The Battle of Neighborhoods

Capstone Project

Shannon Wang

30 June 2019

CONTENTS

1. **Introduction: Business Problem** 2
2. **Data** 2
3. **Methodology** 6
4. **Analysis** 6
5. **Results and Discussion** 13
6. **Conclusion** 14

1. Introduction: Business Problem

In this project we will try to find an optimal location for a restaurant. Specifically, this report will be targeted to stakeholders interested in opening an **Italian restaurant** in **Taipei, Taiwan**.

Since there are lots of restaurants in Taipei, we will try to detect locations that are not already crowded with restaurants. We are also particularly interested in areas with no Italian restaurants in vicinity. We would also prefer locations as close to city center as possible, assuming that first two conditions are met.

We will use our data science powers to generate a few most available neighborhoods based on these criteria. Advantages of each area will then be clearly expressed so that best possible final location can be chosen by stakeholders.

2. Data

Based on definition of our problem, factors that will influence our decision are:

- The number of existing restaurants in the neighborhood (any type of restaurant).
- The number of and distance to Italian restaurants in the neighborhood, if any.
- distance of neighborhood from city center.

We decided to use regularly spaced grid of locations, centered around city center, to define our neighborhoods.

Following data sources will be needed to extract/generate the required information:

- The centers of candidate areas will be generated algorithmically and approximate addresses of centers of those areas will be obtained using **Google Maps API reverse geocoding**.
- The number of restaurants and their type and location in every neighborhood will be obtained using **Foursquare API**.
- The coordinate of Taipei center will be obtained using **Google Maps API geocoding** of well-known Taipei location (Taipei Main Station).

Neighborhood Candidates

Let's create latitude & longitude coordinates for centroids of our candidate neighborhoods. We will create a grid of cells covering our area of interest which is approximate 12x12 kilometers centered around Taipei city center.

We first find the latitude & longitude of Taipei city center, using specific, well-known address and Google Maps geocoding API and get the result as below:

```
Coordinate of Taipei Main Station, Taipei, Taiwan: [25.0471778,
121.5172047]
```

Now let's create a grid of area candidates, equally spaced, centered around city center and within ~6km from Taipei Main Station. Our neighborhoods will be defined as circular areas with a radius of 300 meters, so our neighborhood centers will be 600 meters apart.

To accurately calculate distances, we need to create our grid of locations in Cartesian 2D coordinate system which allows us to calculate distances in meters (not in latitude/longitude degrees). Then we'll project those coordinates back to latitude/longitude degrees to be shown on Folium map. So let's create functions to convert between WGS84 spherical coordinate system (latitude/longitude degrees) and UTM Cartesian coordinate system (X/Y coordinates in meters).

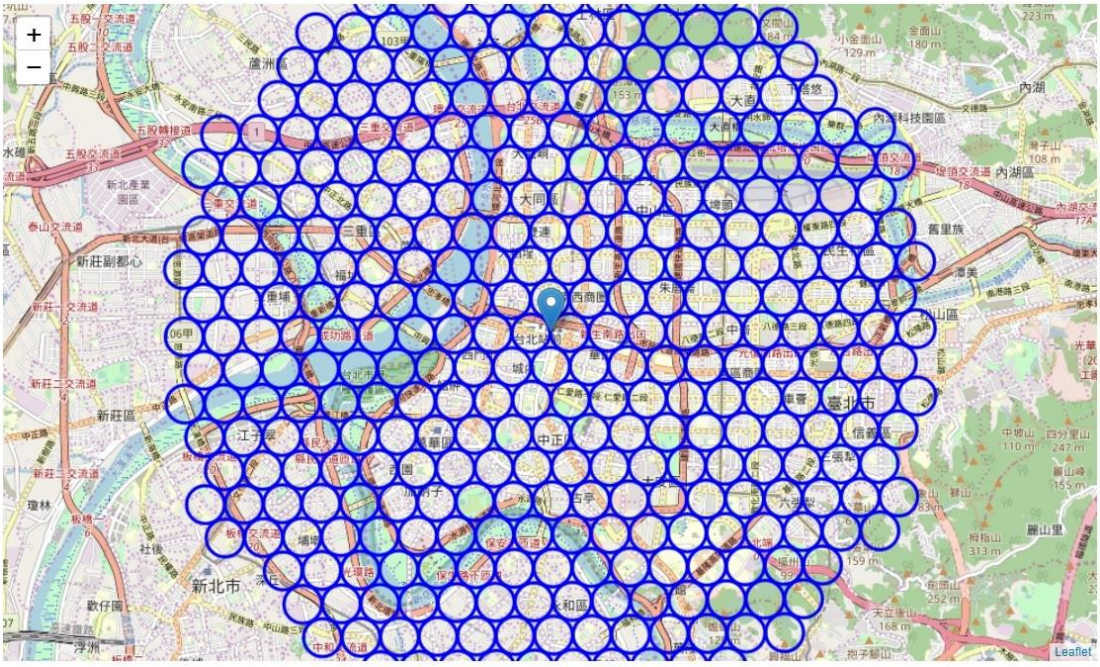
```
Coordinate transformation check
-------------------------------
Taipei center longitude=121.5172047, latitude=25.0471778
Taipei center UTM X=350417.95463453245, Y=2770991.266804541
Taipei center longitude=121.5172047, latitude=25.047177799999993
```

Let's create a **hexagonal grid of cells**: we offset every other row, and adjust vertical row spacing so that **every cell center is equally distant from all its neighbors**.

```
364 candidate neighborhood centers generated.
```

Let's visualize the data we have so far: Taipei center location and candidate neighborhood centers:

Out[6]:



OK, we now have the coordinates of centers of neighborhoods/areas to be evaluated, equally spaced (distance from every point to its neighbors is exactly the same) and within ~6km from Taipei Main Station.

Let's now use Google Maps API to get approximate addresses of those locations.

```
Reverse geocoding check
-----------------------
```

```
Address of [25.0471778, 121.5172047] is: Taipei station, No. 3,
Beiping West Road, Zhongzheng District, Taipei City, Taiwan 100
```

Looking good. Let's now place all this into a Pandas dataframe.

	Address	Latitude	Longitude	X	Y	Distance from center
0	No. 2, Lane 121, Yuantong Road, Zhonghe Distri...	24.995397	121.499994	348617.954635	2.765275e+06	5992.495307
1	No. 8, Mingren Street, Zhonghe District, New T...	24.995457	121.505937	349217.954635	2.765275e+06	5840.376700
2	No. 4, Alley 6, Lane 106, Baojian Road, Zhongh...	24.995516	121.511881	349817.954635	2.765275e+06	5747.173218
3	No. 98, Dayong Street, Zhonghe District, New T...	24.995576	121.517825	350417.954635	2.765275e+06	5715.767665
4	No. 12, Lane 15, Zili Road, Zhonghe District, ...	24.995635	121.523768	351017.954635	2.765275e+06	5747.173218
5	No. 127, Section 4, Huanhe East Road, Yonghe D...	24.995694	121.529712	351617.954635	2.765275e+06	5840.376700
6	No. 124, Jingfu Street, Wenshan District, Taip...	24.995752	121.535656	352217.954635	2.765275e+06	5992.495307
7	No. 213, Jianba Road, Zhonghe District, New Ta...	24.999998	121.491021	347717.954635	2.765795e+06	5855.766389
8	No. 87號, Liancheng Road, Zhonghe District, New...	25.000058	121.496965	348317.954635	2.765795e+06	5604.462508
9	No. 167, Lane 165, Zhonghe Road, Zhonghe Distr...	25.000118	121.502909	348917.954635	2.765795e+06	5408.326913

Foursquare

Now that we have our location candidates, let's use Foursquare API to get info on restaurants in each neighborhood.

We're interested in venues in 'food' category, but only those that are proper restaurants - coffee shops, pizza places, bakeries etc. are not direct competitors so we don't care about those. So we will include in out list only venues that have 'restaurant' in category name, and we'll make sure to detect and include all the subcategories of specific 'Italian restaurant' category, as we need info on Italian restaurants in the neighborhood.

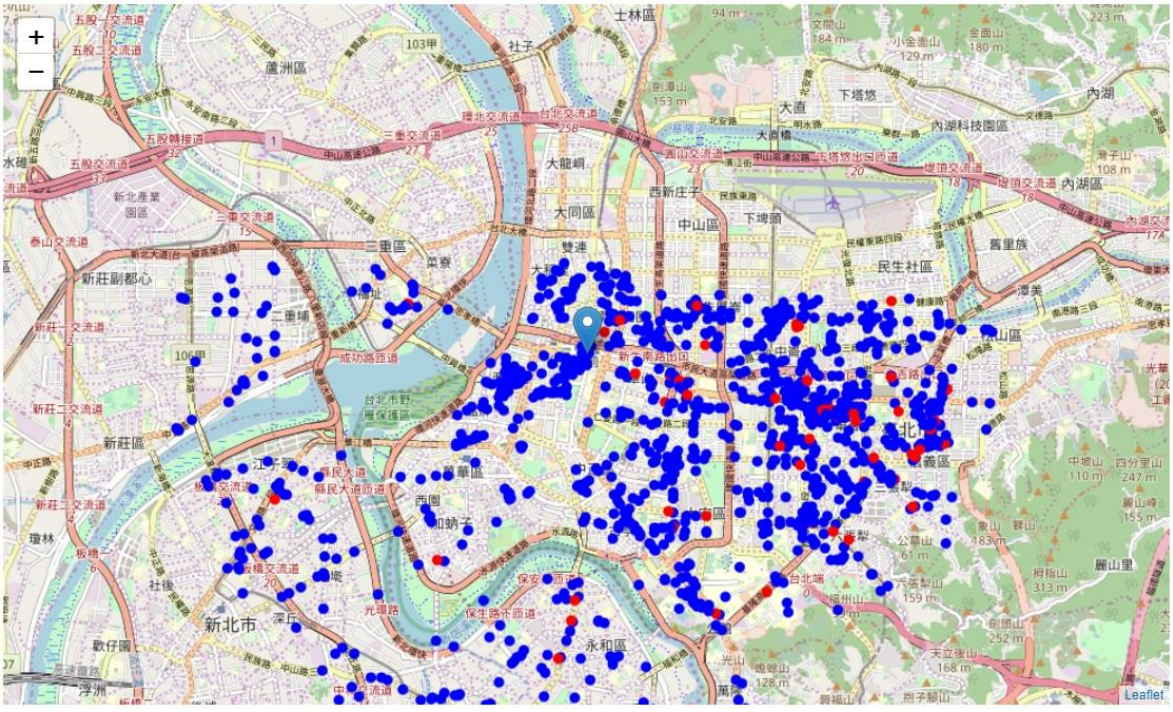
```
Total number of restaurants: 1262
Total number of Italian restaurants: 61
Percentage of Italian restaurants: 4.83%
Average number of restaurants in neighborhood: 2.961538461538461
7
```

```
List of all restaurants
-----------------------
('4edb48c34901c8be1ea30507', '泰國菜', 24.994249713881725, 121.49975390265546, '臺灣', 129, False, 348592.35389252775, 2765148.7
080648555)
('4bee90763686c9b672a0246e', '五花馬水餃館', 24.998199, 121.5000937, '235台湾國台北縣中和市景平路495號, 中和市,  235, 臺灣', 312, Fa
lse, 348631.49148220033, 2765585.7241906556)
('4d20144b5acaa35db20fc535', '炒翻天餐飲店', 24.996419723832847, 121.50307782549402, '新北市中和區南華路36號, 235, 臺灣', 331, Fals
e, 348930.51367471134, 2765385.3344932194)
('563ec56ccd108d4763aa127b', '港麗港式茶餐廳', 24.994414, 121.504985, '臺灣', 150, False, 349120.56439614156, 2765161.0704014087)
('4e1691dfd4c0c7a8fbb3b1e9', '鬍鬚張', 24.994702679542083, 121.50530301538814, '景安路128號, 臺灣省, 臺灣省, 臺灣', 105, False, 34
9153.0162619776, 2765192.688555303)
('4f78466de4b067aa304e749e', 'sushi take-out (爭鮮外帶)', 24.99380714640073, 121.50484013482638, '臺灣', 214, False, 349105.2009
737861, 2765094.0208590967)
('4d42c1d57fb05481251e6e79', '大埔鐵板燒', 24.997524, 121.506586, '景安路52號, 新北市, 臺灣', 239, False, 349285.95822893595, 2765
503.7307358477)
('4ca9cca2ae1eef3b374e3347', '中和宜安路蚵仔麵線', 24.998046972669197, 121.51016306409778, '宜安路117號, New Taipei City,  235, 臺
灣', 271, False, 349647.641754313, 2765557.6785066705)
('535ca7eb498e3de23645cf6f', '銃鐵', 24.995563563065915, 121.51393009827592, '永和區中正路90號 (宜安路), 臺灣省, 臺灣省, 臺灣', 20
6, False, 350024.84589624556, 2765278.460673706)
('4d31851bf8c9224bc9aba7d2', '霸味薑母鴨', 24.992458920160722, 121.51221811724142, '235台湾台北縣中和市景平路171號 (安樂路), 中和
市,  235, 臺灣', 342, False, 349848.27311854804, 2764936.5085371225)
...
Total: 1262
```

```
List of Italian restaurants
---------------------------
('4daefce70f2ca3443cc7e26d', '海盜船義式料理', 25.007450566901777, 121.51305913925171, '永和路一段65巷5-1號，臺灣省，臺灣省，臺
灣', 291, True, 349951.3787680799, 2766595.9428502657)
('552e6362498e772579f25a35', 'Saizeriya 薩莉亞', 25.012303054526733, 121.51497288853705, '永和路二段121號（頂溪店），臺灣', 348,
True, 350150.415348767, 2767131.2513037426)
('518a4bff498ea1a34ff8934a', '嵐迪義大利麵館 Landi Pasta', 25.01502978967108, 121.51544130460657, '臺灣', 230, True, 350200.997
9794085, 2767432.7268443564)
('5249019a498e6a3375bbfbe7', 'Just Italian (義饗食堂)', 25.0132398443613, 121.53599366193363, '羅斯福路四段83號二樓，台北市，臺
灣', 152, True, 352272.9798533323, 2767211.913861379)
('53d3a127498e45540f53ad2c', '紅蔥 Shallot', 25.016149, 121.543215, '基隆路三段137號，台北市，臺灣', 255, True, 353005.22277695
93, 2767526.2525170096)
('5749643c498e3b6d1149ca5c', '義式傳奇', 25.02027, 121.49562, '萬華區台北市萬華區萬大路486巷59弄4號，台北市， 108，臺灣', 196, Tr
ue, 348207.08491504844, 2768035.1667253007)
('534690a4498e30a8bf88a312', '薩莉亞 Saizeriya', 25.026680921778592, 121.52911907696742, '和平東路一段129-1號，台北市，臺灣', 34
5, True, 351595.3609761123, 2768708.0613643606)
('4cfb94f4feec6dcb4a724736', '米克諾斯簡餐 Mykonos', 25.024695832067795, 121.5297549539281, '泰順街26巷32號，台北市， 106，臺
灣', 102, True, 351657.1398775263, 2768487.510789399)
('4c3d432b4bc9a5934fdfd371', 'Amigo', 25.026089497322417, 121.5344663016568, '和平東路一段199巷2號，大安區，臺北市，臺灣', 258,
True, 352134.23690207175, 2768636.7090610736)
```

```
Restaurants around location
---------------------------
Restaurants around location 101:
Restaurants around location 102:
Restaurants around location 103:
Restaurants around location 104: 新東南海鮮餐廳，山內雞肉，臭老闆蒸臭豆腐，來來水餃館，秀昌水餃牛肉麵，林家豬腸冬粉，蒸臭豆腐
Restaurants around location 105: 秘魯烤雞 Polleria, Ebisu Curry & Coffee，蔡萬興寧波餐廳，黃龍莊，四海包子店，牯嶺由飯
Restaurants around location 106: 晉江茶堂，蘇杭點心店，樂埔町 Leputing，TGI Fridays (星期五美式餐廳)，Buffalo 水牛城美式碳烤牛排，Su
kiya (すき家 Sukiya)
Restaurants around location 107: 台北月見ル君想フ，游壽司，全國素食自助餐，台電勵進餐廳 Taipower Restaurant，林記燈籠牛肉麵
Restaurants around location 108: 鴻疆石，大隱酒食 James Kitchen，初魚料亭
Restaurants around location 109: 樂子 The Diner，要性子 Xai Xing Dé，Teotihuacán，日日香小館，Ruei An Taiwan Buffet (瑞安自助餐)，
上鼎豐小籠湯包
Restaurants around location 110: 禾豐涮涮鍋，小李子清粥小菜，一流清粥小菜，七里亭，爭鮮迴轉壽司 Sushi Express 科技店，角屋關東煮，無名
子清粥小菜
```

Let's now see all the collected restaurants in our area of interest on map, and let's also show Italian restaurants in different color.



Looking good. So now we have all the restaurants in area within few kilometers from Taipei Main Station, and we know which ones are Italian restaurants! We also know which restaurants exactly are in vicinity of every neighborhood candidate center.

This concludes the data gathering phase - we're now ready to use this data for analysis to produce the report on optimal locations for a new Italian restaurant!

3. Methodology

In this project we will direct our efforts on detecting areas of Taipei that have low restaurant density, particularly those with low number of Italian restaurants. We will limit our analysis to area ~6km around city center.

In first step we have collected the required **data: location and type (category) of every restaurant within 6km from city center** (Taipei Main Station). We have also **identified Italian restaurants** (according to Foursquare categorization).

Second step in our analysis will be calculation and exploration of '**restaurant density**' across different areas of Taipei - we will use **heatmaps** to identify a few promising areas close to center with low number of restaurants in general (*and* no Italian restaurants in vicinity) and focus our attention on those areas.

In third and final step we will focus on most promising areas and within those create **clusters of locations that meet some basic requirements** established in discussion with stakeholders: we will take into consideration locations with **no more than two restaurants in radius of 250 meters**, and we want locations **without Italian restaurants in radius of 400 meters**. We will present map of all such locations but also create clusters (using **k-means clustering**) of those locations to identify general zones / neighborhoods / addresses which should be a starting point for final 'street level' exploration and search for optimal venue location by stakeholders.

4. Analysis

We perform some basic explanatory data analysis and derive some additional info from our raw data. First, we count the **number of restaurants in every area candidate**:

```
Average number of restaurants in every area with radius=300m: 2.92032967032967
```

	Address	Latitude	Longitude	X	Y	Distance from center	Restaurants in area
0	No. 2, Lane 121, Yuantong Road, Zhonghe Distri...	24.995397	121.499994	348617.954635	2.765275e+06	5992.495307	1
1	No. 8, Mingren Street, Zhonghe District, New T...	24.995457	121.505937	349217.954635	2.765275e+06	5840.376700	4
2	No. 4, Alley 6, Lane 106, Baojian Road, Zhongh...	24.995516	121.511881	349817.954635	2.765275e+06	5747.173218	1
3	No. 98, Dayong Street, Zhonghe District, New T...	24.995576	121.517825	350417.954635	2.765275e+06	5715.767665	1
4	No. 12, Lane 15, Zili Road, Zhonghe District, ...	24.995635	121.523768	351017.954635	2.765275e+06	5747.173218	3
5	No. 127, Section 4, Huanhe East Road, Yonghe D...	24.995694	121.529712	351617.954635	2.765275e+06	5840.376700	0
6	No. 124, Jingfu Street, Wenshan District, Taip...	24.995752	121.535656	352217.954635	2.765275e+06	5992.495307	1
7	No. 213, Jianba Road, Zhonghe District, New Ta...	24.999998	121.491021	347717.954635	2.765795e+06	5855.766389	0
8	No. 87號, Liancheng Road, Zhonghe District, New...	25.000058	121.496965	348317.954635	2.765795e+06	5604.462508	2
9	No. 167, Lane 165, Zhonghe Road, Zhonghe Distr...	25.000118	121.502909	348917.954635	2.765795e+06	5408.326913	4

Then, we calculate the **distance to nearest Italian restaurant from every area candidate center** (not only those within 300m - we want distance to closest one, regardless of how distant it is).

	Address	Latitude	Longitude	X	Y	Distance from center	Restaurants in area	Distance to Italian restaurant
0	No. 2, Lane 121, Yuantong Road, Zhonghe Distri...	24.995397	121.499994	348617.954635	2.765275e+06	5992.495307	1	1876.590396
1	No. 8, Mingren Street, Zhonghe District, New T...	24.995457	121.505937	349217.954635	2.765275e+06	5840.376700	4	1510.457730
2	No. 4, Alley 6, Lane 106, Baojian Road, Zhongh...	24.995516	121.511881	349817.954635	2.765275e+06	5747.173218	1	1327.167507
3	No. 98, Dayong Street, Zhonghe District, New T...	24.995576	121.517825	350417.954635	2.765275e+06	5715.767665	1	1400.451582
4	No. 12, Lane 15, Zili Road, Zhonghe District, ...	24.995635	121.523768	351017.954635	2.765275e+06	5747.173218	3	1697.396734
5	No. 127, Section 4, Huanhe East Road, Yonghe D...	24.995694	121.529712	351617.954635	2.765275e+06	5840.376700	0	2044.201559
6	No. 124, Jingfu Street, Wenshan District, Taip...	24.995752	121.535656	352217.954635	2.765275e+06	5992.495307	1	1937.196363
7	No. 213, Jianba Road, Zhonghe District, New Ta...	24.999998	121.491021	347717.954635	2.765795e+06	5855.766389	0	2292.832949
8	No. 87號, Liancheng Road, Zhonghe District, New...	25.000058	121.496965	348317.954635	2.765795e+06	5604.462508	2	1819.175812
9	No. 167, Lane 165, Zhonghe Road, Zhonghe Distr...	25.000118	121.502909	348917.954635	2.765795e+06	5408.326913	4	1307.398820

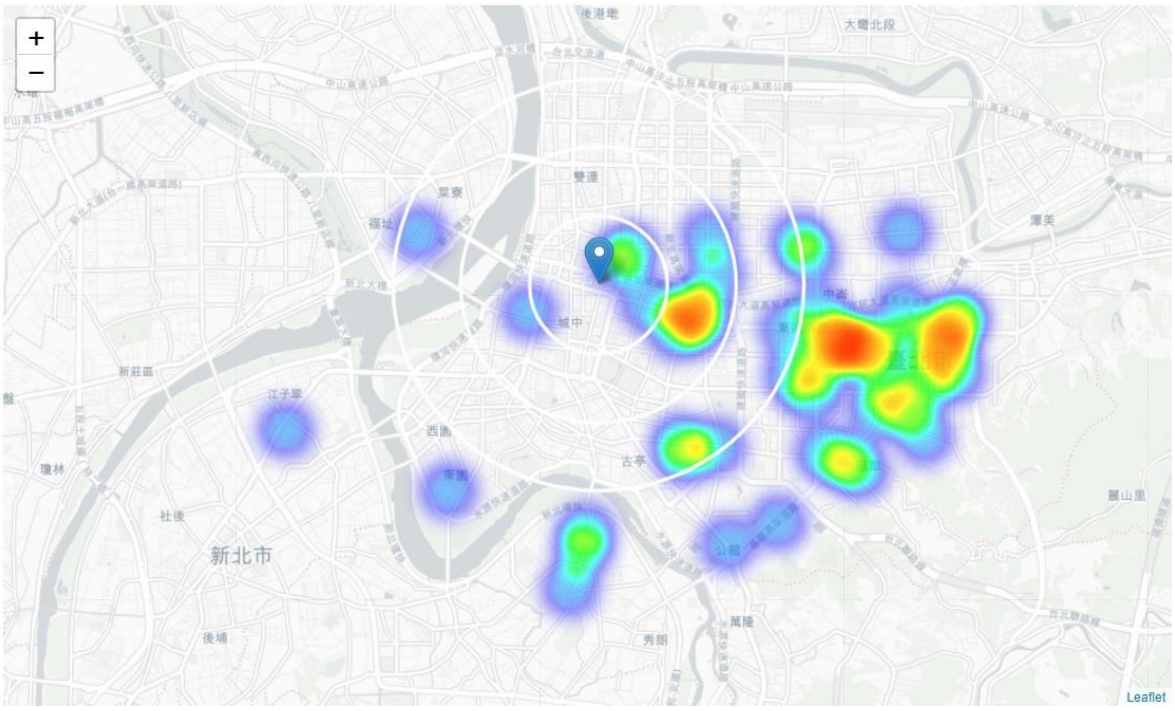
```
Average distance to closest Italian restaurant from each area ce
nter: 1579.2245937379353m
```

On average, **Italian restaurant can be found within ~1.6km** from every area center candidate. That's not close, so we need to filter our areas carefully!

After that, Let's create a map showing **heatmap / density of restaurants** and try to extract some meaningful info from that. Also, let's show **borders of Taipei boroughs** on our map and a few circles indicating distance of 1km, 2km and 3km from Taipei Main Station.

We are going to find a few pockets of low restaurant density closest to city center in the **south, south-east and east from Taipei Main Station**.

Let's create another heatmap map showing **heatmap/density of Italian restaurants** only.



This map is not so 'hot'. Italian restaurants represent a subset of ~5% of all restaurants in Taipei. But it also indicates higher density of existing Italian restaurants southeast from Taipei Main Station.

Based on this we will now focus our analysis on areas *south-east from Taipei center* - we will move the center of our area of interest and reduce its size to have a radius of **2km**. This places our location candidates mostly in **the Eastern District of Taipei**.

The Eastern District of Taipei

The Eastern District of Taipei (Chinese: 臺北東區) refers to the newly developed area in eastern Taipei, Taiwan. In its broadest sense, the Eastern District of Taipei is the whole region east of Fuxing South Road. In general, however, the Eastern District refers to the area between Civic Boulevard and Xinyi Road, including most part of Daan District, Xinyi District and Songshan District, the administrative districts in eastern Taipei.
With a plethora of business buildings, department stores and shopping districts, the Eastern District has now become one of the most cosmopolitan parts of Taipei. Taipei City Hall, Taipei 101 and Daan Forest Park are all located in this district.

Not bad - this nicely covers all the pockets of high restaurant density in the Eastern District closest to Taipei center.

Let's also create new and more dense grid of location candidates restricted to our new region of interest (let's make our location candidates 100m apart). There are 1369 candidate neighborhood centers be generated.

We calculate two most important things for each location candidate: **number of restaurants in vicinity** (we'll use radius of **250 meters**) and **distance to closest Italian restaurant**.

	Latitude	Longitude	X	Y	Restaurants nearby	Distance to Italian restaurant
0	25.020589	121.549730	353667.954635	2.768011e+06	5	499.889909
1	25.020598	121.550721	353767.954635	2.768011e+06	5	439.842154
2	25.020608	121.551712	353867.954635	2.768011e+06	6	396.273035
3	25.020617	121.552702	353967.954635	2.768011e+06	10	364.068878
4	25.020627	121.553693	354067.954635	2.768011e+06	10	302.633643
5	25.020637	121.554684	354167.954635	2.768011e+06	10	265.759469
6	25.021336	121.546253	353317.954635	2.768097e+06	1	554.755774
7	25.021346	121.547244	353417.954635	2.768097e+06	2	500.307898
8	25.021356	121.548234	353517.954635	2.768097e+06	6	453.148006
9	25.021366	121.549225	353617.954635	2.768097e+06	6	424.709593

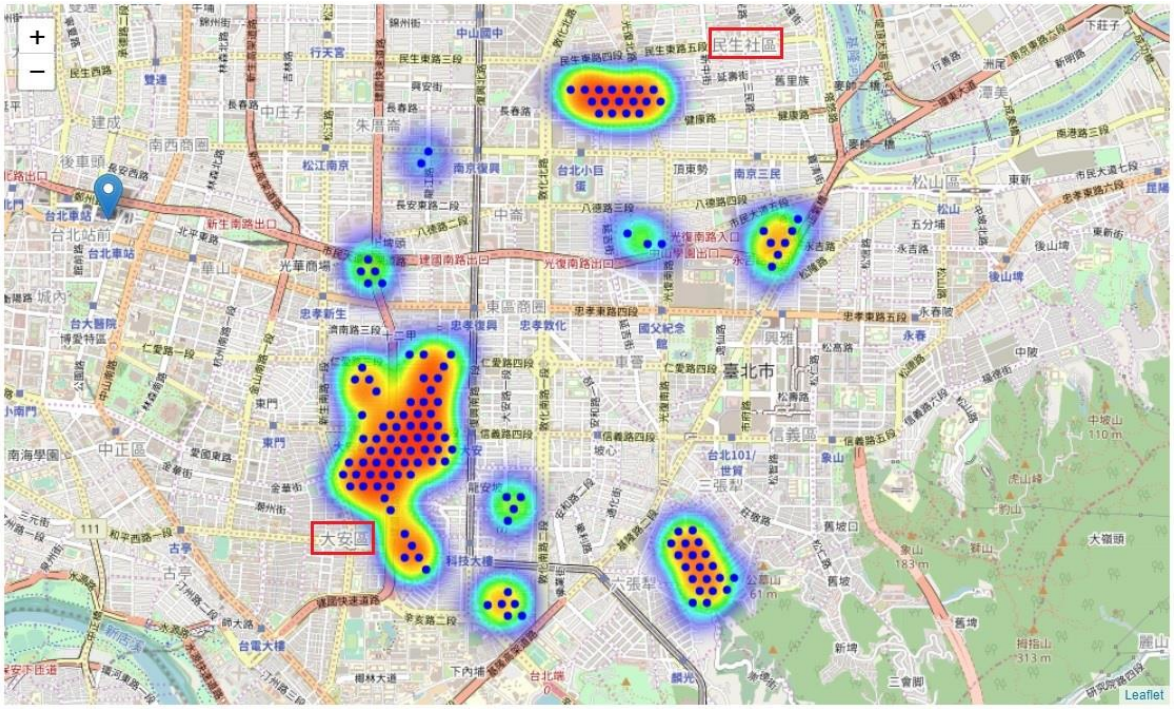
Then we filter those locations: we're interested only in **locations with no more than two restaurants in radius of 250 meters**, and **no Italian restaurants in radius of 400 meters**.

```
Locations with no more than two restaurants nearby: 211
Locations with no Italian restaurants within 400m: 519
Locations with both conditions met: 127
```

Let's see how this looks on a map.

Looks good. We now have a bunch of locations fairly close to the Eastern District of Taipei, and we know that each of those locations has no more than two restaurants in radius of 250m, and no Italian restaurant closer than 400m. Any of those locations is a potential candidate for a new Italian restaurant, at least based on nearby competition.

Let's now show those good locations in a form of heatmap:



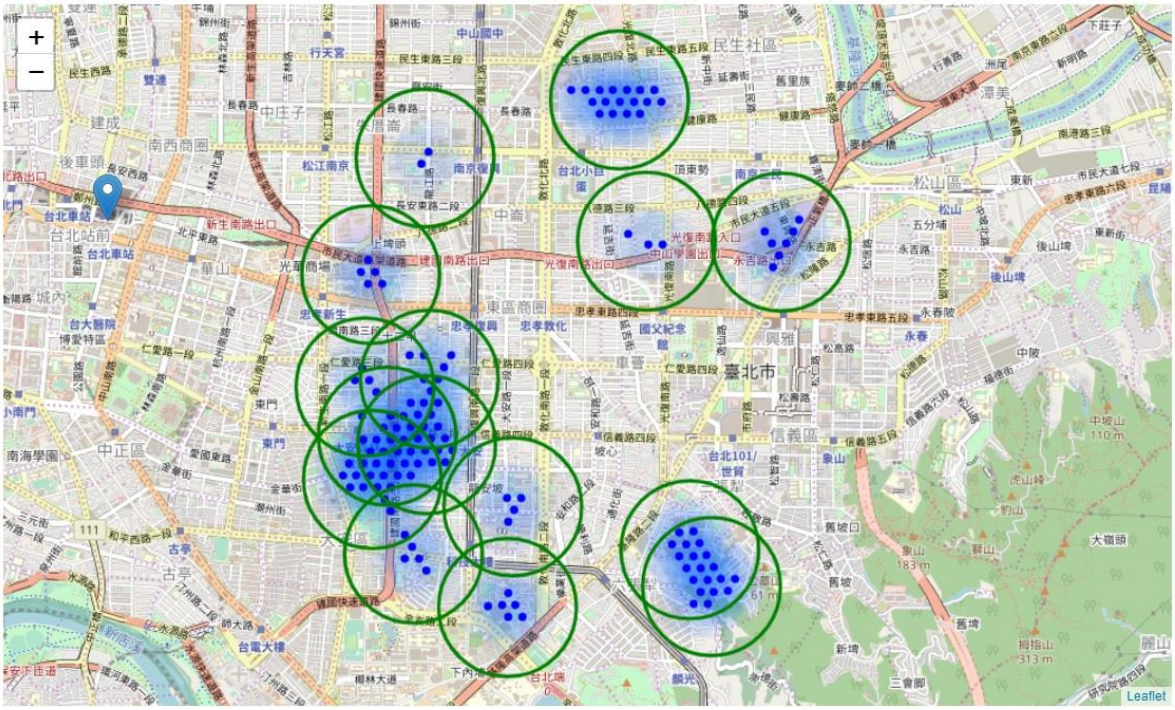
Looking good. What we have now is a clear indication of zones with low number of restaurants in vicinity, and *no* Italian restaurants at all nearby.

Let us now **cluster** those locations to create **centers of zones containing good locations**.

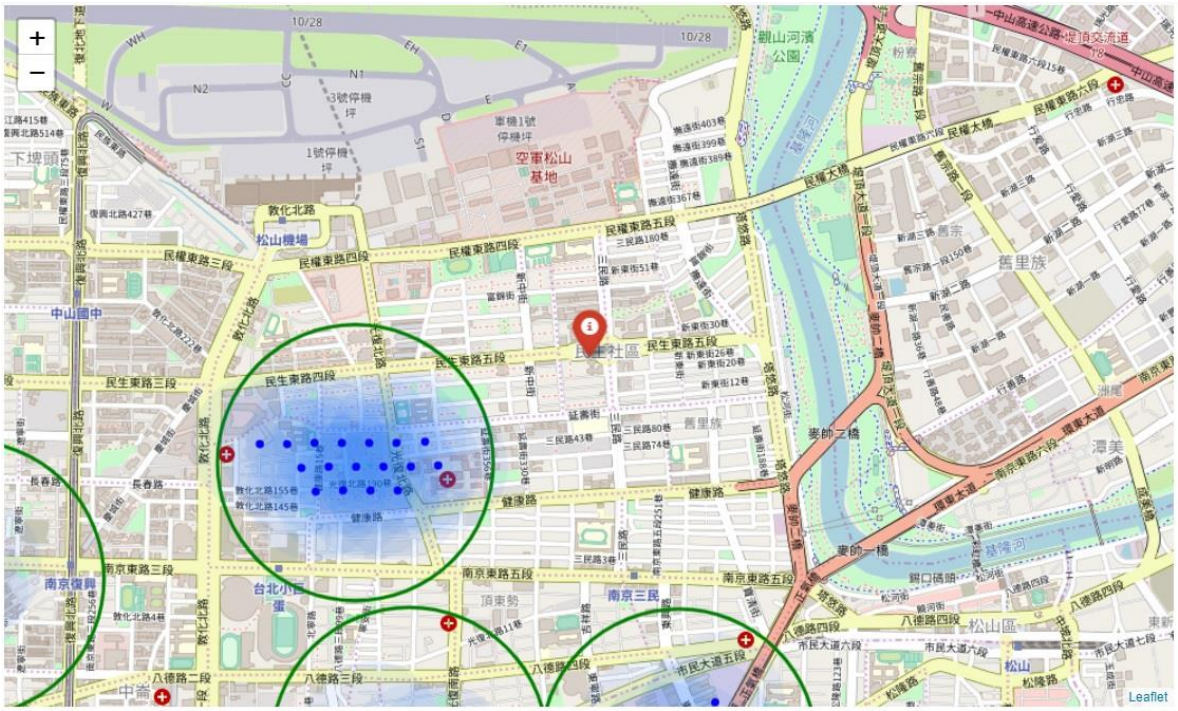
Those zones, their centers and addresses will be the final result of our analysis.

Not bad - our clusters represent groupings of most of the candidate locations and cluster centers are placed nicely in the middle of the zones 'rich' with location candidates. Addresses of those cluster centers will be a good starting point for exploring the neighborhoods to find the best possible location based on neighborhood specifics.

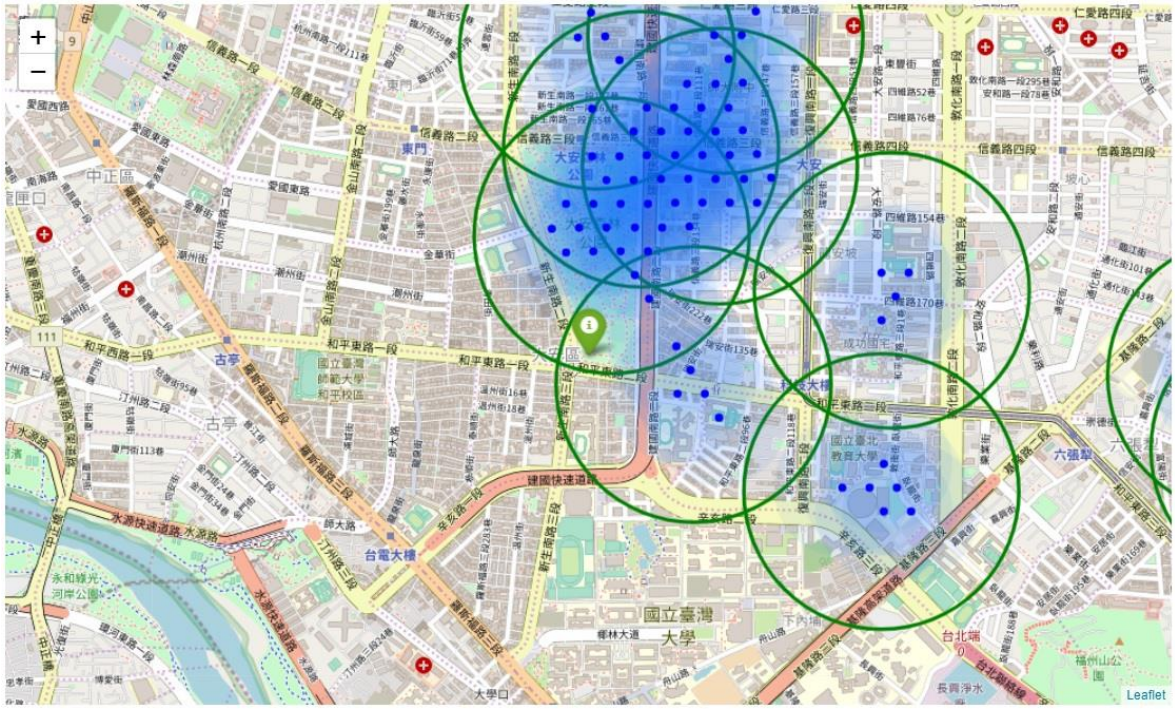
Let's see those zones on a city map without heatmap, using shaded areas to indicate our clusters:



Let's zoom in on candidate areas in **Minsheng Community (Chinese:民生社區)**:



...and candidate areas in **Daan District (Chinese:大安區)**:

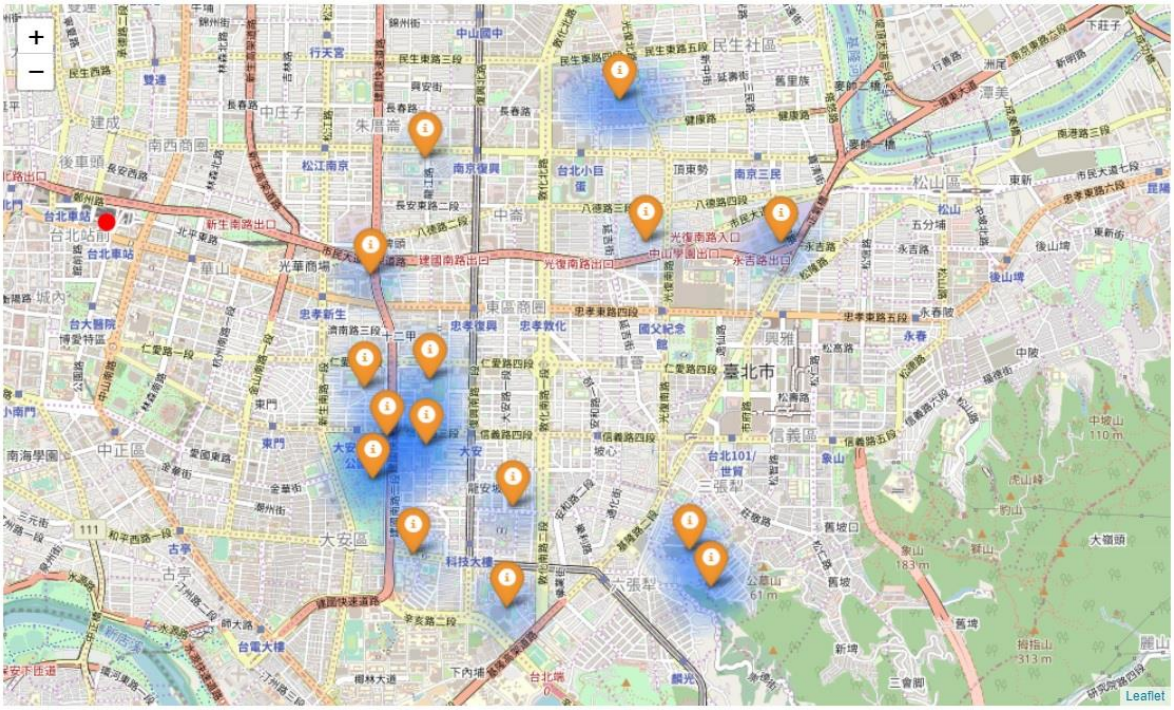


Finally, let's **reverse geocode those candidate area centers to get the addresses** which can be presented to stakeholders.

```
============================================================
Addresses of centers of areas recommended for further analysis
============================================================

105, Taipei City, Songshan District, 5F, No 331 Fusing N. Rd., Taipei 105 => 3.8km from Taipei Main Station
No. 152-3, Section 3, Xinyi Road, Daan District, Taipei City 106 => 2.8km from Taipei Main Station
No. 11, Alley 201, Lane 103, Xin'an Street, Xinyi District, Taipei City 110 => 4.9km from Taipei Main Station
No. 47, Lane 10, Section 2, Bade Road, Daan District, Taipei City 106 => 2.0km from Taipei Main Station
No. 22, Lane 46, Guangfu South Road, Songshan District, Taipei City 105 => 3.9km from Taipei Main Station
No. 19-3, Lane 56, Wolong Street, Daan District, Taipei City 106 => 4.0km from Taipei Main Station
Daan Forest Park, No. 1號, Section 2, Xinsheng South Road, Daan District, Taipei City 106 => 2.7km from Taipei Main Station
No. 35, Jianguo Elevated Road, Daan District, Taipei City 106 => 2.6km from Taipei Main Station
No. 2, Alley 3, Lane 118, Section 3, Ren'ai Road, Daan District, Taipei City 106 => 2.6km from Taipei Main Station
No. 75, Section 2, Heping East Road, Daan District, Taipei City 106 => 3.3km from Taipei Main Station
110, Taipei City, Xinyi District, 東興路              => 4.9km from Taipei Main Station
No. 7, Lane 141, Section 2, Da'an Road, Daan District, Taipei City 106 => 3.6km from Taipei Main Station
No. 106, Alley 22, Lane 284, Wuxing Street, Xinyi District, Taipei City 110 => 5.1km from Taipei Main Station
No. 36, Lane 270, Section 1, Jianguo South Road, Daan District, Taipei City 106 => 2.2km from Taipei Main Station
No. 1, Lane 76, Longjiang Road, Zhongshan District, Taipei City 10491 => 2.4km from Taipei Main Station
```

This concludes our analysis. We have created 15 addresses representing centers of zones containing locations with low number of restaurants and no Italian restaurants nearby, all zones being fairly close to city center (all less than 4km from Taipei Main Station, and about half of those less than 2km from Taipei Main Station). Although zones are shown on map with a radius of ~500 meters (green circles), their shape is actually very irregular and their centers/addresses should be considered only as a starting point for exploring area neighborhoods in search for potential restaurant locations. Most of the zones are located in Daan District, which we have identified as interesting due to being popular with tourists, fairly close to city center and well connected by public transport.



5. Results and Discussion

Our analysis shows that although there is a great number of restaurants in Taipei (~2000 in our initial area of interest which was 12x12km around **Taipei Main Station**), there are pockets of low restaurant density fairly close to city center. Highest concentration of restaurants was detected south and east from Taipei Main Station, so we focused our attention to areas south, south-east and east, corresponding to **the Eastern District of**

Taipei.
Another borough was identified as potentially interesting (**Minsheng Community**, north-east from Taipei Main Station), but our attention was focused on **Daan District** which offer a combination of popularity among tourists, closeness to city center, strong socio-economic dynamics *and* a number of pockets of low restaurant density.

After directing our attention to this smaller area of interest (covering approx. 5x5km south-east from Taipei Main Station) we first created a dense grid of location candidates (spaced 100m apart); those locations were then filtered so that those with more than two restaurants in radius of 250m and those with an Italian restaurant closer than 400m were removed.

Those location candidates were then clustered to create zones of interest which contain greatest number of location candidates. Addresses of centers of those zones were also generated using reverse geocoding to be used as markers/starting points for more detailed local analysis based on other factors.

Result of all this is 15 zones containing largest number of potential new restaurant locations based on number of and distance to existing venues - both restaurants in general and Italian restaurants particularly. This, of course, does not imply that those zones are actually optimal locations for a new restaurant! Purpose of this analysis was to only provide info on areas close to Taipei center but not crowded with existing restaurants (particularly Italian) - it is entirely possible that there is a very good reason for small number of restaurants in any of those areas, reasons which would make them unsuitable for a new restaurant regardless of lack of competition in the area. Recommended zones should therefore be considered only as a starting point for more detailed analysis which could eventually result in location which has not only no nearby competition but also other factors taken into account and all other relevant conditions met.

6. Conclusion

Purpose of this project was to identify Taipei areas close to center with low number of restaurants (particularly Italian restaurants) in order to aid stakeholders in narrowing down the search for optimal location for a new Italian restaurant. By calculating restaurant density distribution from Foursquare data we have first identified general boroughs that justify further analysis (The Eastern District of Taipei), and then generated extensive collection of locations which satisfy some basic requirements regarding existing nearby restaurants. Clustering of those locations was then performed in order to create major zones of interest (containing greatest number of potential locations) and addresses of those zone centers were created to be used as starting points for final exploration by stakeholders.

The final decision on optimal restaurant location will be made by stakeholders based on specific characteristics of neighborhoods and locations in every recommended zone, taking into consideration additional factors like attractiveness of each location (proximity to park or water), levels of noise / proximity to major roads, real estate availability, prices,

social and economic dynamics of every neighborhood etc.