Capstone Project - The Battle of Neighborhoods

1. Introduction

Ottawa is the capital city of Canada, with a city population over a million(June 2019) and urban area of 520 km^2. As a city with high quality of living, there are many people relocating to Ottawa every year.

If a newcomer looking to open a restaurant, where would be a good place? This project will leverage the Foursquare location data to help the business owner to find an optimal place to open a restaurant in Ottawa, Canada.

2. Data

2.1 Data Source

I scraped https://en.wikipedia.org/wiki/List_of_neighbourhoods_in_Ottawa for neighbourhoods information in Ottawa. Then, coordinates of the neighbourhoods were generated using geocoder in python. Afterwards, I collected the venues information(including restaurant type, location etc.) using Foursquare API.

2.2 Data Cleaning

Neighbourhood names and their coordinates were merged into one data frame. According to our parameter settings, Foursquare API got top 100 venues within a radius of 800 meters. Finally, only venues related to restaurant were kept for further analysis. Sample data frame is shown in Fig. 1.

	Neighbourhood	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Lincoln Heights	45.37041	-75.781740	Tony Capone's	45.366760	-75.779147	Italian Restaurant
1	Lincoln Heights	45.37041	-75.781740	Nutrichem Pharmacy	45.367996	-75.785347	Pharmacy
2	Lincoln Heights	45.37041	-75.781740	Lincoln Fields Station	45.366266	-75.783375	Bus Station
3	Chartrand	45.47452	-75.511581	Farm Boy	45.477637	-75.513385	Grocery Store
4	Chartrand	45.47452	-75.511581	Occo Kitchen	45.476782	-75.513818	Burger Joint

Fig. 1 Ottawa Venues Data Frame

3. Exploratory Data Analysis

Restaurants are supposed to open in a spot that is easily accessible and draws crowds. In this way, the restaurant should be open near a commercial zone or a restaurants zone where there is a great potential people will drop by. So I set 5 restaurants as a criteria, which means only neighbourhoods which contain no less than 5 restaurants would be taken into consideration. A summary of number of restaurants in each neighbourhood is shown in Fig.2.
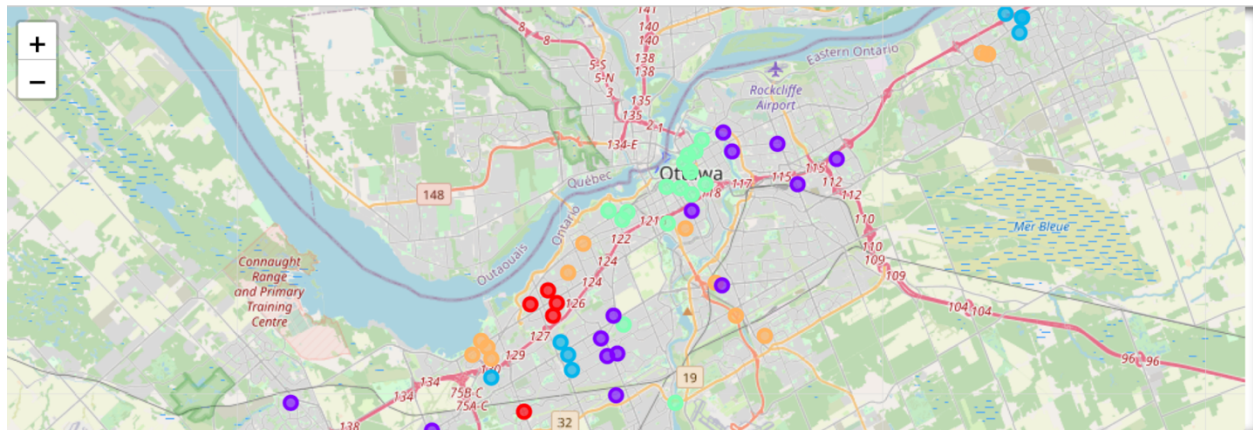
Fig. 2 Restaurant Counts of Neighborhoods in Ottawa

4. Methodology

Restaurants with similar type of cuisine opening proximity to each other will form a "restaurant zone". Opening a restaurant near the zone will attract customers which have similar taste. It is a great way to bring your restaurant to the target groups' attention. To achieve the goal, we need to cluster our neighbourhoods. By partitioning our neighbourhoods into groups based on similar characteristics(Most common restaurants), we will figure out different "restaurant zone" and finally we can choose the location accordingly.

I choose K-means algorithm to group the neighbourhoods. K-means is an unsupervised clustering method. It partitions the data into non-overlapping groups based on theirs similarities. Examples within a cluster are very similar to each other, while examples across clusters are very different. In another way, K-means algorithm will group the neighbourhoods which have restaurants with similar type of cuisine together. This will efficiently help us find out "restaurant zone".

5. Results

In this project, a total of 58 neighbourhoods were analyzed by K-means clustering algorithm. These neighbourhoods were grouped into 5 clusters based on the their characteristics. The results are shown in Fig. 3.

Fig. 3 K-means Clustering Result

Cluster 0 (Red)

Neighbourhood	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 Venu
Trend Village	45.32990	-75.78191	0	Vietnamese Restaurant	BBQ Joint	Chinese Restaurant	Greek Restaurant	Restaurant	Fast Food Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	India Restaurai
Carlingwood	45.37620	-75.76875	0	Chinese Restaurant	Thai Restaurant	Indian Restaurant	Swiss Restaurant	Greek Restaurant	Diner	Fast Food Restaurant	Restaurant	Vietnamese Restaurant	Ethiopia Restaurai
Glabar Park	45.37135	-75.76372	0	Fast Food Restaurant	Chinese Restaurant	Swiss Restaurant	Greek Restaurant	Diner	Vietnamese Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	India Restaurai
McKellar Heights	45.36680	-75.76605	0	Chinese Restaurant	Thai Restaurant	Swiss Restaurant	Greek Restaurant	Diner	Fast Food Restaurant	Vietnamese Restaurant	Ethiopian Restaurant	Japanese Restaurant	Italia Restaurai
Woodpark	45.37120	-75.77795	0	Chinese Restaurant	Italian Restaurant	Thai Restaurant	Swiss Restaurant	Greek Restaurant	Diner	Fast Food Restaurant	Vietnamese Restaurant	Ethiopian Restaurant	Japanes Restaurai

Cluster 1 (Purple)

Neighbourhood	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 Mos Commo Venu
Lindenlea	45.43643	-75.67290	1	Mexican Restaurant	Ethiopian Restaurant	Middle Eastern Restaurant	Italian Restaurant	Sushi Restaurant	Diner	Fast Food Restaurant	Japanese Restaurant	Indian Restaurant	Gree Restaurar
Borden Farm	45.35230	-75.73084	1	Fast Food Restaurant	Restaurant	Seafood Restaurant	Middle Eastern Restaurant	Sushi Restaurant	Chinese Restaurant	Ramen Restaurant	Italian Restaurant	Indian Restaurant	Gree Restaurar
Castle Heights	45.43200	-75.64354	1	Fast Food Restaurant	Asian Restaurant	Burrito Place	Indian Restaurant	Greek Restaurant	Vietnamese Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Gluten fre Restaurant
Copeland Park	45.35801	-75.73971	1	Fast Food Restaurant	Asian Restaurant	Mexican Restaurant	Ramen Restaurant	Middle Eastern Restaurant	Chinese Restaurant	Diner	Portuguese Restaurant	Restaurant	Italia Restaurar
Bells Corners	45.32278	-75.83158	1	American Restaurant	Asian Restaurant	Thai Restaurant	Middle Eastern Restaurant	Fast Food Restaurant	Seafood Restaurant	Restaurant	Vietnamese Restaurant	Ethiopian Restaurant	Italia Restaurar
City View	45.35141	-75.73621	1	Fast Food Restaurant	Restaurant	Seafood Restaurant	Middle Eastern Restaurant	Sushi Restaurant	Chinese Restaurant	Ramen Restaurant	Italian Restaurant	Indian Restaurant	Gree Restaurar
Central Park	45.40685	-75.69055	1	Middle Eastern Restaurant	Fast Food Restaurant	Mexican Restaurant	Southern / Soul Food Restaurant	Korean Restaurant	Vegetarian / Vegan Restaurant	French Restaurant	Restaurant	Seafood Restaurant	Italia Restaurar
Cyrville	45.41680	-75.63264	1	Mexican Restaurant	Italian Restaurant	Fast Food Restaurant	Restaurant	Seafood Restaurant	Korean Restaurant	Japanese Restaurant	Indian Restaurant	Greek Restaurant	Gluten fre Restaurant
Fisher Heights	45.36680	-75.73265	1	Restaurant	Fast Food Restaurant	Mexican Restaurant	Asian Restaurant	Middle Eastern Restaurant	Sushi Restaurant	Portuguese Restaurant	Italian Restaurant	Indian Restaurant	Gree Restaurar
Pineview	45.42617	-75.61128	1	Italian Restaurant	Mongolian Restaurant	Sushi Restaurant	Fast Food Restaurant	Restaurant	Vietnamese Restaurant	Ethiopian Restaurant	Japanese Restaurant	Indian Restaurant	Gree Restaurar
Overbrook	45.42912	-75.66827	1	Mexican Restaurant	Ethiopian Restaurant	Thai Restaurant	Diner	Fast Food Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	Gree Restaurar
Billings Bridge	45.37803	-75.67397	1	Seafood Restaurant	Japanese Restaurant	Italian Restaurant	Thai Restaurant	Fast Food Restaurant	Vietnamese Restaurant	Indian Restaurant	Greek Restaurant	Gluten-free Restaurant	Germa Restaurar
Jockvale	45.27188	-75.73778	1	Fast Food Restaurant	Mexican Restaurant	Restaurant	American Restaurant	Thai Restaurant	Middle Eastern Restaurant	Sushi Restaurant	Italian Restaurant	Indian Restaurant	Gree Restaurar
Crestview	45.33643	-75.73184	1	Fast Food Restaurant	Mexican Restaurant	American Restaurant	Middle Eastern Restaurant	Thai Restaurant	Ethiopian Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	Gree Restaurar

Cluster 2 (Blue)

Neighbourhood	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
Town Centre (Orleans)	45.48048	-75.510600	2	Restaurant	Fast Food Restaurant	Vietnamese Restaurant	French Restaurant	Mediterranean Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	Resta
Queenswood Village	45.48174	-75.519000	2	Fast Food Restaurant	Restaurant	French Restaurant	Vietnamese Restaurant	Mediterranean Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	Resta
Bel-Air Park	45.35664	-75.761540	2	Fast Food Restaurant	BBQ Joint	Diner	Restaurant	Vietnamese Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	Resta
Orleans	45.48048	-75.510600	2	Restaurant	Fast Food Restaurant	Vietnamese Restaurant	French Restaurant	Mediterranean Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	Resta
Graham Park	45.34320	-75.799650	2	Fast Food Restaurant	Restaurant	Chinese Restaurant	Vietnamese Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	Greek Restaurant	G Resta
Navaho	45.35145	-75.757536	2	Fast Food Restaurant	BBQ Joint	Diner	French Restaurant	Restaurant	Vietnamese Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Resta
Ryan Farm	45.34590	-75.755450	2	Restaurant	Fast Food Restaurant	BBQ Joint	French Restaurant	Vietnamese Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	Resta
Chartrand	45.47452	-75.511581	2	Fast Food Restaurant	Vietnamese Restaurant	French Restaurant	Restaurant	Mediterranean Restaurant	Kebab Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	Resta

Cluster 3 (Green)

Neighbourhood	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
Downtown	45.413060	-75.690070	3	Greek Restaurant	Restaurant	Seafood Restaurant	American Restaurant	Japanese Restaurant	Korean Restaurant	Vegetarian / Vegan Restaurant	Middle Eastern Restaurant	Fast Food Restaurant	Amer Restau
Skyline	45.363200	-75.727150	3	Restaurant	Sushi Restaurant	Diner	Portuguese Restaurant	Korean Restaurant	Vietnamese Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	G Resta
Tunney's Pasture	45.406660	-75.735830	3	New American Restaurant	Vietnamese Restaurant	Middle Eastern Restaurant	BBQ Joint	Diner	Spanish Restaurant	Fast Food Restaurant	Japanese Restaurant	Italian Restaurant	In Resta
Lower Town	45.433520	-75.684510	3	Middle Eastern Restaurant	Mexican Restaurant	Sushi Restaurant	Indian Restaurant	Restaurant	Korean Restaurant	BBQ Joint	German Restaurant	Chinese Restaurant	A Resta
Burromee	45.421780	-75.691160	3	Restaurant	Tapas Restaurant	French Restaurant	New American Restaurant	Seafood Restaurant	Mexican Restaurant	Italian Restaurant	Fast Food Restaurant	Japanese Restaurant	G Resta
Belltown	45.402063	-75.703244	3	Italian Restaurant	Vietnamese Restaurant	Restaurant	Diner	Indian Restaurant	Korean Restaurant	Burrito Place	Chinese Restaurant	French Restaurant	G Resta
Clearview	45.333400	-75.699350	3	Vietnamese Restaurant	Asian Restaurant	Chinese Restaurant	New American Restaurant	Restaurant	Fast Food Restaurant	Japanese Restaurant	Italian Restaurant	Indian Restaurant	G Resta
Hintonburg	45.403400	-75.727950	3	New American Restaurant	Diner	Vietnamese Restaurant	Spanish Restaurant	Gluten-free Restaurant	Vegetarian / Vegan Restaurant	Middle Eastern Restaurant	French Restaurant	Chinese Restaurant	Sea Resta
Kempark	45.421780	-75.691160	3	Restaurant	Tapas Restaurant	French Restaurant	New American Restaurant	Seafood Restaurant	Mexican Restaurant	Italian Restaurant	Fast Food Restaurant	Japanese Restaurant	G Resta
Mechanicsville	45.406360	-75.725650	3	New American Restaurant	Diner	Asian Restaurant	Thai Restaurant	Tapas Restaurant	BBQ Joint	Indian Restaurant	Gluten-free Restaurant	Seafood Restaurant	Vietnan Resta
Old Ottawa East	45.416800	-75.682640	3	Seafood Restaurant	Italian Restaurant	Asian Restaurant	Vegetarian / Vegan Restaurant	Tapas Restaurant	Diner	New American Restaurant	Restaurant	Ethiopian Restaurant	In Resta
Centretown	45.415400	-75.696240	3	Restaurant	Tapas Restaurant	Greek Restaurant	American Restaurant	Indian Restaurant	Italian Restaurant	Japanese Restaurant	Sushi Restaurant	Seafood Restaurant	Con P Resta
ByWard Market	45.427640	-75.692430	3	Restaurant	New American Restaurant	French Restaurant	Mexican Restaurant	Diner	Tapas Restaurant	Asian Restaurant	Italian Restaurant	Korean Restaurant	Ger Resta
South Gloucester	45.415661	-75.704024	3	Chinese Restaurant	Sushi Restaurant	Vietnamese Restaurant	Restaurant	Greek Restaurant	Korean Restaurant	Italian Restaurant	Indian Restaurant	Middle Eastern Restaurant	Ta Resta

Cluster 4 (Orange)

Neighbourhood	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 C...
Convent Glen	45.466800	-75.532630	4	Restaurant	Turkish Restaurant	Indian Restaurant	Steakhouse	Diner	Vietnamese Restaurant	Japanese Restaurant	Italian Restaurant	Greek Restaurant	Re
Westboro	45.394200	-75.749150	4	Italian Restaurant	Tapas Restaurant	Restaurant	Vegetarian / Vegan Restaurant	French Restaurant	Vietnamese Restaurant	Ethiopian Restaurant	Japanese Restaurant	Indian Restaurant	Re
Ellwood	45.366800	-75.666040	4	Restaurant	Afghan Restaurant	Middle Eastern Restaurant	Thai Restaurant	Indian Restaurant	Chinese Restaurant	Japanese Restaurant	Italian Restaurant	Greek Restaurant	Re
Britannia Heights	45.350100	-75.799350	4	Restaurant	Fast Food Restaurant	Middle Eastern Restaurant	Kebab Restaurant	Italian Restaurant	Indian Restaurant	Chinese Restaurant	Sri Lankan Restaurant	Japanese Restaurant	Re
South Keys	45.359000	-75.650740	4	Restaurant	Fast Food Restaurant	Vietnamese Restaurant	Mediterranean Restaurant	Middle Eastern Restaurant	Mexican Restaurant	Thai Restaurant	Swiss Restaurant	English Restaurant	Re
Orléans Wood	45.466308	-75.528817	4	Restaurant	Turkish Restaurant	American Restaurant	Indian Restaurant	Steakhouse	Chinese Restaurant	Fast Food Restaurant	Vietnamese Restaurant	Ethiopian Restaurant	J Re
Town Centre (Kanata)	45.315170	-75.908140	4	Vietnamese Restaurant	American Restaurant	Japanese Restaurant	Italian Restaurant	Steakhouse	German Restaurant	Restaurant	Ethiopian Restaurant	Indian Restaurant	Re
Heron Park	45.379290	-75.677460	4	Restaurant	Seafood Restaurant	Japanese Restaurant	Thai Restaurant	Vietnamese Restaurant	Italian Restaurant	Indian Restaurant	Greek Restaurant	Gluten-free Restaurant	Re
Highland Park	45.382900	-75.757650	4	Middle Eastern Restaurant	Restaurant	Thai Restaurant	Steakhouse	Vietnamese Restaurant	Italian Restaurant	Indian Restaurant	Greek Restaurant	Gluten-free Restaurant	Re
Bayshore	45.351510	-75.809780	4	Fast Food Restaurant	Restaurant	Middle Eastern Restaurant	Indian Restaurant	Italian Restaurant	Chinese Restaurant	Vietnamese Restaurant	Japanese Restaurant	Greek Restaurant	Re
Boyce	45.357155	-75.804734	4	Middle Eastern Restaurant	Indian Restaurant	Kebab Restaurant	Italian Restaurant	Sri Lankan Restaurant	Restaurant	Ethiopian Restaurant	Japanese Restaurant	Greek Restaurant	Re
Orléans Village	45.466308	-75.528817	4	Restaurant	Turkish Restaurant	American Restaurant	Indian Restaurant	Steakhouse	Chinese Restaurant	Fast Food Restaurant	Vietnamese Restaurant	Ethiopian Restaurant	J Re
The Glebe	45.400100	-75.693740	4	Restaurant	Mexican Restaurant	Diner	Vegetarian / Vegan Restaurant	Middle Eastern Restaurant	French Restaurant	Fast Food Restaurant	Southern / Soul Food Restaurant	English Restaurant	
Michele Heights	45.354705	-75.801279	4	Restaurant	Middle Eastern Restaurant	Indian Restaurant	Kebab Restaurant	Italian Restaurant	Burrito Place	Sri Lankan Restaurant	Fast Food Restaurant	Japanese Restaurant	Re

6. Discussion

To find out what kind of "restaurant zone" are in each cluster, I selected top 1, 2 and 3 most common cuisine in the neighbourhood for each cluster respectively; and merged them together to determine the major cuisine type as recommendations. A summary of cuisine type in each cluster is illustrated in Table 1.

Table 1. Cuisine Type Summary in Each Cluster

	Cuisine Type	Number of neighbourhoods
Cluster 0	Chinese Restaurants	5
	Thai Restaurants	3
Cluster 1	Fast Food Restaurants	10
	Mexican Restaurants	8
	Italian Restaurant	3
	Seafood Restaurant	3
	Asian Restaurant	3
Cluster 2	Fast Food Restaurant	8
	BBQ Joint	3

	Vietnamese Restaurant	3
Cluster 3	New American Restaurant	5
	French Restaurant	5
	Vietnamese Restaurant	5
	Mexican Restaurant	3
	Asian Restaurant	3
	Sushi Restaurant	3
	Tapas Restaurant	3
Cluster 4	Middle Eastern Restaurant	8
	American Restaurant	3
	Indian Restaurant	3
	Turkish Restaurant	3

From table 1, we can see that if a newcomer would like to open a Chinese restaurant, neighbourhoods in cluster 0 would be good choices. I recommend Carlingwood neighbourhood among all the candidates since it has a shopping center.

Similarly, neighbourhoods in Cluster 1 would be good places for people who wants to open a Fast Food or Mexican restaurant. Cluster 1 can also be taken into consideration when comes to Italian, Seafood or Asian Restaurant. Best neighbourhoods would be Central Park and City View neighbourhoods since they have college and retail stores within the neighbourhoods.

Cluster 2 is another good option for opening Fast Food restaurant, some of the neighbourhoods locate in Orleans, Northern part of Ottawa. The rest of them are in Nepean, the southern part of Ottawa.

Cluster 3 covers the most bustling area of the city, including Downtown, Lower Town, Centre Town, ByWard Market and etc. These are the commercial and economic center of Ottawa. Neighbourhoods in Cluster 3 has the highest population density and also have the most number of restaurants. We can see there are most variety of cuisine type exists in this Cluster. Most commonly are New American, French and Vietnamese restaurant.

Cluster 4 would be their first choice for people who want to open a Middle Eastern or Turkish restaurant. Recommended neighbourhoods are South Keys and Bayshore. Because these are neighbourhoods also with shopping malls, cinemas, grocery stores.

7. Conclusion

The distribution of restaurants in Ottawa forms several "restaurant zone". Grouping the neighbourhoods based on their 'restaurant characteristics' effectively helped us finding out "restaurant zone". These information serves as the valuable indications for those new comers coming to Ottawa who want to open a restaurant.