Capstone Project – Green Tea Restaurant Relocation

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I. Introduction & Business Problem

Green Tea Restaurant has long been recognized as the most authentic northern Chinese food restaurant by Chinese immigrants and international students. The owner, who is also the head chef, came to Edmonton in the early 2000s from Harbin which is one of the sister cities of Edmonton. With over 20 years of experience, he can deliver customers the most authentic northern Chinese tastes, even some innovations occasionally.

However, the business has suffered from low business volume and economy recession in these years. The restaurant locates on the west side of the city. If you look into this, you will find this area appears to be an industrial area with rare public transit connected. It takes about 20-minutes drive to get there from downtown Edmonton. The business volume is significantly affected. Which makes this worse is that the economy is performing poorly and does not have a promising outlook.

Figure 1. Green Tea Restaurant current location[1]

The owner expressed his concerns and said they are considering relocating to downtown, where the customer volume is considerably high. This way, they can survive from the economic recession and have a brighter future.

In this project, we will help the owner to find a better location for his restaurant. Our ideal location would have a low density of any type of restaurant; furthermore, no Chinese restaurant nearby for competition.

II. Data Description

Based on the business problem and background, factors that will influence our decision are:

- number of any existing restaurants in the neighborhood
- number of existing Chinese restaurants in the neighborhood
- distance to Chinese restaurants in the neighborhood
- distance of the neighborhood from downtown center

In this project, we will create regularly spaced grid of locations, centered at Rogers Place at Downtown, Edmonton, to define our neighborhoods. Restaurant information can help us to analyze the situation in each grid so that we can make decisions based on the above criteria. We will need to extract/generate the required information from the following data sources:

- **use Google Maps API Geocoding** to obtain coordinate
- scrap approximate addresses for each center of candidate neighborhood using **Google Maps API Reverse Geocoding**
- scrap neighborhood restaurant information using **Foursquare API**

Neighborhood Candidates

We start with creating a grid of cells covering our area of interest. We want the area to cover 2x2 killometers centered around Rogers Place. The reason behind is that Edmonton has a faily small downtown, a cirucle with a radius of one killometer will cover almost all commercial lands in Downtown. Any larger circle will include more residential lands nearby which will eventually distort our analysis and decision.

We will use self-defined function *get_coordiantes* to obtain coordinates of Rogers Place. You may refer to the .ipynb file for higher level of technical details. After we had the coordiantes, a grid of candidate will be generated algorithmically. Note that we can not use coordinates to calculate the distance between two locations. In order to do so, there is another self-defined function *lonlat_to_utm* to convert long/lat degree to UTM degree which can be used for distance calculation. Each cell has a radius of 500 meters. There is a second marker on the map, despite the Rogers Place one, representing the Green Tea Restaurant current location. Appearently, it is unusually far away from

Downtown area. In the map, 15 candidate neighborhood centers are generated for further analysis.

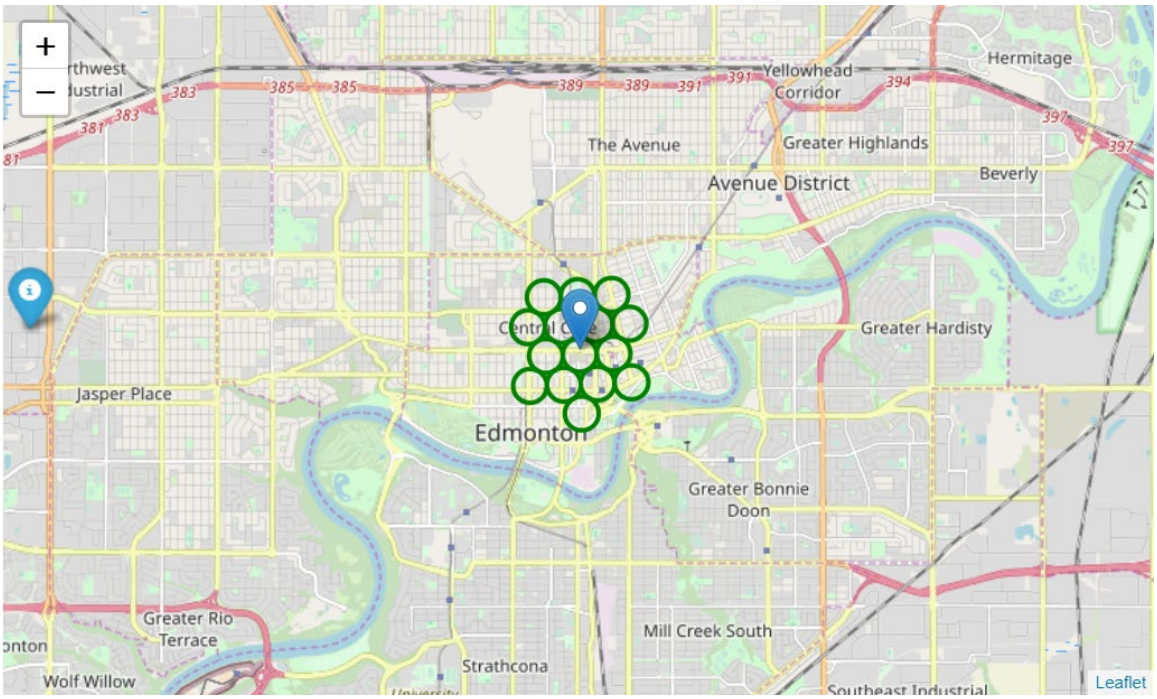

Figure 2. Candidate neighborhoods map

Next, we will use Google Maps API Reverse Geocoding to lookup the address for each coordinate. The result will be stored in a pandas DataFrame and pass to the next step.

	Address	Latitude	Longitude	X	Y	Distance from Downtown
0	9923 103 St NW, Edmonton, AB T5K 2J3	53.537857	-113.496728	334548.703964	5.935005e+06	933.012702
1	The Executive, 10105 109 St NW, Edmonton, AB T...	53.541509	-113.508264	333798.703964	5.935438e+06	901.387819
2	105 Street & Jasper Avenue, Edmonton, AB T5J 3N1	53.541667	-113.500726	334298.703964	5.935438e+06	559.016994
3	10043 Jasper Ave, Edmonton, AB T5J 1S6	53.541825	-113.493188	334798.703964	5.935438e+06	559.016994
4	9751 Jasper Ave, Edmonton, AB T5J 0C5	53.541982	-113.485649	335298.703964	5.935438e+06	901.387819
5	107 Street & 103 Avenue, Edmonton, AB T5J 1K3	53.545477	-113.504724	334048.703964	5.935871e+06	504.467341
6	10340 103 St NW, Edmonton, AB T5J 0Y9	53.545634	-113.497186	334548.703964	5.935871e+06	66.987298
7	10248 99 St NW, Edmonton, AB T5J	53.545792	-113.489647	335048.703964	5.935871e+06	504.467341
8	10568 109 St NW, Edmonton, AB T5H 3B2	53.549286	-113.508724	333798.703964	5.936304e+06	834.550535
9	10572 105 St NW, Edmonton, AB T5H 2W7	53.549444	-113.501184	334298.703964	5.936304e+06	443.254550
10	10574 101 St NW, Edmonton, AB T5H 2R8	53.549602	-113.493645	334798.703964	5.936304e+06	443.254550
11	9618 105A Ave, Edmonton, AB T5H 0M4	53.549759	-113.486105	335298.703964	5.936304e+06	834.550535
12	10808 107 St NW, Edmonton, AB T5H 2Z3	53.553254	-113.505184	334048.703964	5.936738e+06	942.582566
13	10750 103 St NW, Edmonton, AB T5H 2V8	53.553411	-113.497644	334548.703964	5.936738e+06	799.038106
14	97 Street & 108 Avenue, Edmonton, AB T5H	53.553569	-113.490104	335048.703964	5.936738e+06	942.582566

Table 1. Google Maps API Reverse Geocoding result

Foursquare Request

Now that we have our location candidates. For each candidate neighborhood, we will use Foursquare API to search for information on restaurants and categorize them into Restaurant category and Chinese Restaurant category.

First, we will need a Venue Categories list from the Foursquare Developers page. We include every category under Chinese Restaurant regardless of the supported countries and cultural factors. And then, after Foursquare API responded, we categorize the result into Restaurants and Chinese Restaurants, and calculate their distances to Rogers Center. The result shows a low portion (around 13.68%) of Chinese restaurants in a total of 95 restaurants. As of now, we have enough information to plot a map. Each blue dot represents a restaurant, and Chinese restaurants are in red.

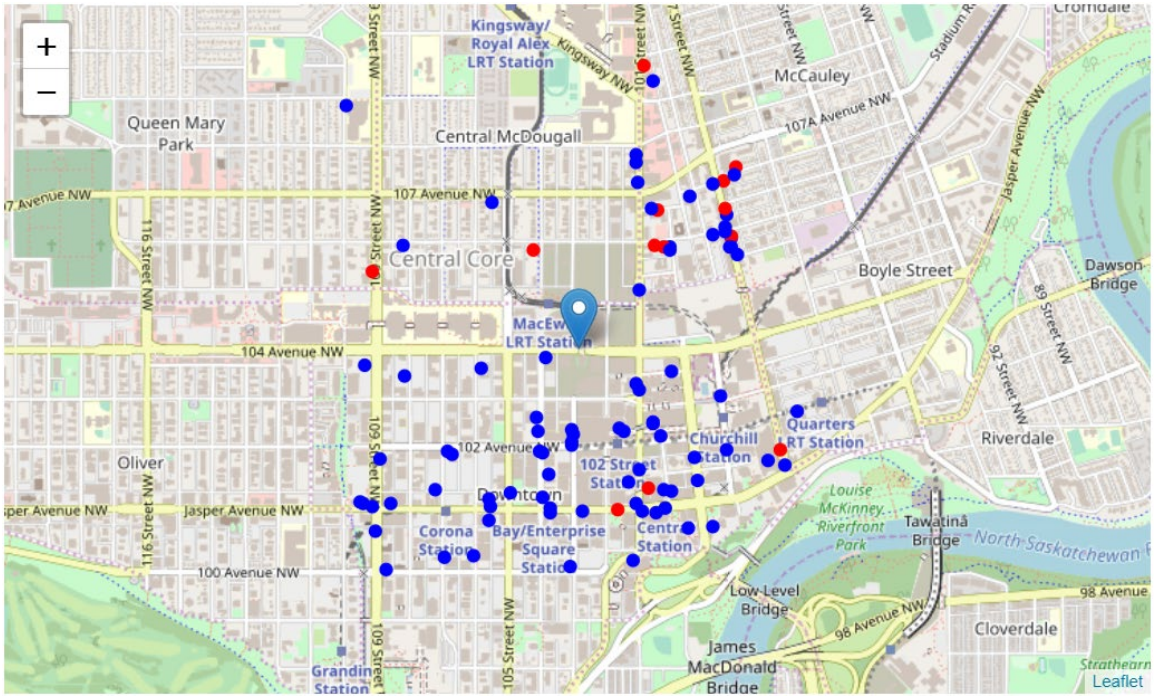

Figure 3. Restaurants distribution

III. Exploratory Data Analysis

Now that we have enough data to proceed and the maps in previous steps helped us to have a basic understanding of what does the situation looks like. In the next steps, we will direct our efforts on detecting areas of Downtown, Edmonton that have low restaurant density, particularly those with low Chinese restaurant density. Our analysis will be limited to an area about 1km around Rogers Place.

Density Heat Map

The first step is to analyze the density of the restaurant. Our basic statistics show that the average number of restaurants in every area with a radius of 250 meters is 5.1. Moreover, the average distance to the closest Chinese restaurant from each area center: 299.6 meters. Heat maps are created to visualize the density of restaurant and Chinese restaurant. The black line circles represent 300m, 600m, and 1,000m distance from Rogers Place.

Figure 4. Density of restaurant heat map

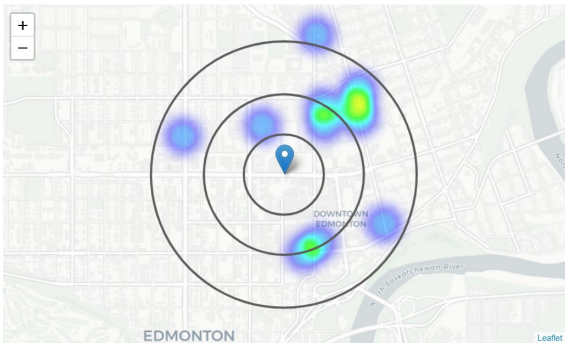

Figure 5. Density of Chinese restaurant heat map

The map demonstrates a high density of restaurants on the southside of Rogers Place. Further, on the northeast side of Rogers Place, there is a high density of Chinese restaurants. As you may guess, that is China Town. Our ideal solution should avoid those areas.

Locate the Solution

Next, we will create a new grid of candidates. Each candidate will be 100m apart from each other. This step returns 89 candidate neighborhood centers. This can help us better analyze this area. And then we will calculate how many restaurants / Chinese restaurants in each neighborhood, also the distance to the closest Chinese restaurant.

We are interested only in locations with no more than three restaurants nearby, and no Chinese restaurants in a radius of 300 meters. Plot the data after we filter it, we can get a heat map with possible locations plotted as blue dots.

Figure 6. Density of Chinese restaurant with possible location plots

On the map, we can see a few locations that met our criteria. We will use the K-Means Clustering method to cluster these plots together and try to find centers of areas containing possible solutions.

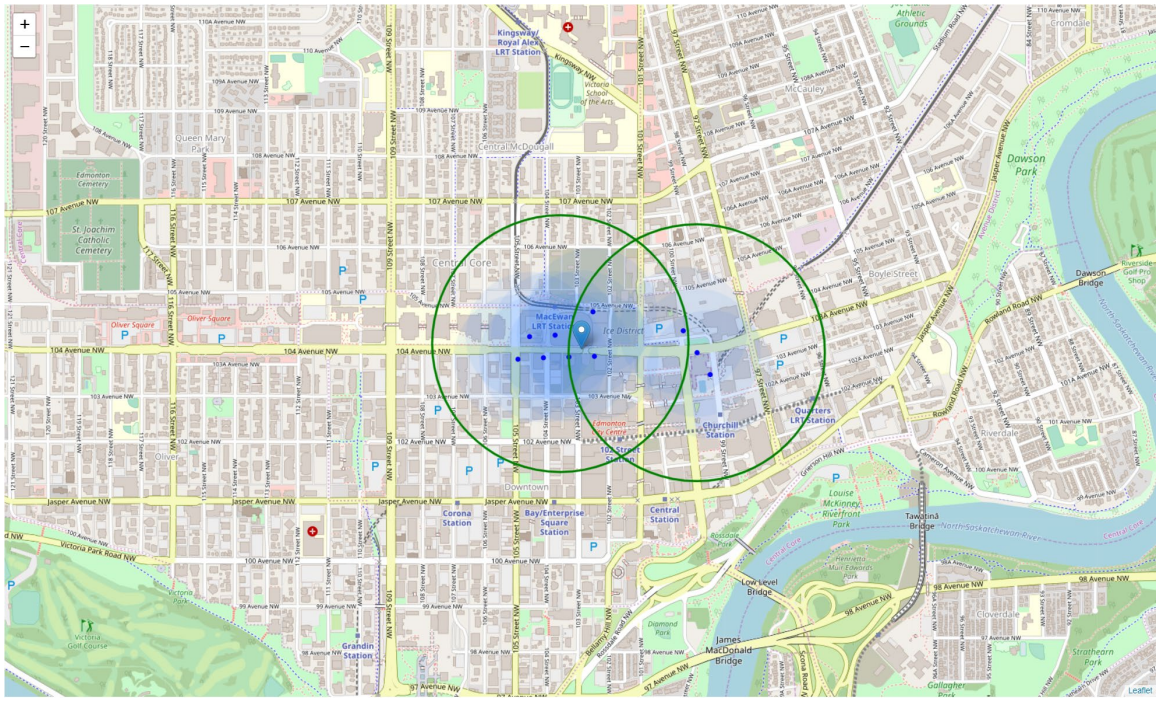

Figure 7. Clustered plots

Those two clusters represent groupings of most of the candidate locations and cluster centers are placed in the middle of the zones 'rich' with location candidates. With those two clusters, we can reverse geocode candidate area centers to get the address that can be presented to Green Tea Restaurant owner for further analysis.

VI. Result & Discussion

With the analysis presented in the above sections, we are able to drive a result of two possible areas with a radius of 250 meters, centered at the following two address:

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Addresses of centers of areas recommended for further analysis
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99 Street & 103A Avenue, Edmonton  => 450.92m from Rogers Place
10224 104 Ave NW, Edmonton         => 85.13m from Rogers Place
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We can also plot a map for the solution area.

Figure 8. Solution map

The result makes sense to us – they are close to Rogers Place. Hockey games and concerts will certainly bring extra visits to a restaurant. These locations also sit at the core area of Downtown, in the meantime, avoid the nearby restaurant and, most importantly, the northeast China Town. The accessible public transit will connect the University of Alberta where there are thousands of Chinese international students who are eager to have authentic Chinese food nearby.

Other Factors

Rent in this area can play a crucial role in our decision making. High rent may erode the benefit of relocation and eventually lead to no difference than stay in terms of the profitability of the business. To deliver a better solution, we can analyze the rent and shop availability in this area. This project is based only on location, that is being said, adding information, such as rent and availability, might make a difference to the results.

Another thing that can be improved in this project is the search area. In our analysis, we only covered an area with a radius of 1,000 meters. Doing so will avoid most residencia lands. Realistically, there could be a lot of small commercial lands surrounded by tons of residential lands. A restaurant sitting in a crowded residential area is surely another kind of perfect solution. To improve that, we will need information on city zoning. For simplicity, we ignored that in this project. Later on, if we can obtain relevant regulation data, combined with the rent and availability information, the analysis will become more complete and helpful for our decision making.

V. Conclusion

In this project, we analyzed some possible relocation solutions for Green Tea Restaurant. We used various APIs to scrape information online and visualized the data to present a better understanding of our audience. At the end of our analysis, we are glad to see some locations met all our criteria. We believe those areas are the best possible relocation solutions by far, in terms of location and competition. We encourage to direct further efforts on cost-benefit analysis and explore more solutions in the residential area nearby.