	阿忠豆菜麵	23.311210	120.316548	Taiwanese Restaurant
4	Tainan City	Xinying District	23.308698	120.316957	阿松臭豆腐	23.313172	120.316683	Food Truck

```
In [35]: ▶ # check the size of the resulting venue dataframe
         tainan_venues.shape
```
Out[35]: (228, 8)

For Tainan, we get 228 venues, of which they can be classified into 77 unique categories.

In order to analyze each district, we group venues based on categories. To do that, we first create one-hot encoding with "venue category" using all venues in a city, and then, for every district, take the mean of the frequency of occurrence of each category.

Category grouping for districts in Taipei:

	City	District	American Restaurant	Arcade	Art Gallery	Asian Restaurant	BBQ Joint	Bakery	Bar	Beer Bar	...	Temple	Thai Restaurant	Theater	Tourist Information Center	Toy / Game Store	Train Station	Tunnel	Vegetarian / Vegan Restaurant	Vietnamese Restaurant	Women's Store
0	New Taipei City	Bali District	0.000000	0.000000	0.000000	0.500000	0.000000	0.000000	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
1	New Taipei City	Banqiao District	0.000000	0.000000	0.000000	0.029412	0.000000	0.000000	0.00000	0.000000	...	0.029412	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.029412	0.000000	0.0
2	New Taipei City	Jinshan District	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
3	New Taipei City	Linkou District	0.000000	0.000000	0.000000	0.100000	0.000000	0.000000	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
4	New Taipei City	Luzhou District	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
5	New Taipei City	Pinglin District	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.111111	0.000000	0.000000	0.0
6	New Taipei City	Pingxi District	0.000000	0.000000	0.000000	0.000000	0.200000	0.000000	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.200000	0.000000	0.000000	0.000000	0.0
7	New Taipei City	Ruifang District	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
8	New Taipei City	Sanchong District	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
9	New Taipei City	Sanxia District	0.000000	0.000000	0.000000	0.000000	0.000000	0.222222	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
10	New Taipei City	Sanzhi District	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.000000	...	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0

Category grouping for districts in Tainan:

	City	District	Accessories Store	American Restaurant	Art Gallery	Art Museum	Asian Restaurant	BBQ Joint	Bakery	Bar	...	Soba Restaurant	Soup Place	Steakhouse	Taiwanese Restaurant	Tea Room	Thai Restaurant	Tourist Information Center	Trail	Train Station	Water Park
0	Tainan City	Anding District	0.000000	0.00	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.00	0.000000	0.000000	0.00	0.00	0.000000	0.00	0.0
1	Tainan City	Annan District	0.000000	0.00	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.250000	0.00	0.000000	0.250000	0.00	0.00	0.000000	0.00	0.0
2	Tainan City	Anping District	0.000000	0.00	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.222222	0.00	0.111111	0.000000	0.00	0.00	0.000000	0.00	0.0
3	Tainan City	Baihe District	0.000000	0.00	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.00	0.250000	0.000000	0.00	0.00	0.000000	0.00	0.0
4	Tainan City	Beimen District	0.000000	0.00	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.00	0.000000	0.000000	0.00	0.25	0.000000	0.00	0.0
5	Tainan City	Cigu District	0.000000	0.00	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.00	0.000000	0.000000	0.00	0.00	0.000000	0.00	0.5
6	Tainan City	Danei District	0.000000	0.00	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.00	0.000000	0.000000	0.00	0.00	0.000000	0.00	0.0
7	Tainan City	Dongshan District	0.000000	0.00	0.00	0.000000	0.400000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.00	0.200000	0.200000	0.00	0.00	0.000000	0.00	0.0
8	Tainan City	East District	0.000000	0.00	0.00	0.000000	0.052632	0.052632	0.000000	0.052632	...	0.000000	0.000000	0.00	0.105263	0.105263	0.00	0.00	0.000000	0.00	0.0
9	Tainan City	Guanmiao District	0.000000	0.00	0.00	0.000000	0.250000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.00	0.250000	0.000000	0.00	0.00	0.000000	0.00	0.0
10	Tainan City	Guantian District	0.000000	0.00	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.00	0.000000	0.000000	0.00	0.00	0.000000	0.20	0.0

Finally, we have refined a data frame with the top 5 most common venues for each district in Taipei and Tainan respectively.

Top 5 most common venues for Taipei districts:

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	New Taipei City	Bali District	Convenience Store	Asian Restaurant	Women's Store	Food Truck	Discount Store
1	New Taipei City	Banqiao District	Café	Hotel	Hotpot Restaurant	Fast Food Restaurant	Ice Cream Shop
2	New Taipei City	Jinshan District	Hotel	Farm	Snack Place	Food Court	Dim Sum Restaurant
3	New Taipei City	Linkou District	Pharmacy	Breakfast Spot	Café	Asian Restaurant	Noodle House
4	New Taipei City	Luzhou District	Pizza Place	Concert Hall	Noodle House	Night Market	Women's Store
5	New Taipei City	Pinglin District	Tea Room	Convenience Store	Chinese Restaurant	Taiwanese Restaurant	Museum
6	New Taipei City	Pingxi District	Bus Station	Platform	Train Station	Café	BBQ Joint
7	New Taipei City	Ruifang District	Taiwanese Restaurant	Women's Store	Food Stand	Dim Sum Restaurant	Diner
8	New Taipei City	Sanchong District	Convenience Store	Restaurant	Café	Taiwanese Restaurant	Women's Store
9	New Taipei City	Sanxia District	Dessert Shop	Bakery	Snack Place	Market	Café
10	New Taipei City	Sanzhi District	Chinese Restaurant	Women's Store	Food Stand	Diner	Discount Store

Top 5 most common venues for Tainan districts:

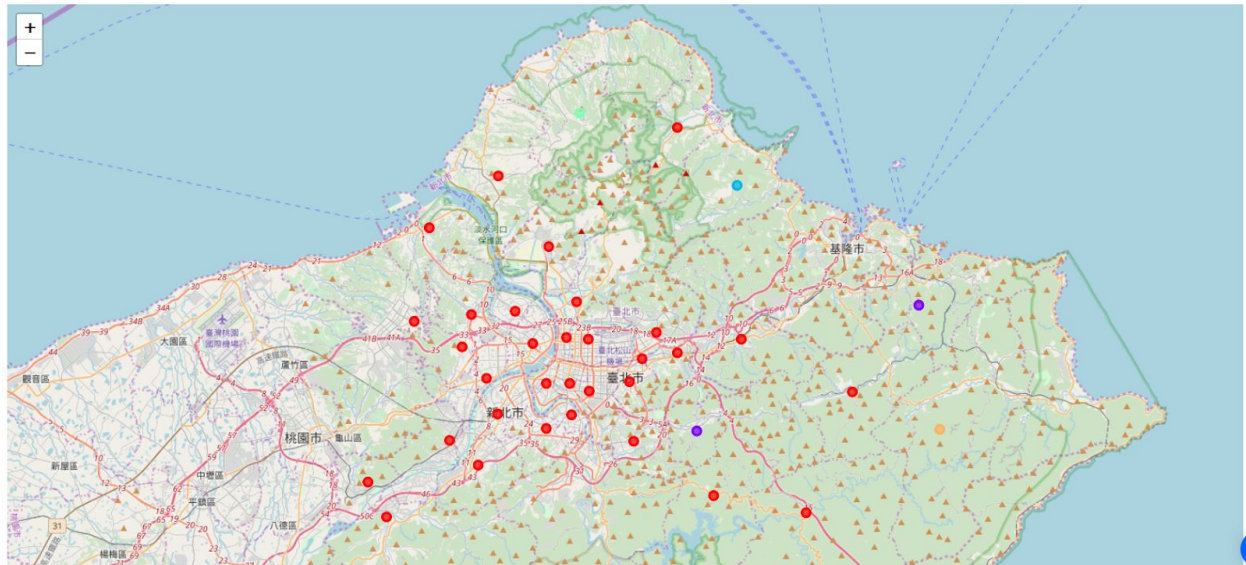|	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Tainan City	Anding District	Convenience Store	Fast Food Restaurant	Department Store	Dessert Shop	Dim Sum Restaurant
1	Tainan City	Annan District	Concert Hall	Seafood Restaurant	Tea Room	Soup Place	Deli / Bodega
2	Tainan City	Anping District	Soup Place	Convenience Store	Food Truck	Dessert Shop	Taiwanese Restaurant
3	Tainan City	Baihe District	Taiwanese Restaurant	Flower Shop	Restaurant	Bus Station	Water Park
4	Tainan City	Beimen District	Grocery Store	Outdoor Sculpture	Tourist Information Center	History Museum	Farmers Market
5	Tainan City	Cigu District	Water Park	Seafood Restaurant	Convenience Store	Department Store	Dessert Shop
6	Tainan City	Danei District	Public Art	Electronics Store	Water Park	Convenience Store	Department Store
7	Tainan City	Dongshan District	Asian Restaurant	Food Truck	Tea Room	Taiwanese Restaurant	Water Park
8	Tainan City	East District	Noodle House	Tea Room	Taiwanese Restaurant	Chinese Restaurant	Café
9	Tainan City	Guanmiao District	Asian Restaurant	Taiwanese Restaurant	Chinese Restaurant	Bus Station	Water Park
10	Tainan City	Guantian District	Park	Night Market	Train Station	Dessert Shop	Farmers Market

3.3 Running K-Means Clustering Algorithm

Afterall, using the above datasets, we will segment the districts using k-means clustering and analyze the clusters formed in Taipei and Tainan.

In our case, we have an unlabelled dataset, so running k-means clustering is an appropriate approach to solve the problem. By taking k=5, we will segment the districts into 5 clusters in each city, and find out any pattern or characteristic in these clusters, thereby trying to identify any similarities or dissimilarities between these two cities.
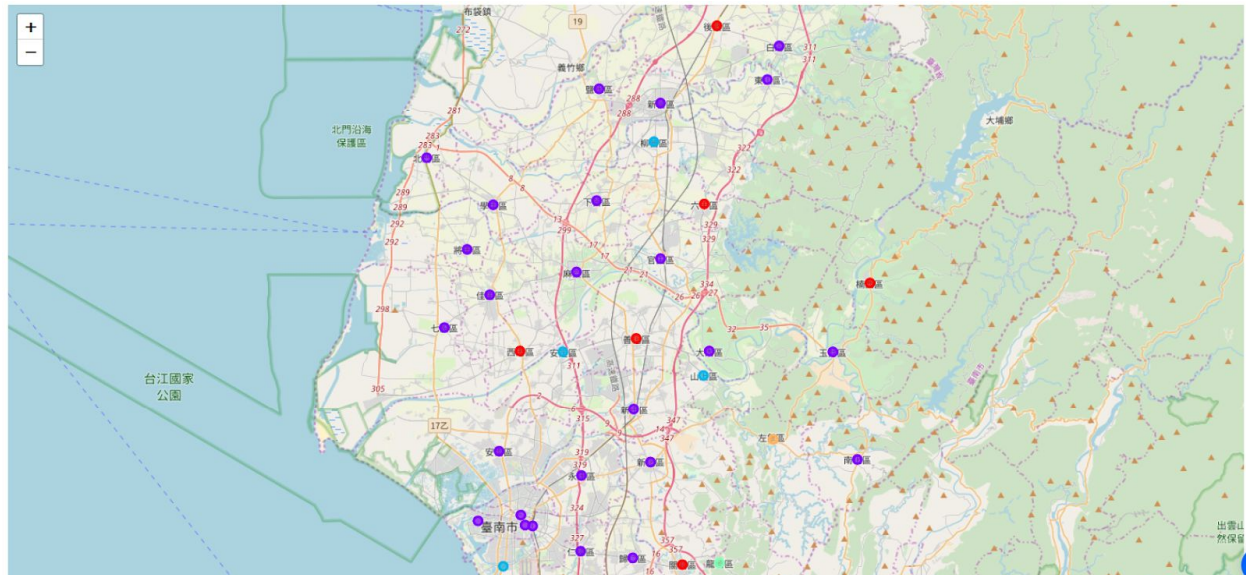
4. Results

First, using the **Folium** library, we can visualize the clusters formed in a map for Taipei and Tainan.

District clustering in Taipei:

District clustering in Tainan:

Next, we list the districts under each cluster in Taipei and Tainan.

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	New Taipei City	Banqiao District	Café	Hotel	Hotpot Restaurant	Fast Food Restaurant	Ice Cream Shop
1	New Taipei City	Sanchong District	Convenience Store	Restaurant	Café	Taiwanese Restaurant	Women's Store
2	New Taipei City	Zhonghe District	Hotel	Coffee Shop	Café	Sporting Goods Shop	Furniture / Home Store
3	New Taipei City	Yonghe District	Convenience Store	Museum	Farmers Market	Steakhouse	Coffee Shop
4	New Taipei City	Xinzhuang District	Hotpot Restaurant	Coffee Shop	Gym / Fitness Center	Night Market	Food & Drink Shop
5	New Taipei City	Shulin District	Food Truck	Italian Restaurant	Coffee Shop	Bus Stop	Fast Food Restaurant
6	New Taipei City	Yingge District	Art Gallery	Convenience Store	Food	Women's Store	Food Truck
7	New Taipei City	Sanxia District	Dessert Shop	Bakery	Snack Place	Market	Café
8	New Taipei City	Tamsui District	Indie Theater	Asian Restaurant	Golf Course	Women's Store	Farmers Market
9	New Taipei City	Xizhi District	Korean Restaurant	Convenience Store	Fast Food Restaurant	Japanese Restaurant	Chinese Restaurant
11	New Taipei City	Tucheng District	Convenience Store	Chinese Restaurant	Motorcycle Shop	Bus Station	Metro Station
12	New Taipei City	Luzhou District	Pizza Place	Concert Hall	Noodle House	Night Market	Women's Store
13	New Taipei City	Wugu District	Gourmet Shop	Breakfast Spot	Women's Store	Food Stand	Diner
14	New Taipei City	Taishan District	Food Truck	Convenience Store	Ramen Restaurant	Market	Chinese Restaurant
15	New Taipei City	Linkou District	Pharmacy	Breakfast Spot	Café	Asian Restaurant	Noodle House
17	New Taipei City	Shiding District	Bike Rental / Bike Share	Bus Stop	Women's Store	Food Truck	Discount Store
18	New Taipei City	Pinglin District	Tea Room	Convenience Store	Chinese Restaurant	Taiwanese Restaurant	Museum
20	New Taipei City	Bali District	Convenience Store	Asian Restaurant	Women's Store	Food Truck	Discount Store
21	New Taipei City	Pingxi District	Bus Station	Platform	Train Station	Café	BBQ Joint
23	New Taipei City	Jinshan District	Hotel	Farm	Snack Place	Food Court	Dim Sum Restaurant
25	Taipei City	Songshan District	Seafood Restaurant	Japanese Restaurant	Taiwanese Restaurant	Shabu-Shabu Restaurant	Chinese Restaurant
26	Taipei City	Xinyi District	Department Store	Electronics Store	Lounge	BBQ Joint	Coffee Shop
27	Taipei City	Daan District	Café	Convenience Store	Tea Room	Park	Deli / Bodega
28	Taipei City	Zhongshan District	Hotel	Seafood Restaurant	Massage Studio	BBQ Joint	Fish Market
29	Taipei City	Zhongzheng District	Café	Noodle House	Monument / Landmark	Bakery	Theater
30	Taipei City	Datong District	Taiwanese Restaurant	Dessert Shop	Café	Supermarket	Convenience Store
31	Taipei City	Wanhua District	Chinese Restaurant	Taiwanese Restaurant	Dessert Shop	Coffee Shop	Bakery
32	Taipei City	Wenshan District	Coffee Shop	Japanese Restaurant	Convenience Store	Café	Ice Cream Shop
33	Taipei City	Nangang District	Shopping Mall	Bubble Tea Shop	Train Station	Toy / Game Store	BBQ Joint
34	Taipei City	Neihu District	Grocery Store	Convenience Store	Asian Restaurant	Coffee Shop	Gym
35	Taipei City	Shilin District	Café	Ice Cream Shop	Chinese Restaurant	Shoe Store	Noodle House
36	Taipei City	Beitou District	Tea Room	Dessert Shop	Coffee Shop	Japanese Restaurant	Park

==Taipei== Cluster #2 -

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
10	New Taipei City	Ruifang District	Taiwanese Restaurant	Women's Store	Food Stand	Dim Sum Restaurant	Diner
16	New Taipei City	Shenkeng District	Taiwanese Restaurant	Women's Store	Food Stand	Dim Sum Restaurant	Diner

==Taipei== Cluster #3 -

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
24	New Taipei City	Wanli District	Electronics Store	Women's Store	Dessert Shop	Diner	Discount Store

Taipei Cluster #4 -

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
19	New Taipei City	Sanzhi District	Chinese Restaurant	Women's Store	Food Stand	Diner	Discount Store

Taipei Cluster #5 -

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
22	New Taipei City	Shuangxi District	Women's Store	Dessert Shop	Diner	Discount Store	Donut Shop

Tainan Cluster #1 -

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
4	Tainan City	Houbi District	Train Station	Bakery	Chinese Restaurant	Deli / Bodega	Fruit & Vegetable Store
8	Tainan City	Lioujia District	Snack Place	Flea Market	Chinese Restaurant	Optical Shop	Food Truck
13	Tainan City	Sigang District	Historic Site	Chinese Restaurant	Night Market	Convenience Store	Art Museum
18	Tainan City	Shanhua District	Chinese Restaurant	Night Market	Thai Restaurant	Farmers Market	Department Store
23	Tainan City	Nansi District	Asian Restaurant	Chinese Restaurant	Campground	Water Park	Fast Food Restaurant
28	Tainan City	Guanmiao District	Asian Restaurant	Taiwanese Restaurant	Chinese Restaurant	Bus Station	Water Park

==Tainan== Cluster #2, the *major* cluster -

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Tainan City	Xinying District	Park	Food Truck	Dessert Shop	Taiwanese Restaurant	Food
1	Tainan City	Yanshuei District	Noodle House	Indie Movie Theater	Night Market	Dessert Shop	Lake
2	Tainan City	Baihe District	Taiwanese Restaurant	Flower Shop	Restaurant	Bus Station	Water Park
5	Tainan City	Dongshan District	Asian Restaurant	Food Truck	Tea Room	Taiwanese Restaurant	Water Park
6	Tainan City	Madou District	Grocery Store	Multiplex	Ice Cream Shop	Movie Theater	Farmers Market
7	Tainan City	Xiaying District	Fruit & Vegetable Store	Food Stand	Pharmacy	Restaurant	Convenience Store
9	Tainan City	Guantian District	Park	Night Market	Train Station	Dessert Shop	Farmers Market
10	Tainan City	Danei District	Public Art	Electronics Store	Water Park	Convenience Store	Department Store
11	Tainan City	Jiali District	Park	Asian Restaurant	Steakhouse	Bus Station	Water Park
12	Tainan City	Syuejia District	Taiwanese Restaurant	Dessert Shop	Ice Cream Shop	Asian Restaurant	Bakery
14	Tainan City	Cigu District	Water Park	Seafood Restaurant	Convenience Store	Department Store	Dessert Shop
15	Tainan City	Jiangjun District	Ice Cream Shop	Art Gallery	Asian Restaurant	Water Park	Flea Market
16	Tainan City	Beimen District	Grocery Store	Outdoor Sculpture	Tourist Information Center	History Museum	Farmers Market
17	Tainan City	Xinhua District	Bus Station	Asian Restaurant	Food Truck	Road	Water Park
19	Tainan City	Sinshih District	Taiwanese Restaurant	Snack Place	Fast Food Restaurant	Dim Sum Restaurant	Indian Restaurant
22	Tainan City	Yujing District	Convenience Store	Dessert Shop	Ice Cream Shop	Farmers Market	Bus Station
24	Tainan City	Nanhua District	Trail	Asian Restaurant	Food Stand	Water Park	Fast Food Restaurant
26	Tainan City	Rende District	Bus Station	American Restaurant	Pet Store	Breakfast Spot	Water Park
27	Tainan City	Gueiren District	Bubble Tea Shop	Ice Cream Shop	Fast Food Restaurant	Flea Market	Dessert Shop
30	Tainan City	Yongkang District	Dim Sum Restaurant	Fast Food Restaurant	Taiwanese Restaurant	Intersection	Water Park
31	Tainan City	East District	Noodle House	Tea Room	Taiwanese Restaurant	Chinese Restaurant	Café
33	Tainan City	North District	Convenience Store	Café	Historic Site	Dessert Shop	Taiwanese Restaurant
34	Tainan City	Annan District	Concert Hall	Seafood Restaurant	Tea Room	Soup Place	Deli / Bodega
35	Tainan City	Anping District	Soup Place	Convenience Store	Food Truck	Dessert Shop	Taiwanese Restaurant
36	Tainan City	West Central District	Café	Taiwanese Restaurant	Coffee Shop	Chinese Restaurant	Tea Room

Tainan Cluster #3 -

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
3	Tainan City	Liuying District	Convenience Store	History Museum	Gourmet Shop	Art Gallery	Art Museum
20	Tainan City	Anding District	Convenience Store	Fast Food Restaurant	Department Store	Dessert Shop	Dim Sum Restaurant
21	Tainan City	Shanshang District	Convenience Store	Fast Food Restaurant	Department Store	Dessert Shop	Dim Sum Restaurant
32	Tainan City	South District	Convenience Store	Noodle House	Garden	Farmers Market	Department Store

Tainan Cluster #4 -

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
29	Tainan City	Longci District	Dog Run	Water Park	Fast Food Restaurant	Department Store	Dessert Shop

Tainan Cluster #5 -

	City	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
25	Tainan City	Zuojhen District	History Museum	Water Park	Flea Market	Dessert Shop	Dim Sum Restaurant

At first glance of the results in map, we can see that both cities have a major cluster, in which more than 65% of the districts are resided in it. Obviously, that cluster would be the city center with mostly commercial and residential venues, like restaurants and cafes, shopping malls, stores and hotels etc. The other clusters in each city would probably be the suburban communities, in which it is less populated with fewer shops and restaurants in that area.

5. Discussion

By taking a closer look of the venue info under each cluster, we can make 2 more observations between Taipei and Tainan.

When comparing the biggest cluster formed, the size of it (cluster #1, 86% districts resides in it) in Taipei is larger than that (cluster #2, 68%) in Tainan. This makes sense because Taipei is the capital of Taiwan. Definitely Taipei will have a larger city center than Tainan, and is a more densely populated urban area than Tainan.

By examining the clusters in Tainan, we also find that Tainan is a city with more historical spots for tourism and sightseeing. We can see historic site and art museum in cluster #1, historic site, outdoor sculpture and tourist information center in cluster #2, history museum and art gallery in cluster #3 and #5. This observation aligns with our understanding that Tainan is the cultural heart of Taiwan, of which it is rich in history and local traditions. It is because Tainan is the old capital of Taiwan.

Although we can get favorable information for our problem, it is not accurate enough. During the data processing, we find that for some districts in Taipei and Tainan, we don't have much location data from Foursquare.

In Taipei, 13 districts out of 37 (i.e. 35%) have less than 5 venue data.

City	District	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
New Taipei City	Bali District	2	2	2	2	2	2
	Banqiao District	34	34	34	34	34	34
	Jinshan District	3	3	3	3	3	3
	Linkou District	10	10	10	10	10	10
	Luzhou District	4	4	4	4	4	4
	Pinglin District	9	9	9	9	9	9
	Pingxi District	5	5	5	5	5	5
	Ruifang District	1	1	1	1	1	1
	Sanchong District	4	4	4	4	4	4
	Sanxia District	9	9	9	9	9	9

In Tainan, 24 districts out of 37 (i.e. 64%) have less than 5 venue data.

City	District	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Tainan City	Anding District	1	1	1	1	1	1
	Annan District	4	4	4	4	4	4
	Anping District	9	9	9	9	9	9
	Baihe District	4	4	4	4	4	4
	Beimen District	4	4	4	4	4	4
	Cigu District	2	2	2	2	2	2
	Danei District	2	2	2	2	2	2
	Dongshan District	5	5	5	5	5	5
	East District	19	19	19	19	19	19
	Guanmiao District	4	4	4	4	4	4

So when examining clusters in our result, we only focus on the 5 most common venues, instead of 10 as in our lab assignment. To improve accuracy in further studies, in addition to Foursquare's data, we need to source more venue data for analysis.

6. Conclusion

The study can provide supportive information for Immigration Agency to make a high level comparison between the two cities in Taiwan. From that, they are able to come up with evidence to identify similarities and dissimilarities between Taipei and Tainan. Both cities have a well-established city center, which is also similar to Hong Kong urban's living style. However, if people would like to slow down the fast pace in city's life and experience a more cultural and leisure neighborhood in Taiwan, Tainan would be a good choice for immigration, because it is less densely populated and has more historical and rural attractions to explore with.

7. References

Notebook:
https://jp-tok.dataplatform.cloud.ibm.com/analytics/notebooks/v2/ceb871eb-6dbf-43d7-88f0-a1bc541b1321/view?access_token=1efbf131fc223da10d201e898991273558dbcb724fd2b0ca39c8092dbaf56467