Capstone Project: The Battle of Neighbourhoods

1. Introduction

1.1 Description of the Problem

There are many practical questions that require the comparison across city neighborhoods. For example, a job seeker with transferable skills may wish to focus his/her search on a single neighborhood with jobs that best match his/her qualifications, rather than dispersing his/her search efforts across multiple neighborhoods. Likewise, a restaurant looking to expand its locations might perhaps select neighborhoods it wishes to expand into before considering particular sites or neighborhoods. Additionally, many within-city computations might be aided by modelling a neighborhood's relationship to other neighborhoods. For example, a person buying or renting a home in a new city might want to be able to compare the neighborhoods of the city.

1.2 Objective

Taipei and New Taipei City are two major cities in Taiwan. Both cities have been centers of attention for residential, job employment, tourism, education, shopping and sport activities. Both municipalities located in the north of Taiwan with New Taipei City surrounds Taipei.

Taipei is the capital city of Taiwan. Most part of New Taipei City are mountain area.

The aim of this project is to segment these two cities' neighborhoods based on data collected from Foursquare about venue categories in totally 41 neighborhoods across the cities. Using segmentation and clustering, I hope I can determine:

1. The similarity or dissimilarity between neighborhoods.
2. Classification of a neighborhood inside a city whether it is residential, tourism places, or others.

2. Data

This project will rely on public data from websites and Foursquare.

In order to segment the neighborhoods and explore them, I will need a dataset that contains the 2 boroughs and the neighborhoods that exist in each borough as well as the latitude and longitude coordinates of each neighborhood.

A Wikipedia page: https://en.wikipedia.org/wiki/List_of_townships,_county-administered_cities_and_districts_of_Taiwan exists that has a list of townships, county-administered cities and districts of Taiwan. The Nominatim library can be used to get the latitude and longitude values of all neighborhoods.

3. Methodology

3.1 Data preparation

I scraped the Wikipedia page and wrangled the data, cleaned it, and then read it into a pandas dataframe so that it is in a structured format that consist of two columns of 2 Boroughs and 41 Neighborhoods of both cities.

I then use the Nominatim library to get the latitude and longitude values of all neighborhoods.
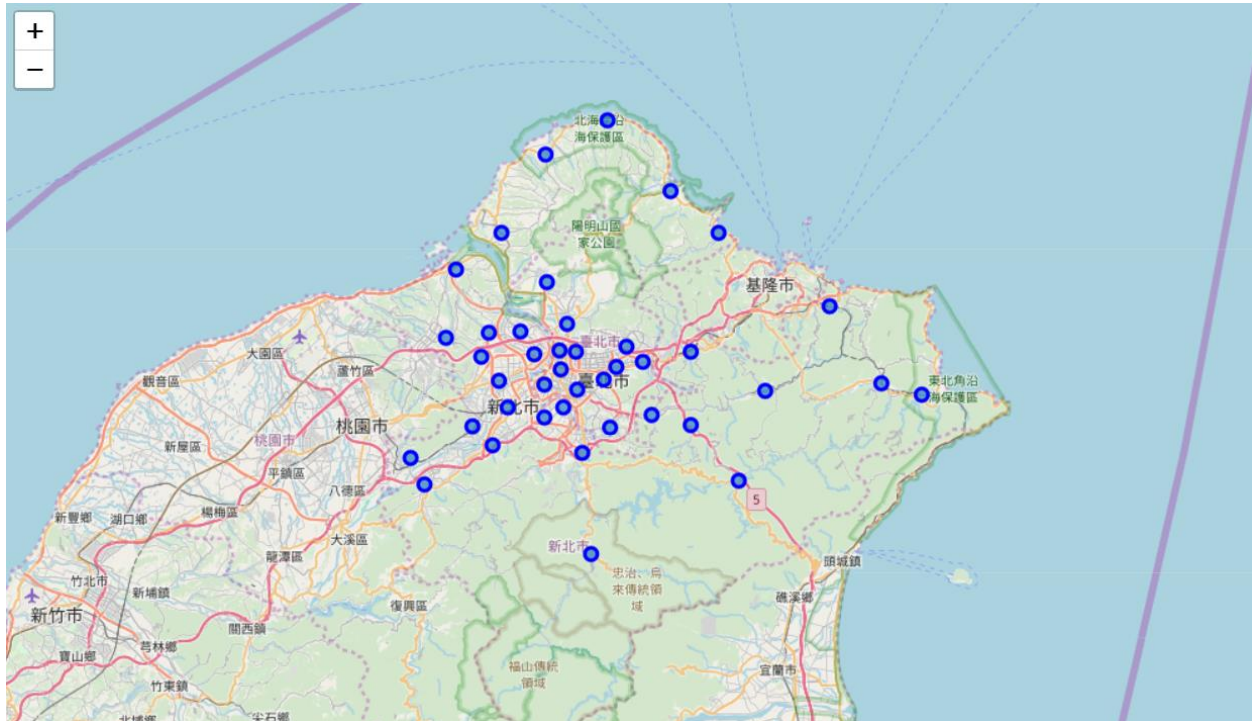

Fig. 1. Map of Taipei and New Taipei City. The markers are the neighborhoods in my analysis.

3.2 Data acquisition

The Foursquare API was used to search for nearby venues of each neighborhood in radius of 2000 meters. Only the venues name and venues category (i.e. café, restaurant, school, etc.) are extracted.

After obtaining all the venues, the total number of venues in each category is counted for each neighborhood. To clarify, I also builded a table with top 10 most frequent venue categories for each neighborhood.

3.3 Data Analysis

According to the total number of venues in each category, I applied *k*-means clustering method to compare neighborhoods among cities.
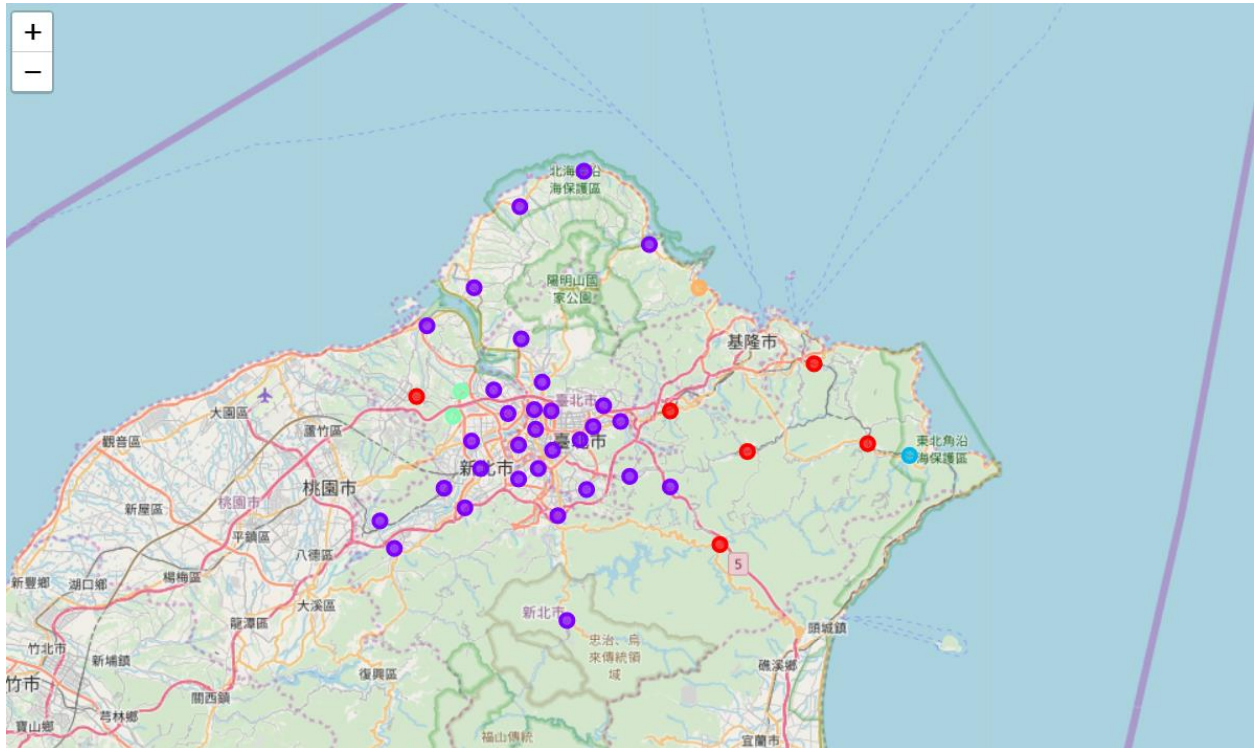

Fig. 2. *k*-means clustering visualization of all the neighborhoods in Taipei and New Taipei City.

4. Results

4.1 Cluster 0

Cluster 0 contains the mountain neighborhoods of New Taipei City with historic sites, train stations, convenience stores, and restaurants.

Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue
New Taipei City	Linkou	25.077531	121.391602	0	Convenience Store	Department Store	Skate Park	Japanese Restaurant	Breakfast Spot	Italian Restaurant	Coffee Shop	NaN	NaN
New Taipei City	Xizhi	25.064159	121.658748	0	Convenience Store	Train Station	Market	Supermarket	Breakfast Spot	BBQ Joint	Thai Restaurant	Food Court	Shopping Mall
New Taipei City	Ruifang	25.108911	121.809768	0	Convenience Store	Fast Food Restaurant	Bubble Tea Shop	Food Court	Food & Drink Shop	Dessert Shop	Ice Cream Shop	Train Station	Ramen Restaurant
New Taipei City	Pingxi	25.025797	121.739144	0	Train Station	Gift Shop	Historic Site	Chinese Restaurant	Dessert Shop	BBQ Joint	Tea Room	NaN	NaN
New Taipei City	Shuangxi	25.033409	121.865676	0	Café	Convenience Store	Dessert Shop	Train Station	NaN	NaN	NaN	NaN	NaN
New Taipei City	Pinglin	24.937388	121.711185	0	Convenience Store	Café	Tunnel	Museum	NaN	NaN	NaN	NaN	NaN

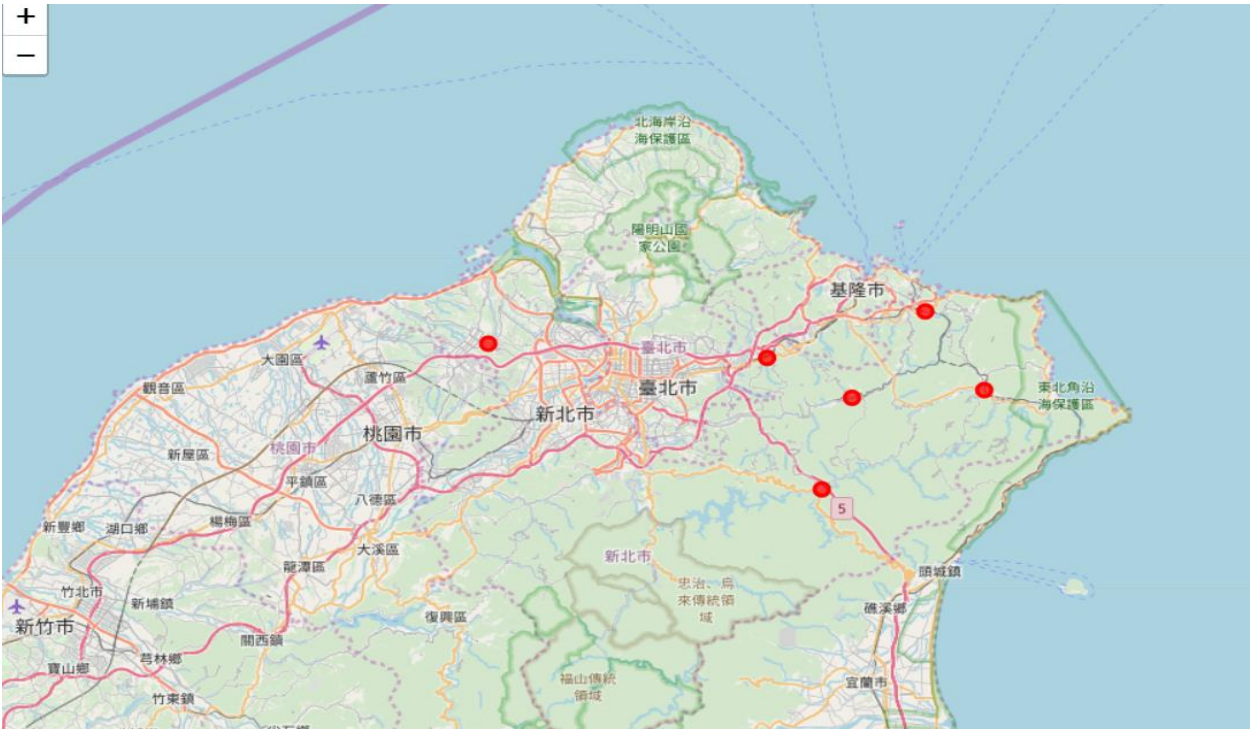Table 1. List of neighborhoods in Cluster 0.

Fig. 3 Neighborhoods in Cluster 0.

4.2 Cluster 1

Cluster 1 has the heart of both cities. All Taipei neighborhoods and most New Taipei City neighborhoods close to Taipei are included. All these neighborhoods are similar to each other to have access to a variety of venues, including restaurants, hotels, convenience stores and department stores.

Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue
Taipei	Zhongzheng	25.047565	121.516946	1	Hotel	Café	Noodle House	Taiwanese Restaurant	Coffee Shop	Ramen Restaurant	Asian Restaurant	Bakery
Taipei	Datong	25.065986	121.515514	1	Taiwanese Restaurant	Hotel	Dessert Shop	Chinese Restaurant	Japanese Restaurant	Hotpot Restaurant	Asian Restaurant	Coffee Shop
Taipei	Zhongshan	25.064361	121.533468	1	Hotel	Chinese Restaurant	Taiwanese Restaurant	Café	Hotpot Restaurant	Dumpling Restaurant	Asian Restaurant	Japanese Restaurant
Taipei	Songshan	25.049885	121.577272	1	Café	Department Store	Noodle House	Hotel	Chinese Restaurant	Park	Taiwanese Restaurant	Hotpot Restaurant
Taipei	Da'an	25.026515	121.534395	1	Café	Chinese Restaurant	Noodle House	Taiwanese Restaurant	Hotel	Bakery	Bubble Tea Shop	Hotpot Restaurant
Taipei	Wanhua	25.031933	121.499332	1	Noodle House	Taiwanese Restaurant	Coffee Shop	Café	Hotel	Hostel	Hotpot Restaurant	Ice Cream Shop
Taipei	Xinyi	25.037520	121.563680	1	Department Store	Café	Hotel	Japanese Restaurant	Dessert Shop	Cocktail Bar	Noodle House	Lounge
Taipei	Shilin	25.091840	121.524207	1	Convenience Store	Café	Coffee Shop	Taiwanese Restaurant	Park	Breakfast Spot	Chinese Restaurant	Noodle House
Taipei	Beitou	25.132419	121.501379	1	Hotel	Hot Spring	Convenience Store	Noodle House	Resort	Park	Café	Japanese Restaurant
Taipei	Neihu	25.069664	121.588998	1	Convenience Store	Coffee Shop	Japanese Restaurant	Café	Italian Restaurant	Noodle House	Bakery	Supermarket
Taipei	Nangang	25.054578	121.606600	1	Convenience Store	Coffee Shop	Fast Food Restaurant	Japanese Restaurant	Noodle House	Breakfast Spot	Café	Park
Taipei	Wenshan	24.989786	121.570458	1	Convenience Store	Coffee Shop	Exhibit	Zoo Exhibit	Café	Breakfast Spot	Farmers Market	Cable Car
New Taipei City	Banqiao	25.009670	121.459099	1	Coffee Shop	Convenience Store	Shopping Mall	Restaurant	Fast Food Restaurant	Asian Restaurant	Chinese Restaurant	Bookstore
New Taipei City	Xinzhuang	25.035772	121.450248	1	Convenience Store	Gym / Fitness Center	Hotpot Restaurant	Park	Café	Coffee Shop	Plaza	Bus Stop
New Taipei City	Zhonghe	24.999397	121.498980	1	Coffee Shop	Convenience Store	Park	Dessert Shop	Japanese Restaurant	Night Market	Noodle House	Taiwanese Restaurant
New Taipei City	Yonghe	25.009235	121.520070	1	Convenience Store	Café	Coffee Shop	Dessert Shop	Park	Taiwanese Restaurant	Bookstore	Chinese Restaurant
New Taipei City	Tucheng	24.972201	121.443348	1	Convenience Store	Chinese Restaurant	Bus Stop	Italian Restaurant	Bubble Tea Shop	Supermarket	Shopping Mall	Café
New Taipei City	Shulin	24.990706	121.420533	1	Basketball Court	Seafood Restaurant	Convenience Store	Train Station	Indoor Play Area	Japanese Restaurant	Food Truck	Night Market
New Taipei City	Sanxia	24.934339	121.368905	1	Japanese Restaurant	Dumpling Restaurant	Convenience Store	Coffee Shop	Fast Food Restaurant	Bakery	Dessert Shop	Dim Sum Restaurant
New Taipei City	Yingge	24.959945	121.353771	1	Chinese Restaurant	Shopping Mall	Art Museum	Food	Train Station	Café	Sushi Restaurant	Convenience Store
New Taipei City	Sanchong	25.061486	121.488102	1	Park	Fast Food Restaurant	Convenience Store	Taiwanese Restaurant	Restaurant	Breakfast Spot	Market	Shopping Mall
New Taipei City	Luzhou	25.084923	121.473700	1	Convenience Store	Shopping Mall	Sushi Restaurant	Japanese Restaurant	Coffee Shop	Bakery	Miscellaneous Shop	Supermarket

New Taipei City	Bali	25.145692	121.403511	1	History Museum	Hotel	Boat or Ferry	Café	Tunnel	Noodle House	Hot Spring	Harbor / Marina	
New Taipei City	Tamsui	25.181304	121.453148	1	Taiwanese Restaurant	Convenience Store	Coffee Shop	Chinese Restaurant	Café	Japanese Restaurant	Fast Food Restaurant	Supermarket	S
New Taipei City	Sanzhi	25.258047	121.500866	1	Italian Restaurant	Café	Chinese Restaurant	Steakhouse	Tourist Information Center	Bakery	German Restaurant	NaN	
New Taipei City	Shimen	25.291300	121.567684	1	Café	Convenience Store	Seafood Restaurant	Hotel	Asian Restaurant	Dim Sum Restaurant	Scenic Lookout	NaN	
New Taipei City	Jinshan	25.221883	121.636427	1	Convenience Store	Dessert Shop	Taiwanese Restaurant	Asian Restaurant	Café	Market	Steakhouse	Surf Spot	
New Taipei City	Xindian	24.964748	121.539697	1	Convenience Store	Chinese Restaurant	Fast Food Restaurant	Coffee Shop	Noodle House	Café	Dumpling Restaurant	Lake	
New Taipei City	Shenkeng	25.002329	121.615670	1	Dessert Shop	Café	Bus Stop	Bakery	Chinese Restaurant	Food Truck	Dumpling Restaurant	Convenience Store	
New Taipei City	Shiding	24.991679	121.658567	1	Convenience Store	Chinese Restaurant	Mountain	Asian Restaurant	Dessert Shop	Trail	NaN	NaN	
New Taipei City	Wulai	24.865296	121.550531	1	Hotel	Trail	Resort	Waterfall	Museum	Platform	Cable Car	Hot Spring	Tr

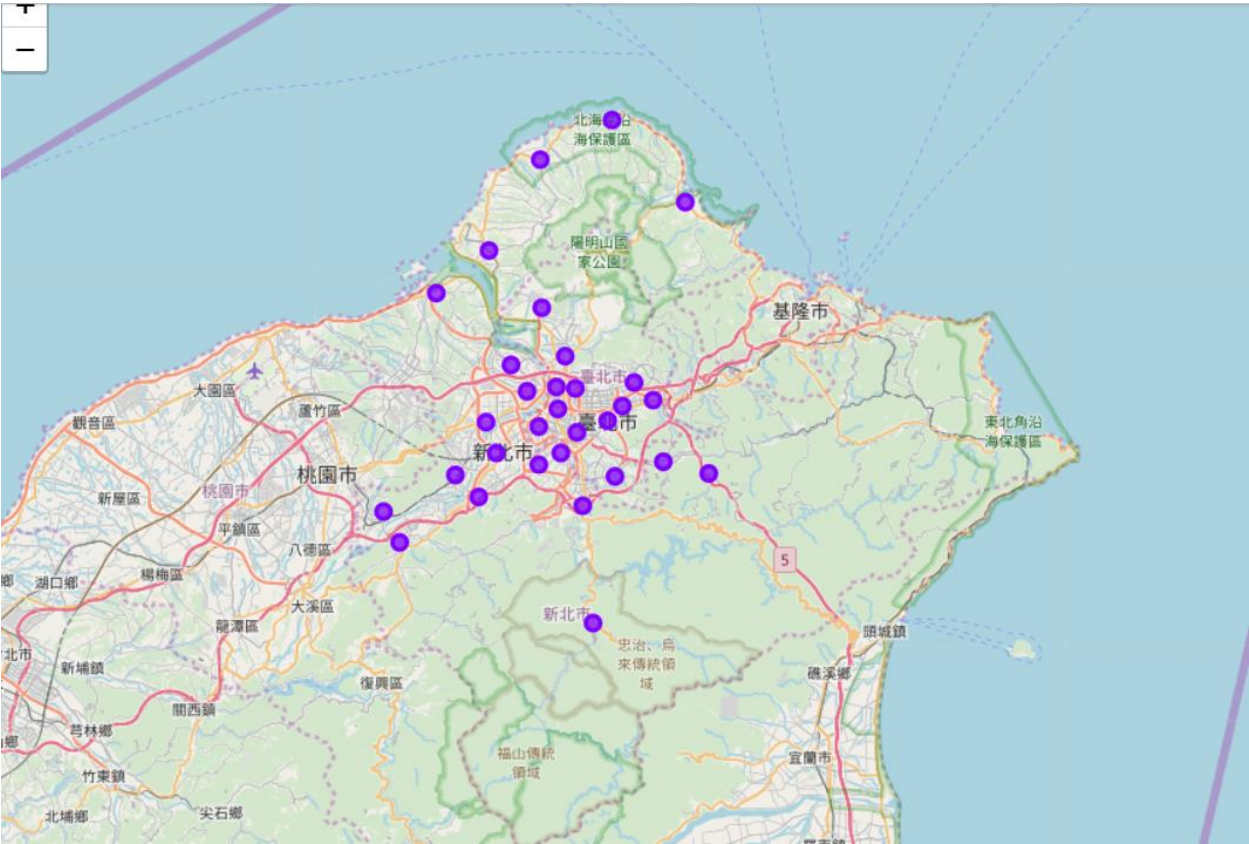Table 2. List of neighborhoods in Cluster 1.

Fig. 4 Neighborhoods in Cluster 1.

4.3 Cluster 2

Cluster 2 contains only one far outside neighborhood of New Taipei City. The Foursquare only returned two categories (train station and campground) of venues for it.

Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
New Taipei City	Gongliao	25.022043	121.910082	2	Train Station	Campground	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

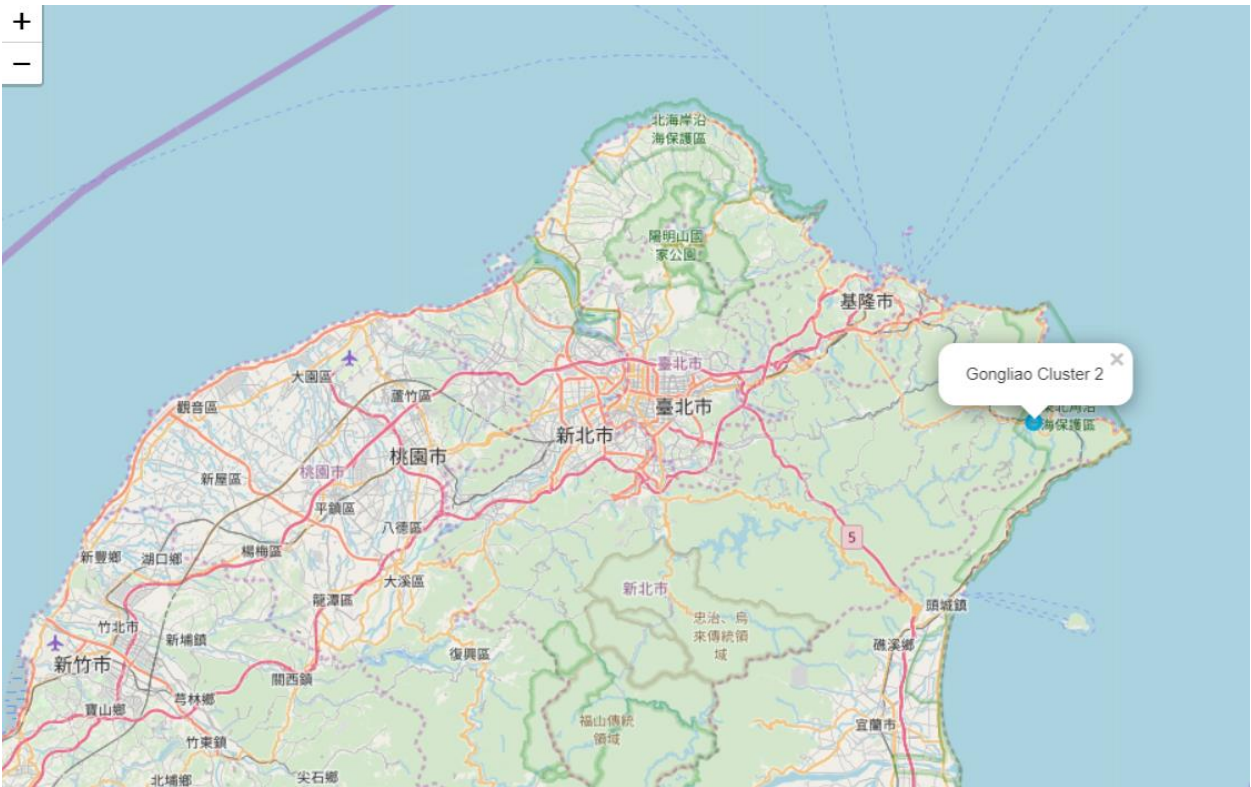Table 3. List of neighborhoods in Cluster 2.

Fig. 5 Neighborhoods in Cluster 2.

4.4 Cluster 3

Cluster 3 includes two close to center mountain neighborhoods of New Taipei City. Both neighborhoods are similar to have top access to bakeries, convenience stores.

Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	Con V
New Taipei City	Wugu	25.082743	121.438156	3	Bakery	Convenience Store	Baseball Field	Fast Food Restaurant	Lake	NaN	NaN	NaN	NaN	
New Taipei City	Taishan	25.058864	121.430811	3	Convenience Store	Bakery	Market	Mountain	Dessert Shop	Burger Joint	NaN	NaN	NaN	

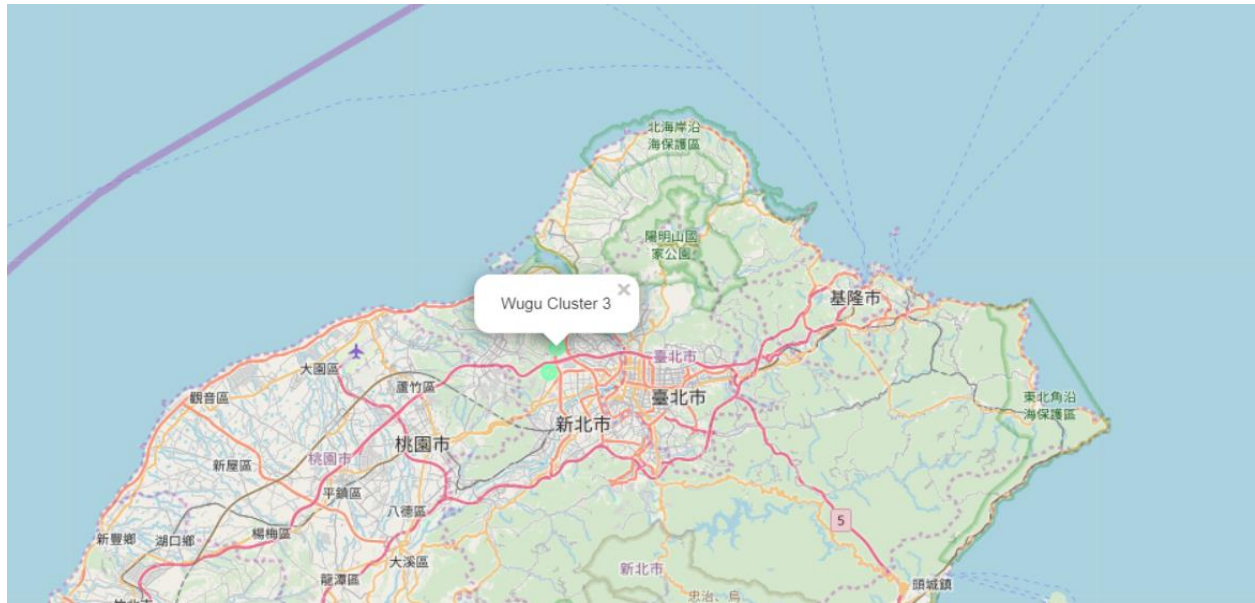Table 4. List of neighborhoods in Cluster 3.

Fig. 6 Neighborhoods in Cluster 3.

4.5 Cluster 4

Cluster 4 includes only one neighborhood of New Taipei City. It is close to the seashore and has access to seafood restaurants, beaches, harbor/marina, and resorts etc.

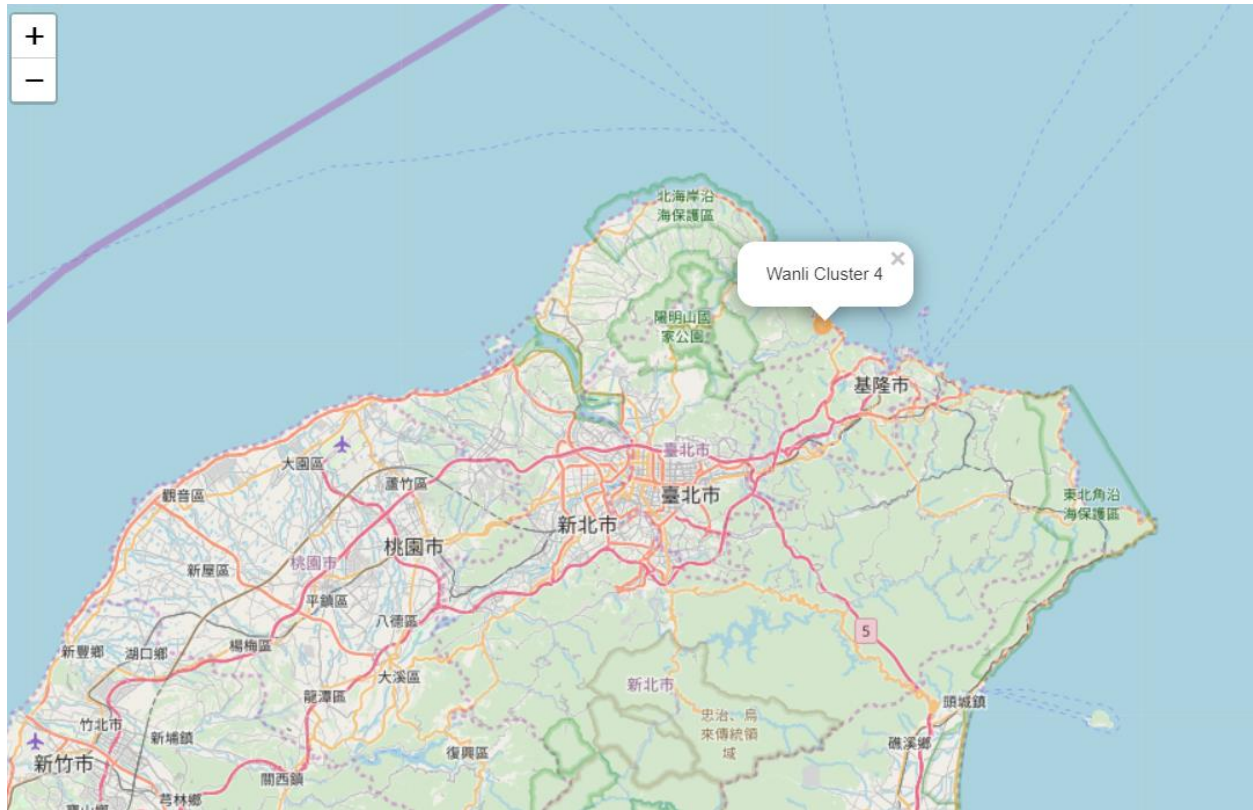| Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
New Taipei City	Wanli	25.181234	121.688687	4	Seafood Restaurant	Beach	Harbor / Marina	Resort	Bakery	Park	Market	NaN	NaN	NaN

Table 5. List of neighborhoods in Cluster 4.

Fig. 7 Neighborhoods in Cluster 4.

5. Discussion

Overall, the results are not surprising. All Taipei neighborhoods and the New Taipei City neighborhoods surrounding Taipei are much similar than other New Taipei City mountain neighborhoods.

For those blue-collar job seekers, neighborhoods in cluster 1 will be a good consideration. These neighborhoods located in city center, has a good choice of restaurants and supermarkets.

For a Japanese restaurant looking to expand its locations might perhaps select neighborhoods in cluster 0 because there are not many Japanese restaurants there in these districts.

6. Conclusion

I believe the limitation on the Foursquare API has its effect on the result of the neighborhood clustering. If more venues can be returned then the feature of each neighborhood will be highlighted and in return the effectiveness of the result will be improved.