

IBM Data Science Capstone Project  
KNN Clustering of Neighbourhoods in Toronto and Montreal Based on The Venues  
Dawei Zhou

## Introduction:

Toronto and Montreal are two major cities in Canada. They are the commercial and cultural centers of Canada. Many well-known universities are also located in the two cities. Every year, thousands of students graduate from school and decide to go to the other major city to start a new life there. While they are already familiar with the neighbourhood they currently live in, it's intuitive for them to choose a similar neighbourhood in the new city. How are they going to make an informative choice to achieve that goal? Are they going to do tons of research and spend days and days on that? In this report, we will provide an efficient tool for that, which only takes seconds to find out the candidates for you and the only thing you need to provide is the neighbourhood you are currently comfortable with.

## Data:

The data used in this project includes:

1. Administrative limit of the agglomeration of Montreal Provided --- City of Montreal:  
This GeoJSON file provides neighbourhood information in Montreal, including the boundary information, latitudes and longitudes. This file will be used with the Python folium package to create a visualization of neighbourhoods in Montreal. The geographical coordination will be used to query venues data by using Foursquare API.  
URL: <https://donnees.montreal.ca/ville-de-montreal/polygones-arrondissements>
2. Venues information of each neighbourhoods in the Great Toronto Area --- IBM Watson Studio  
This csv file is generated by using Foursquare API. It has columns: Neighbourhood, Neighbourhood Latitudes, Neighbourhood Longitudes, Venues, Venues Latitude, Venues Longitude, Venue Category. This dataset will be joined later with the similar dataset for Monreal.

Table 1

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Regent Park, Harbourfront	43.65426	-79.360636	Roselle Desserts	43.653447	-79.362017	Bakery
1	Regent Park, Harbourfront	43.65426	-79.360636	Tandem Coffee	43.653559	-79.361809	Coffee Shop
2	Regent Park, Harbourfront	43.65426	-79.360636	Cooper Koo Family YMCA	43.653249	-79.358008	Distribution Center
3	Regent Park, Harbourfront	43.65426	-79.360636	Body Blitz Spa East	43.654735	-79.359874	Spa
4	Regent Park, Harbourfront	43.65426	-79.360636	Impact Kitchen	43.656369	-79.356980	Restaurant

3. Foursquare API will also be used for the venue data in Montreal.

## Methodology:

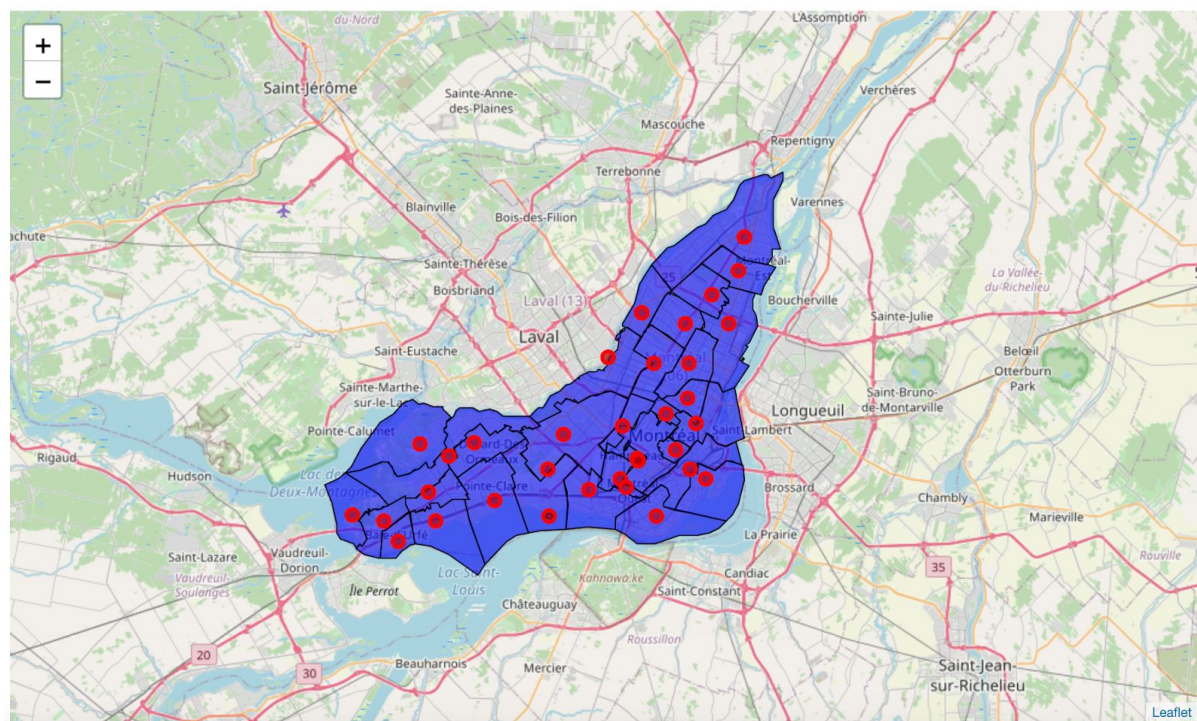
First, we will use the GeoJSON file provided by the City of Montreal. Since the geographical coordinates of the center of each neighbourhood are not provided, we will approximate it with the mean latitude and longitude of the boundary points. There are 34 neighbourhoods in total. The result is as following:

Table 2

	Neighborhood	Longitude	Latitude
0	Outremont	-73.607894	45.514219
1	LaSalle	-73.619272	45.431967
2	Mont-Royal	-73.657714	45.504546
3	Ville-Marie	-73.574694	45.506104
4	Le Plateau-Mont-Royal	-73.583341	45.526789
5	Hampstead	-73.641883	45.478693
6	Le Sud-Ouest	-73.580558	45.469547
7	Rivière-des-Prairies-Pointe-aux-Trembles	-73.518578	45.655368
8	Lachine	-73.695655	45.452941
9	Dorval	-73.743065	45.469728
10	Montréal-Nord	-73.636356	45.595179
11	L'Île-Bizard-Sainte-Genève	-73.888181	45.489570
12	Kirkland	-73.879104	45.451867
13	Dollard-des-Ormeaux	-73.826586	45.491093
14	Senneville	-73.965830	45.433391
15	Ahuntsic-Cartierville	-73.674273	45.559576
16	Côte-Saint-Luc	-73.660656	45.461789
17	Saint-Léonard	-73.586362	45.585966
18	Montréal-Ouest	-73.654088	45.454891
19	Pointe-Claire	-73.802918	45.444589
20	L'Île-Dorval	-73.741498	45.432439
21	Mercier-Hochelaga-Maisonneuve	-73.536675	45.586082
22	Côte-des-Neiges-Notre-Dame-de-Grâce	-73.640154	45.476786
23	Rosemont-La Petite-Patrie	-73.582466	45.554925
24	Saint-Laurent	-73.725783	45.498050
25	Beaconsfield	-73.870311	45.428059
26	Villeray-Saint-Michel-Parc-Extension	-73.622007	45.554611
27	Westmount	-73.597496	45.484906
28	Montréal-Est	-73.526326	45.628024
29	Anjou	-73.556824	45.609607
30	Pierrefonds-Roxboro	-73.855612	45.480166
31	Sainte-Anne-de-Bellevue	-73.929492	45.428250
32	Verdun	-73.563002	45.462127
33	Baie-d'Urfé	-73.913494	45.412291

Using Table 2, we can use python Folium package to visualize the result:

Graph 1



As we can easily see, the red marker doesn't always be the exact center of each neighbourhood. This is because the shapes of some neighbourhoods are too extensive and irregular. However, in this project, the approximation is good enough.

With the geographical coordinates of each neighbourhood, we can then use Foursquare API to query the venues information in 1000 meters radius. The result dataframe is in the same format as Table 1.

Table 3

```
print(mtl_venues.shape)
mtl_venues.head()
```

(881, 7)

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Outremont	45.514219	-73.607894	Parc Outremont	45.518101	-73.604877	Park
1	Outremont	45.514219	-73.607894	Le Glacier Bilboquet	45.518993	-73.609737	Ice Cream Shop
2	Outremont	45.514219	-73.607894	Pizzeria No. 900	45.520129	-73.608715	Pizza Place
3	Outremont	45.514219	-73.607894	Parc Saint-Viateur	45.520589	-73.607117	Park
4	Outremont	45.514219	-73.607894	CEPSUM	45.508854	-73.614398	College Gym

We have collected 881 records for the venues in Montreal. When we grouped the records according to the neighbourhood they belong to, we found that there are some neighborhoods which have less than 10 venues. Neighbourhoods like this are out of the range we care about, so we will drop the venues in Table 3 where the neighbourhoods have less than 10 venues.

Table 4

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Ahuntsic-Cartierville	25	25	25	25	25	25
1	Anjou	12	12	12	12	12	12
2	Baie-d'Urfé	4	4	4	4	4	4
3	Beaconsfield	4	4	4	4	4	4
4	Côte-Saint-Luc	15	15	15	15	15	15
5	Côte-des-Neiges-Notre-Dame-de-Grâce	18	18	18	18	18	18
6	Dollard-des-Ormeaux	7	7	7	7	7	7
7	Dorval	4	4	4	4	4	4
8	Hampstead	16	16	16	16	16	16
9	Kirkland	5	5	5	5	5	5
10	L'Île-Bizard-Sainte-Genève	5	5	5	5	5	5
11	L'Île-Dorval	5	5	5	5	5	5
12	LaSalle	56	56	56	56	56	56
13	Lachine	5	5	5	5	5	5
14	Le Plateau-Mont-Royal	100	100	100	100	100	100
15	Le Sud-Ouest	48	48	48	48	48	48
16	Mercier-Hochelaga-Maisonneuve	47	47	47	47	47	47
17	Mont-Royal	27	27	27	27	27	27
18	Montréal-Est	1	1	1	1	1	1
19	Montréal-Nord	15	15	15	15	15	15
20	Montréal-Ouest	11	11	11	11	11	11

Then we can merge these two dataframe and do one-hot encoding on the merged dataframe and calculate the expected percentage of venues for each neighbourhood.

Table 5

	Neighborhood	Yoga Studio	ATM	Airport	Airport Food Court	Airport Lounge	Airport Service	Airport Terminal	American Restaurant	Antique Shop	...	Train Station	Tunnel	Vegetarian / Vegan Restaurant	Video Game Store	Video Store	Vietna Resta
0	Ahuntsic-Cartierville	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.000000	0.000000	0.000000	0.00
1	Anjou	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.083333	0.0	...	0.0	0.0	0.000000	0.000000	0.000000	0.00
2	Berczy Park	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.017241	0.000000	0.000000	0.00
3	Brockton, Parkdale Village, Exhibition Place	0.041667	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.000000	0.000000	0.000000	0.00
4	Business reply mail Processing Centre, South C...	0.058824	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.000000	0.000000	0.000000	0.00
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
56	University of Toronto, Harbord	0.031250	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.000000	0.03125	0.000000	0.00
57	Verdun	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.000000	0.000000	0.014085	0.00
58	Ville-Marie	0.010000	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.020000	0.000000	0.000000	0.00
59	Villeray-Saint-Michel-Parc-Extension	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.000000	0.000000	0.000000	0.00
60	Westmount	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.000000	0.000000	0.000000	0.00

Now we are ready to do KNN clustering on the neighbourhoods of all neighbourhoods by using the sklearn package with a number of clusters equal to 5.

Results & Discussion:

Clustering result:

Table 6

	Cluster Labels	Neighborhood	City	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
0	2	Ahuntsic-Cartierville	Montreal	Park	Metro Station	Bus Station	Hockey Arena	Coffee Shop	Asian Restaurant	Fast Food Restaurant	Sandwich Place	Italian Restaurant	Dog Run
1	2	Anjou	Montreal	Convenience Store	Pizza Place	BBQ Joint	Dance Studio	Motorsports Shop	Drugstore	Fast Food Restaurant	Supermarket	Pharmacy	American Restaurant
2	1	Berczy Park	Toronto	Coffee Shop	Bakery	Cocktail Bar	Pharmacy	Cheese Shop	Beer Bar	Farmers Market	Restaurant	Seafood Restaurant	Jazz Club
3	1	Brockton, Parkdale Village, Exhibition Place	Toronto	Café	Breakfast Spot	Coffee Shop	Nightclub	Climbing Gym	Burrito Place	Stadium	Italian Restaurant	Intersection	Bar
4	2	Business reply mail Processing Centre, South C...	Toronto	Gym / Fitness Center	Smoke Shop	Auto Workshop	Brewery	Burrito Place	Butcher	Comic Shop	Farmers Market	Fast Food Restaurant	Garden
...	...	...	...	...	...	...	...	...	...	...	...	...	...
56	1	University of Toronto, Harbord	Toronto	Café	Bar	Bakery	Bookstore	Japanese Restaurant	Yoga Studio	Italian Restaurant	Bank	Sushi Restaurant	Beer Bar
57	2	Verdun	Montreal	Pizza Place	Grocery Store	Restaurant	Indian Restaurant	Café	Bakery	Trail	Playground	Sushi Restaurant	Italian Restaurant
58	1	Ville-Marie	Montreal	Café	Restaurant	French Restaurant	Coffee Shop	Hotel	Sandwich Place	Art Museum	Bakery	Cosmetics Shop	Pizza Place
59	2	Villeray-Saint-Michel-Parc-Extension	Montreal	Fast Food Restaurant	Gas Station	Pharmacy	Portuguese Restaurant	Sandwich Place	Diner	Bakery	Ice Cream Shop	Deli / Bodega	Restaurant
60	1	Westmount	Montreal	Coffee Shop	Bank	Park	Bakery	Ice Cream Shop	Sushi Restaurant	Gastropub	Café	Scenic Lookout	Pizza Place

61 rows × 13 columns

Let’s have a closer look on each cluster:

Table 6.1 : cluster 1

	Cluster Labels	Neighborhood	City	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
43	0	Roselawn	Toronto	Garden	Health & Beauty Service	Home Service	Women’s Store	Dumpling Restaurant	Distribution Center	Dog Run	Doner Restaurant	Donut Shop	Drugstore

There is only one neighbourhood that falls into the first cluster. The top common venues in this neighbourhood are Garden, Health & Beauty Service, Women’s Store, Restaurant and Distribution Center. We can safely deduce that this neighbourhood has a good natural environment and perhaps it is close to uptown area.

Table 6.2 : cluster 2

	Cluster Labels	Neighborhood	City	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
2	1	Berczy Park	Toronto	Coffee Shop	Bakery	Cocktail Bar	Pharmacy	Cheese Shop	Beer Bar	Farmers Market	Restaurant	Seafood Restaurant	Jazz Club
3	1	Brockton, Parkdale Village, Exhibition Place	Toronto	Café	Breakfast Spot	Coffee Shop	Nightclub	Climbing Gym	Burrito Place	Stadium	Italian Restaurant	Intersection	Bar
5	1	CN Tower, King and Spadina, Railway Lands, Har...	Toronto	Airport Terminal	Airport Lounge	Airport Service	Boat or Ferry	Sculpture Garden	Bar	Harbor / Marina	Coffee Shop	Airport Food Court	Airport
6	1	Central Bay Street	Toronto	Coffee Shop	Café	Sandwich Place	Italian Restaurant	Thai Restaurant	Japanese Restaurant	Burger Joint	Bubble Tea Shop	Salad Place	Ramen Restaurant
8	1	Church and Wellesley	Toronto	Coffee Shop	Japanese Restaurant	Sushi Restaurant	Gay Bar	Restaurant	Yoga Studio	Pub	Café	Mediterranean Restaurant	Men's Store

9	1	Commerce Court, Victoria Hotel	Toronto	Coffee Shop	Restaurant	Café	Hotel	Gym	American Restaurant	Italian Restaurant	Deli / Bodega	Japanese Restaurant	Seafood Restaurant
11	1	Côte-des-Neiges-Notre-Dame-de-Grâce	Montreal	Coffee Shop	Ice Cream Shop	Greek Restaurant	Hockey Arena	Pet Store	Pizza Place	Convenience Store	Café	Liquor Store	Korean Restaurant
12	1	Davisville	Toronto	Dessert Shop	Sandwich Place	Pizza Place	Italian Restaurant	Café	Gym	Coffee Shop	Sushi Restaurant	Indian Restaurant	Deli / Bodega
15	1	First Canadian Place, Underground city	Toronto	Coffee Shop	Café	Hotel	Restaurant	Japanese Restaurant	Gym	Steakhouse	Asian Restaurant	Salad Place	American Restaurant
17	1	Garden District, Ryerson	Toronto	Clothing Store	Coffee Shop	Japanese Restaurant	Café	Cosmetics Shop	Italian Restaurant	Hotel	Bubble Tea Shop	Middle Eastern Restaurant	Movie Theater
18	1	Hampstead	Montreal	Coffee Shop	Ice Cream Shop	Grocery Store	Gas Station	Food	Italian Restaurant	Bank	Café	Hockey Arena	Liquor Store
19	1	Harbourfront East, Union Station, Toronto Islands	Toronto	Coffee Shop	Aquarium	Hotel	Café	Scenic Lookout	Fried Chicken Joint	Italian Restaurant	Restaurant	Brewery	Park
22	1	Kensington Market, Chinatown, Grange Park	Toronto	Café	Coffee Shop	Bar	Vietnamese Restaurant	Vegetarian / Vegan Restaurant	Mexican Restaurant	Grocery Store	Farmers Market	Park	Gaming Cafe
25	1	Le Plateau-Mont-Royal	Montreal	Café	Bakery	French Restaurant	Vegetarian / Vegan Restaurant	Bookstore	Furniture / Home Store	Bar	Coffee Shop	Middle Eastern Restaurant	Dessert Shop
27	1	Little Portugal, Trinity	Toronto	Bar	Restaurant	Café	Vegetarian / Vegan Restaurant	Asian Restaurant	Men's Store	Cuban Restaurant	Beer Store	Brewery	Record Shop
28	1	Mercier-Hochelaga-Maisonneuve	Montreal	Coffee Shop	Liquor Store	Restaurant	Sushi Restaurant	Sandwich Place	Supermarket	Fast Food Restaurant	Pharmacy	Clothing Store	Department Store
29	1	Mont-Royal	Montreal	Coffee Shop	Café	Arts & Crafts Store	Hotel	Indian Restaurant	Bank	Metro Station	Restaurant	Italian Restaurant	Cafeteria
33	1	North Toronto West, Lawrence Park	Toronto	Clothing Store	Coffee Shop	Sporting Goods Shop	Gift Shop	Health & Beauty Service	Ice Cream Shop	Fast Food Restaurant	Mexican Restaurant	Diner	Park
35	1	Parkdale, Roncesvalles	Toronto	Breakfast Spot	Gift Shop	Cuban Restaurant	Italian Restaurant	Coffee Shop	Movie Theater	Bookstore	Dessert Shop	Restaurant	Eastern European Restaurant
38	1	Queen's Park, Ontario Provincial Government	Toronto	Coffee Shop	Diner	College Cafeteria	Sushi Restaurant	Italian Restaurant	Japanese Restaurant	Mexican Restaurant	Distribution Center	Fried Chicken Joint	Creperie
39	1	Regent Park, Harbourfront	Toronto	Coffee Shop	Bakery	Park	Theater	Café	Breakfast Spot	Pub	Performing Arts Venue	Hotel	Event Space
40	1	Richmond, Adelaide, King	Toronto	Coffee Shop	Café	Restaurant	Thai Restaurant	Clothing Store	Bakery	Deli / Bodega	Gym	Hotel	Bookstore
45	1	Runnymede, Swansea	Toronto	Sushi Restaurant	Café	Coffee Shop	Pizza Place	Pub	Italian Restaurant	Yoga Studio	Restaurant	Bank	Bar
47	1	St. James Town	Toronto	Coffee Shop	Café	Gastropub	Cocktail Bar	American Restaurant	Moroccan Restaurant	Hotel	Seafood Restaurant	Italian Restaurant	Restaurant
48	1	St. James Town, Cabbagetown	Toronto	Coffee Shop	Café	Italian Restaurant	Chinese Restaurant	Pub	Park	Bakery	Restaurant	Pizza Place	Snack Place
49	1	Stn A PO Boxes	Toronto	Coffee Shop	Seafood Restaurant	Beer Bar	Italian Restaurant	Bakery	Cocktail Bar	Japanese Restaurant	Café	Restaurant	Pharmacy
50	1	Studio District	Toronto	Coffee Shop	American Restaurant	Bakery	Brewery	Café	Gastropub	Gym / Fitness Center	Fish Market	Pet Store	Park
51	1	Summerhill West, Rathnelly, South Hill, Forest...	Toronto	Coffee Shop	Sushi Restaurant	Liquor Store	Vietnamese Restaurant	Bagel Shop	Restaurant	Pizza Place	Supermarket	American Restaurant	Light Rail Station



52	1	The Annex, North Midtown, Yorkville	Toronto	Coffee Shop	Café	Sandwich Place	Pharmacy	Furniture / Home Store	Pizza Place	Pub	Middle Eastern Restaurant	Donut Shop	Burger Joint
54	1	The Danforth West, Riverdale	Toronto	Greek Restaurant	Coffee Shop	Italian Restaurant	Furniture / Home Store	Ice Cream Shop	Cosmetics Shop	Bookstore	Brewery	Bubble Tea Shop	Restaurant
55	1	Toronto Dominion Centre, Design Exchange	Toronto	Coffee Shop	Hotel	Café	Restaurant	Salad Place	Bakery	Italian Restaurant	Japanese Restaurant	Seafood Restaurant	American Restaurant
56	1	University of Toronto, Harbord	Toronto	Café	Bar	Bakery	Bookstore	Japanese Restaurant	Yoga Studio	Italian Restaurant	Bank	Sushi Restaurant	Beer Bar
58	1	Ville-Marie	Montreal	Café	Restaurant	French Restaurant	Coffee Shop	Hotel	Sandwich Place	Art Museum	Bakery	Cosmetics Shop	Pizza Place
60	1	Westmount	Montreal	Coffee Shop	Bank	Park	Bakery	Ice Cream Shop	Sushi Restaurant	Gastropub	Café	Scenic Lookout	Pizza Place

In the second cluster, we can easily find that these neighbourhoods are featured for bars and restaurants. They are likely close to the center of the city or perhaps they are close to some tourist attractions, University or business center.

Table 6.3 : cluster 3

Cluster Labels	Neighborhood	City	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
0	2	Ahuntsic-Cartierville	Montreal	Park	Metro Station	Bus Station	Hockey Arena	Coffee Shop	Asian Restaurant	Fast Food Restaurant	Sandwich Place	Italian Restaurant
1	2	Anjou	Montreal	Convenience Store	Pizza Place	BBQ Joint	Dance Studio	Motorsports Shop	Drugstore	Fast Food Restaurant	Supermarket	Pharmacy
4	2	Business reply mail Processing Centre, South C...	Toronto	Gym / Fitness Center	Smoke Shop	Auto Workshop	Brewery	Burrito Place	Butcher	Comic Shop	Farmers Market	Fast Food Restaurant
7	2	Christie	Toronto	Grocery Store	Café	Park	Baby Store	Coffee Shop	Italian Restaurant	Restaurant	Candy Store	Nightclub
10	2	Côte-Saint-Luc	Montreal	Bank	Pharmacy	Gas Station	Fast Food Restaurant	Shopping Mall	Discount Store	Restaurant	Liquor Store	Asian Restaurant
13	2	Davisville North	Toronto	Gym / Fitness Center	Breakfast Spot	Hotel	Food & Drink Shop	Department Store	Park	Sandwich Place	Pizza Place	American Restaurant
14	2	Dufferin, Dovercourt Village	Toronto	Pharmacy	Bakery	Pool	Bank	Bar	Supermarket	Middle Eastern Restaurant	Music Venue	Café
16	2	Forest Hill North & West, Forest Hill Road Park	Toronto	Trail	Jewelry Store	Sushi Restaurant	Mexican Restaurant	Women's Store	Dog Run	Doner Restaurant	Donut Shop	Drugstore
20	2	High Park, The Junction South	Toronto	Mexican Restaurant	Café	Thai Restaurant	Diner	Discount Store	Cajun / Creole Restaurant	Restaurant	Music Venue	Furniture / Home Store
21	2	India Bazaar, The Beaches West	Toronto	Sandwich Place	Fast Food Restaurant	Pet Store	Food & Drink Shop	Coffee Shop	Pizza Place	Pub	Movie Theater	Restaurant
23	2	LaSalle	Montreal	Breakfast Spot	Fast Food Restaurant	Pharmacy	Coffee Shop	Grocery Store	Pizza Place	Gym / Fitness Center	Discount Store	Sandwich Place

26	2	Le Sud-Ouest	Montreal	Pizza Place	French Restaurant	Restaurant	Brewery	Mexican Restaurant	Breakfast Spot	Bakery	Park	Grocery Store	
30	2	Montréal-Nord	Montreal	Pharmacy	Restaurant	Fast Food Restaurant	Gas Station	Gastropub	Pizza Place	Convenience Store	Sandwich Place	Ice Cream Shop	
31	2	Montréal-Ouest	Montreal	Park	Tunnel	Bakery	Bank	Deli / Bodega	Baseball Field	Burger Joint	Shipping Store	Pharmacy	
34	2	Outremont	Montreal	Park	Bakery	Restaurant	Italian Restaurant	Café	Mediterranean Restaurant	Sandwich Place	Asian Restaurant	French Restaurant	Re
36	2	Pierrefonds-Roxboro	Montreal	Pizza Place	Grocery Store	Restaurant	Pharmacy	Asian Restaurant	Coffee Shop	Diner	Sandwich Place	Discount Store	
37	2	Pointe-Claire	Montreal	Park	Soccer Field	Hobby Shop	Bakery	Organic Grocery	Liquor Store	Bank	Shopping Mall	Bar	
41	2	Rivière-des-Prairies-Pointe-aux-Trembles	Montreal	Restaurant	Pharmacy	Grocery Store	Italian Restaurant	Business Service	Thai Restaurant	Breakfast Spot	Shopping Mall	Supermarket	I
44	2	Rosemont-La Petite-Patrie	Montreal	Pharmacy	Park	Convenience Store	Breakfast Spot	Sandwich Place	Italian Restaurant	Grocery Store	Bar	Hardware Store	
46	2	Saint-Léonard	Montreal	Italian Restaurant	Gas Station	Dessert Shop	Hotel	Drugstore	Restaurant	Coffee Shop	Discount Store	Miscellaneous Shop	
53	2	The Beaches	Toronto	Trail	Asian Restaurant	Health Food Store	Pub	Eastern European Restaurant	Distribution Center	Dog Run	Doner Restaurant	Donut Shop	C
57	2	Verdun	Montreal	Pizza Place	Grocery Store	Restaurant	Indian Restaurant	Café	Bakery	Trail	Playground	Sushi Restaurant	Re
59	2	Villeray-Saint-Michel-Parc-Extension	Montreal	Fast Food Restaurant	Gas Station	Pharmacy	Portuguese Restaurant	Sandwich Place	Diner	Bakery	Ice Cream Shop	Deli / Bodega	Re

The cluster 3 is somehow similar to the cluster 2. But we might notice that, Compared to cluster 2, there are more diverse categories of venues and not just restaurants, coffee shops and bars. The neighbourhoods in cluster 3 seems to cover more aspects of people's living. Therefore, the neighbourhoods in this cluster is likely to be close to midtown or suburbs.

Table 6.4 : cluster 4

Cluster Labels	Neighborhood	City	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	
24	3	Lawrence Park	Toronto	Bus Line	Park	Swim School	Women's Store	Dumpling Restaurant	Dog Run	Doner Restaurant	Donut Shop	Drugstore	Eastern European Restaurant

Table 6.5 : cluster 5

Cluster Labels	Neighborhood	City	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	
32	4	Moore Park, Summerhill East	Toronto	Trail	Restaurant	Park	Women's Store	Discount Store	Distribution Center	Dog Run	Doner Restaurant	Donut Shop	Drugstore
42	4	Rosedale	Toronto	Park	Playground	Trail	Women's Store	Dumpling Restaurant	Discount Store	Distribution Center	Dog Run	Doner Restaurant	Donut Shop

Cluster 4 and 5 are similar since they both have more parks and trails where people can walk their dogs or have a picnic. It is very likely that these two clusters will be merged when setting cluster number to be 4 instead of 5.

## Conclusion:

With these clustering information, if we know the neighbourhood that someone likes, we can recommend a similar neighbourhood in another city. This can reduce the time people spend on doing research and quickly find out the candidate neighbourhoods to choose. In future study, the number of city covered can be further extended and provide stronger functionality.