# Capstone Project - The Battle of Neighbourhoods

**By Mudundi Sri Harsha**

**Email: harsha8745@gmail.com**

## Introduction/Business Problem

New York City and the city of Toronto are very diverse and are the financial capitals of their respective countries. Since we already explored certain boroughs of New York City and the city of Toronto and segmented and clustered their neighbourhoods, this time let's try to cluster whole city and their entire neighbourhoods to find similarities among them.

The aim of this project is to build a guide which will show which neighbourhoods are similar between these two cities. This can be helpful for businesses that are trying to expand from one city to another or for people trying to relocate from one city to another and doesn't want to miss out the amenities they had in the previous city.

## Data

1. **New York Data**

   - New York has a total of 5 boroughs and 306 neighbourhoods. In order to segment the neighbourhoods and explore them, we will essentially need a dataset that contains the 5 boroughs and the neighbourhoods that exist in each borough as well as the the latitude and longitude coordinates of each neighbourhood.
   - The following json file has been used to obtain the data about the neighbourhoods in New York.
     - Source: https://cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud/IBMDeveloperSkillsNetwork-DS0701EN-SkillsNetwork/labs/newyork_data.json
   - Geopy library was used to get the latitude and longitude values of New York City.

2. **Toronto data**
   - Toronto has a total of 10 boroughs and 103 neighbourhoods. In order to segment the neighbourhoods and explore them, we will essentially need a dataset that contains the 10 boroughs and the neighbourhoods that exist in each borough as well as the the latitude and longitude coordinates of each neighbourhood.
   - Web scraping was used to acquire the data about neighbourhoods in Toronto, from the following source
     - Source: https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M
   - Sometimes geopy is not reliable in retrieving coordinates, so for getting coordinates of all the neighbourhoods in Toronto the following source was used
     - Source of geographical coordinates of the neighbourhoods in Toronto: http://cocl.us/Geospatial_data
   - Geopy library was used to get the latitude and longitude values of Toronto

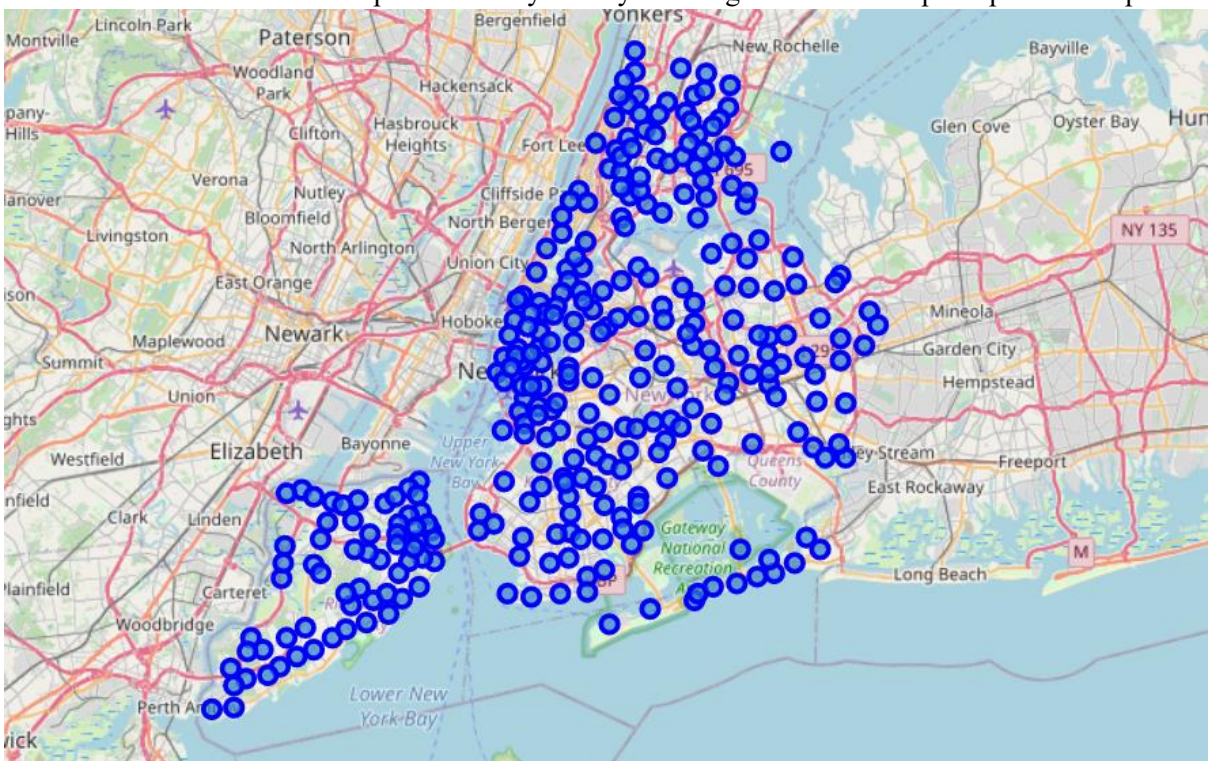
3. **Foursquare API**
   Foursquare API was utilizing the to explore the neighbourhoods and to get the data about venues and segment them.

## Methodology

1. The required libraries were loaded

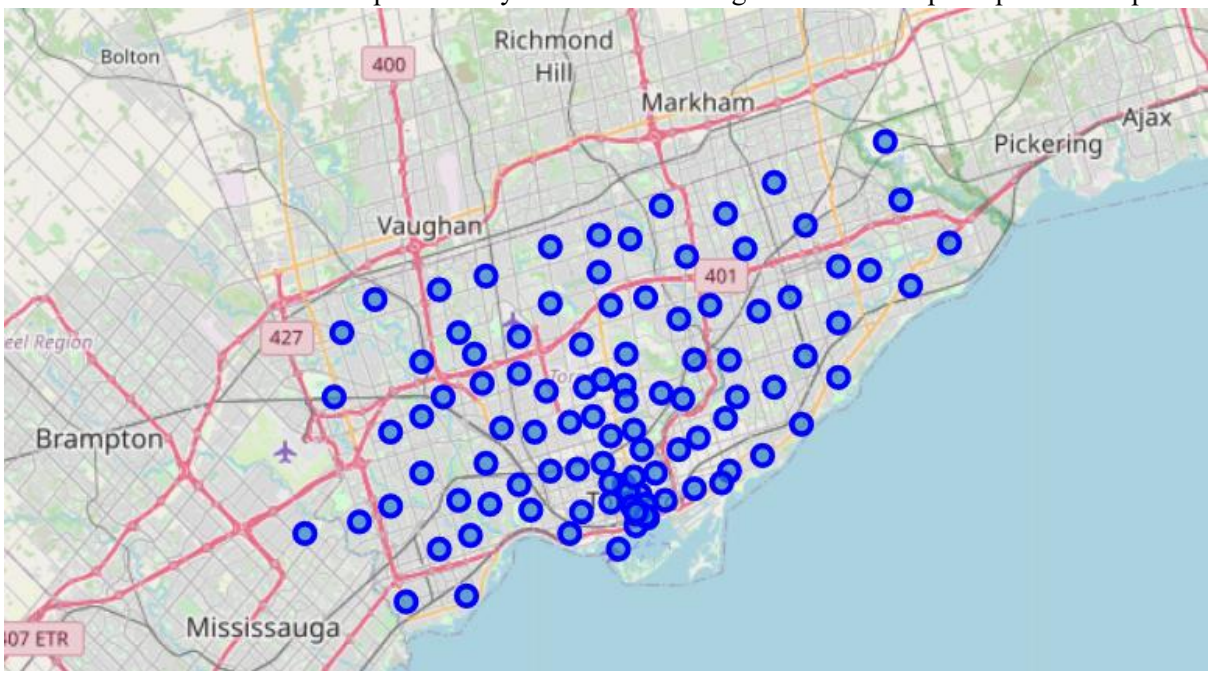
```
In [ ]: import numpy as np # library to handle data in a vectorized manner

        import pandas as pd # library for data analsysis
        pd.set_option('display.max_columns', None)
        pd.set_option('display.max_rows', None)

        from geopy.geocoders import Nominatim # convert an address into latitude and longitude values

        import requests # library to handle requests
        import json # library to handle JSON files
        from pandas import json_normalize # tranform JSON file into a pandas dataframe

        # Matplotlib and associated plotting modules
        import matplotlib.cm as cm
        import matplotlib.colors as colors

        # import k-means from clustering stage
        from sklearn.cluster import KMeans

        import folium # map rendering library

        print('Libraries imported.')

           Libraries imported.
```

2. Features data from the downloaded new york json file was loaded into a data frame
3. Data wrangling was done to extract 'Borough', 'Neighborhood', 'Latitude', 'Longitude' data of various neighbourhoods in ney york city
4. The coordinates of ney york city were obtained using geopy library
5. Folium was used to create a map of the new york city and neighbourhood's superimposed on top.




6. Now toronto data was acquired using web scraping with the help of pandas library
7. Data wrangling was done to remove bouroghs which were not not assigned.
8. File containing geographical coordinates of the neighborhoods in toronto was loaded as a data frame
9. The data was merged inorder to obtain 'Borough', 'Neighborhood', 'Latitude', 'Longitude' data of various neighbourhoods in city of toronto
10. The coordinates of city of toronto were obtained using geopy library

11. Folium was used to create a map of the city of toronto and neighbourhood's superimposed on top.




12. Now both Ney york data and city of toronto were merged together with column containing 'Borough', 'Neighborhood', 'Latitude', 'Longitude' data of various neighbourhoods

```
In [ ]: neighborhoods.reset_index(drop=True,inplace=True)
        neighborhoods
```

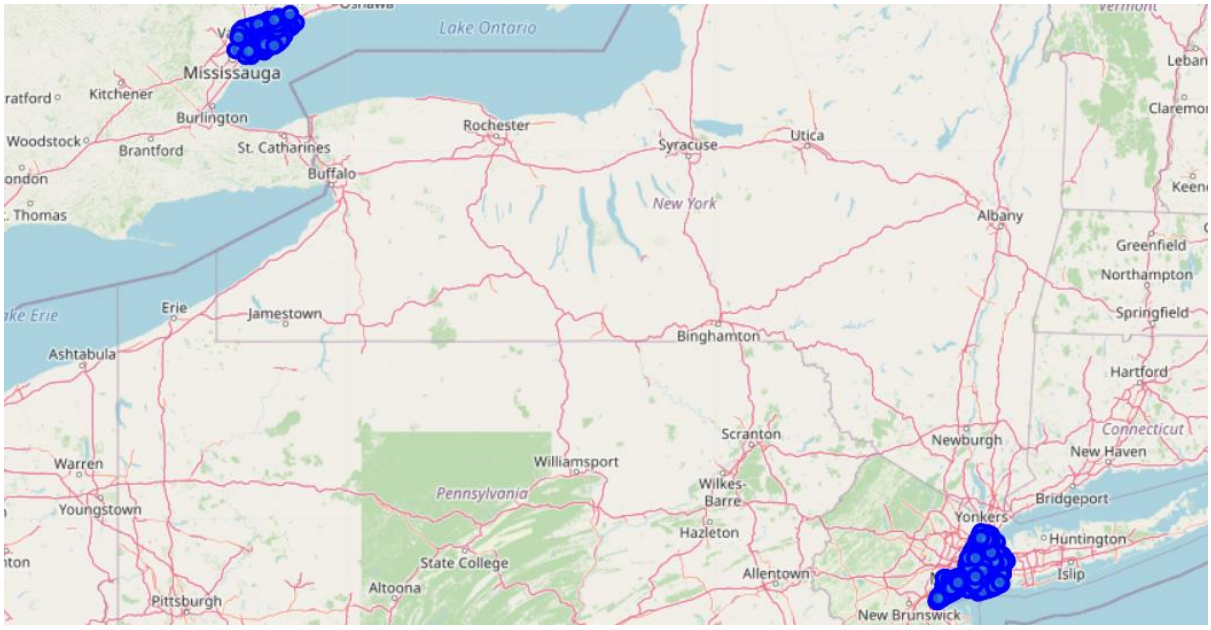
Out[55]:

| | Borough | Neighborhood | Latitude | Longitude |
|---|---|---|---|---|
| 0 | Bronx | Wakefield | 40.894705 | -73.847201 |
| 1 | Bronx | Co-op City | 40.874294 | -73.829939 |
| 2 | Bronx | Eastchester | 40.887556 | -73.827806 |
| 3 | Bronx | Fieldston | 40.895437 | -73.905643 |
| 4 | Bronx | Riverdale | 40.890834 | -73.912585 |
| 5 | Bronx | Kingsbridge | 40.881687 | -73.902818 |
| 6 | Manhattan | Marble Hill | 40.876551 | -73.910660 |
| 7 | Bronx | Woodlawn | 40.898273 | -73.867315 |
| 8 | Bronx | Norwood | 40.877224 | -73.879391 |
| 9 | Bronx | Williamsbridge | 40.881039 | -73.857446 |
| 10 | Bronx | Baychester | 40.866858 | -73.835798 |
| 11 | Bronx | Pelham Parkway | 40.857413 | -73.854756 |

```
In [ ]: neighborhoods['Borough'].unique()
```

```
Out[56]: array(['Bronx', 'Manhattan', 'Brooklyn', 'Queens', 'Staten Island',
                 'North York', 'Downtown Toronto', 'Etobicoke', 'Scarborough',
                 'East York', 'York', 'East Toronto', 'West Toronto',
                 'Central Toronto', 'Mississauga'], dtype=object)
```

13. Folium was used to create a map of the combined data and neighbourhood's superimposed on top.




14. Foursquare was used to get the data of all venues in the neighborhoods. This was done by passing the credentials and query into the uri of the foursquare api
15. One hot encoding was done to convert categorical variables into dummies.

**Analyze Each Neighborhood**

```
In [ ]: # one hot encoding
combined_cities_onehot = pd.get_dummies(venues_list[['Venue Category']], prefix="", prefix_sep="")

# add neighborhood column back to dataframe
combined_cities_onehot['Neighborhood'] = venues_list['Neighborhood']
```

Out[70]:

| | Yoga Studio | Accessories Store | Adult Boutique | Afghan Restaurant | African Restaurant | Airport | Airport Food Court | Airport Gate | Airport Lounge | Airport Service | Airport Terminal | American Restaurant | Animal Shelter | Antique Shop | Aquarium | Arcade | Arepa Restaurant | Argentinian Restaurant | Art Gallery | Art Museum | Arts & Crafts Store | En |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

16. The data was grouped rows by neighborhood and by taking the mean of the frequency of occurrence of each category
17. K means was for clustering because its fast and efficient in analysing large sized databases
18. K was set to 10 clusters, so that we can have more choice in identifying clusters that are very similar

**Cluster Neighborhoods**

Lets run *k*-means to cluster the neighborhood into 10 clusters, so that we can have more choice in identifying clusters that are very similar

```
In [ ]: # set number of clusters
kclusters = 10

combined_cities_grouped_clustering = combined_cities_grouped.drop('Neighborhood', 1)

# run k-means clustering
kmeans = KMeans(n_clusters=kclusters, random_state=0).fit(combined_cities_grouped_clustering)

# check cluster labels generated for each row in the dataframe
kmeans.labels_[0:10]
```

```
Out[91]: array([0, 1, 1, 1, 1, 1, 1, 0, 0, 1], dtype=int32)
```

19. The labels data was visualized using folium as s shown below

In [ ]:
```
# add clustering labels
neighborhoods_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)

# merge manhattan_grouped with manhattan_data to add latitude/longitude for each neighborhood
neighborhoods_venues_sorted = neighborhoods_venues_sorted.join(neighborhoods.set_index('Neighborhood'), on='Neighborhood')

neighborhoods_venues_sorted.head() # check the last columns!
```

Out[92]:

| | Cluster Labels | Neighborhood | 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 | Borough | Latitude | Longitude |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | Agincourt | Print Shop | Breakfast Spot | Latin American Restaurant | Lounge | Wings Joint | Falafel Restaurant | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Scarborough | 43.794200 | -79.262029 |
| 1 | 1 | Alderwood, Long Branch | Pizza Place | Athletics & Sports | Dance Studio | Pub | Gym | Skating Rink | Sandwich Place | Coffee Shop | Event Service | Ethiopian Restaurant | Etobicoke | 43.602414 | -79.543484 |
| 2 | 1 | Allerton | Pizza Place | Supermarket | Deli / Bodega | Spa | Chinese Restaurant | Intersection | Electronics Store | Grocery Store | Breakfast Spot | Check Cashing Service | Bronx | 40.865788 | -73.859319 |
| 3 | 1 | Annadale | Pizza Place | Pub | Diner | Restaurant | Train Station | Food | Cosmetics Shop | Liquor Store | Duty-free Shop | Eastern European Restaurant | Staten Island | 40.538114 | -74.178549 |
| 4 | 1 | Arden Heights | Coffee Shop | Pharmacy | Deli / Bodega | Pizza Place | Wings Joint | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Staten Island | 40.549286 | -74.185887 |

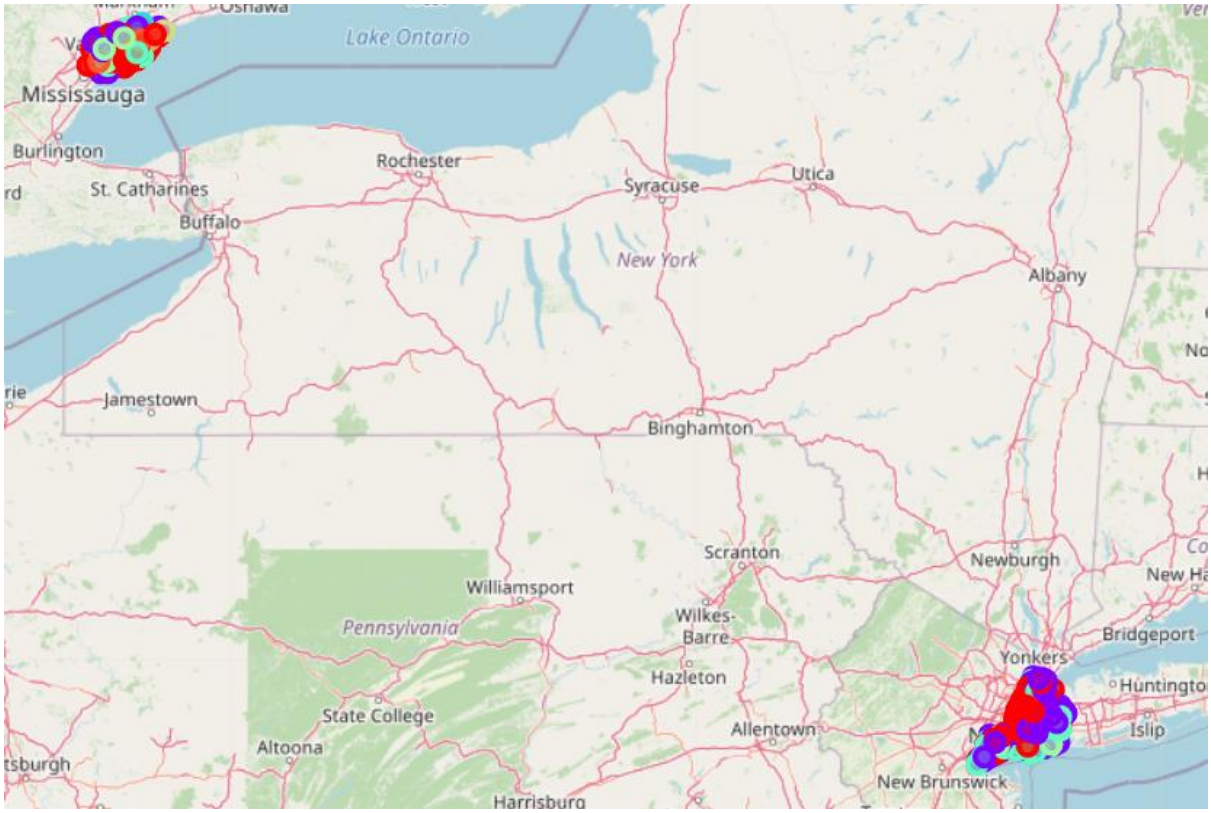



Fig: clusters of new york city and City of toronto created using folium

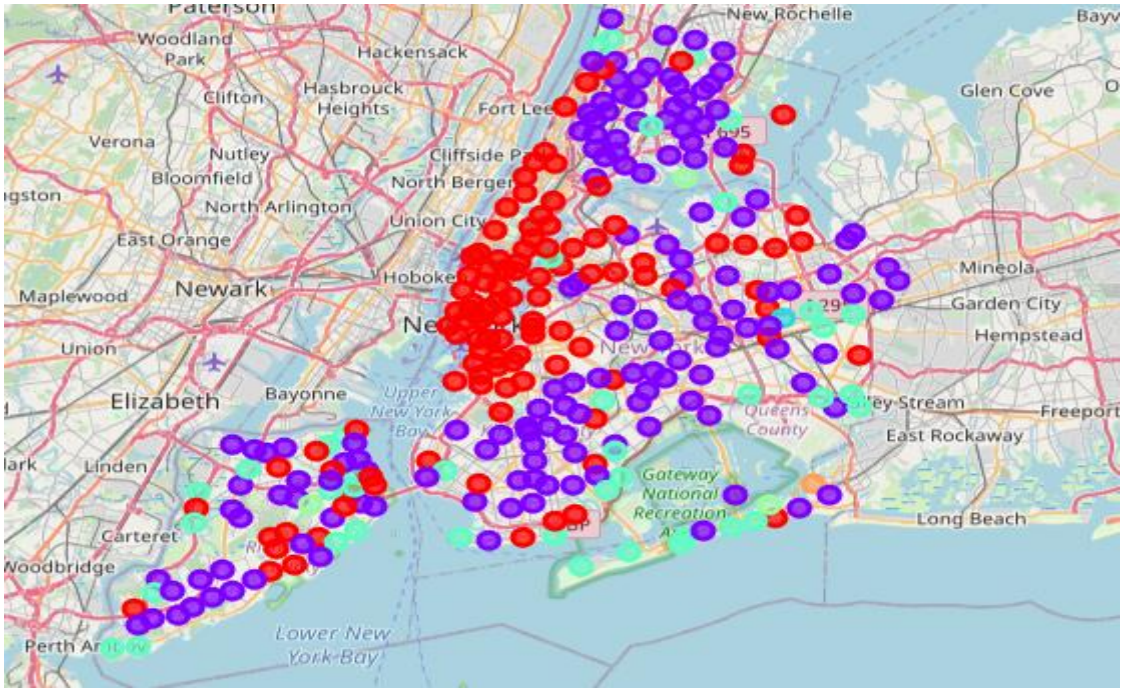



Fig: Close view at the clusters of New york city created using folium

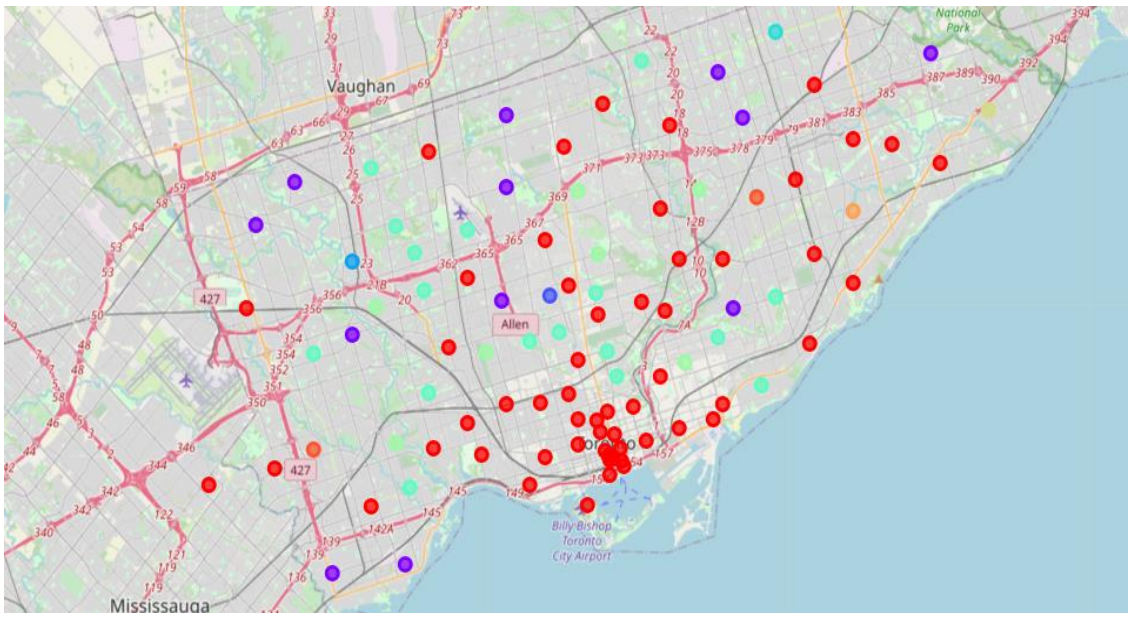



Fig: Close view at the clusters of city of toronto created using folium

# Results and discussion

The following clusters were obtained:

**Cluster 1**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 0, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[114]:

| | Neighborhood | 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 | Agincourt | Print Shop | Breakfast Spot | Latin American Restaurant | Lounge | Wings Joint | Falafel Restaurant | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service |
| 7 | Arverne | Surf Spot | Sandwich Place | Metro Station | Board Shop | Restaurant | Café | Beach | Bus Stop | Donut Shop | Burrito Place |
| 8 | Astoria | Bar | Middle Eastern Restaurant | Seafood Restaurant | Bakery | Greek Restaurant | Mediterranean Restaurant | Hookah Bar | Café | Indian Restaurant | Gym / Fitness Center |
| 10 | Auburndale | Italian Restaurant | Discount Store | Athletics & Sports | Toy / Game Store | Pet Store | Pharmacy | Supermarket | Bar | Noodle House | Fast Food Restaurant |
| 13 | Battery Park City | Park | Hotel | Coffee Shop | Boat or Ferry | Clothing Store | Gym | Memorial Site | Food Court | Burger Joint | Sandwich Place |
| 14 | Bay Ridge | Pizza Place | Italian Restaurant | Spa | American Restaurant | Bagel Shop | Bar | Grocery Store | Greek Restaurant | Cosmetics Shop | Pharmacy |
| 15 | Bay Terrace | Clothing Store | Donut Shop | Supermarket | Women's Store | American Restaurant | Shoe Store | Men's Store | Kids Store | Mobile Phone Shop | Cosmetics Shop |
| 15 | Bay Terrace | Clothing Store | Donut Shop | Supermarket | Women's Store | American Restaurant | Shoe Store | Men's Store | Kids Store | Mobile Phone Shop | Cosmetics Shop |
| 17 | Bayside | Bar | Pub | Sushi Restaurant | Indian Restaurant | Pizza Place | Mexican Restaurant | Bakery | Donut Shop | Italian Restaurant | Steakhouse |
| 19 | Bayview Village | Chinese Restaurant | Japanese Restaurant | Bank | Café | Wings Joint | Farm | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant |

**Cluster 2**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 1, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[113]:

| | Neighborhood | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Alderwood, Long Branch | Pizza Place | Athletics & Sports | Dance Studio | Pub | Gym | Skating Rink | Sandwich Place | Coffee Shop | Event Service | Ethiopian Restaurant |
| 2 | Allerton | Pizza Place | Supermarket | Deli / Bodega | Spa | Chinese Restaurant | Intersection | Electronics Store | Grocery Store | Breakfast Spot | Check Cashing Service |
| 3 | Annadale | Pizza Place | Pub | Diner | Restaurant | Train Station | Food | Cosmetics Shop | Liquor Store | Duty-free Shop | Eastern European Restaurant |
| 4 | Arden Heights | Coffee Shop | Pharmacy | Deli / Bodega | Pizza Place | Wings Joint | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room |
| 5 | Arlington | Bus Stop | Boat or Ferry | Grocery Store | Deli / Bodega | Coffee Shop | Wings Joint | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant |
| 6 | Arrochar | Pizza Place | Bagel Shop | Bus Stop | Italian Restaurant | Deli / Bodega | Liquor Store | Mediterranean Restaurant | Supermarket | Middle Eastern Restaurant | Taco Place |
| 9 | Astoria Heights | Italian Restaurant | Bowling Alley | Pizza Place | Burger Joint | Bus Station | Supermarket | Bakery | Chinese Restaurant | Museum | Cocktail Bar |
| 11 | Bath Beach | Pizza Place | Chinese Restaurant | Bubble Tea Shop | Fast Food Restaurant | Donut Shop | Cantonese Restaurant | Gas Station | Italian Restaurant | Pharmacy | Ice Cream Shop |
| 12 | Bathurst Manor, Wilson Heights, | Bank | Coffee Shop | Grocery Store | Mobile Phone Shop | Bridal Shop | Sandwich Place | Shopping Mall | Gas Station | Sushi Restaurant | Middle Eastern |

**Cluster 3**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 2, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[115]:

| | Neighborhood | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 303 | Roselawn | Garden | Wings Joint | Farmers Market | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |

**Cluster 4**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 3, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[116]:

| | Neighborhood | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 175 | Humberlea, Emery | Baseball Field | Wings Joint | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |

**Cluster 5**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 4, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[117]:

| | Neighborhood | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 183 | Jamaica Estates | Intersection | Dog Run | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |
| 228 | Milliken, Agincourt North, Steeles East, L'Amo... | Intersection | Park | Playground | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant |

**Cluster 6**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 5, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[118]:

| | Neighborhood | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | Belle Harbor | Beach | Pub | Spa | Deli / Bodega | Bakery | Chinese Restaurant | Bagel Shop | Donut Shop | Mexican Restaurant | Boutique |
| 30 | Bergen Beach | Harbor / Marina | Park | Athletics & Sports | Baseball Field | Playground | Falafel Restaurant | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service |
| 33 | Bloomfield | Theme Park | Bus Stop | Recreation Center | Burger Joint | Duty-free Shop | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room |
| 36 | Breezy Point | Beach | Monument / Landmark | Trail | Bus Stop | Wings Joint | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |
| 45 | Brownsville | Moving Target | Fried Chicken Joint | Trail | Plaza | Playground | Pizza Place | Performing Arts Venue | Chinese Restaurant | Park | Farmers Market |
| 49 | Butler Manor | Pool | Baseball Field | Gas Station | Wings Joint | Farmers Market | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant |
| 86 | Country Club | Sandwich Place | Athletics & Sports | Playground | Trail | Wings Joint | Factory | Duty-free Shop | Eastern European Restaurant | Electronics Store | Empanada Restaurant |

**Cluster 7**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 6, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[119]:

| | Neighborhood | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | Caledonia-Fairbanks | Park | Women's Store | Pool | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant |
| 72 | Clason Point | Park | Pool | Boat or Ferry | South American Restaurant | Bus Stop | Grocery Store | Convenience Store | Curling Ice | Empanada Restaurant | Cupcake Shop |
| 106 | East Toronto, Broadview North (Old East York) | Intersection | Park | Convenience Store | Accessories Store | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant |
| 195 | Lawrence Park | Park | Bus Line | Swim School | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |
| 269 | Parkwoods | Park | Food & Drink Shop | Wings Joint | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant |
| 318 | Somerville | Park | Wings Joint | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |
| 346 | The Kingsway, Montgomery Road, Old Mill North | Park | River | Wings Joint | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant |
| 349 | Todt Hill | Park | Wings Joint | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |
| 376 | Weston | Convenience Store | Park | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |
| 392 | York Mills West | Convenience Store | Park | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |

**Cluster 8**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 7, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[120]:

| | Neighborhood | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 305 | Rouge Hill, Port Union, Highland Creek | Bar | Wings Joint | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |

**Cluster 9**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 8, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[121]:

| | Neighborhood | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Bayswater | Tennis Court | Playground | Wings Joint | Farm | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant |
| 311 | Scarborough Village | Playground | Wings Joint | Farmers Market | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service |

**Cluster 10**

```
In [ ]: neighborhoods_venues_sorted.loc[neighborhoods_venues_sorted['Cluster Labels'] == 9, neighborhoods_venues_sorted.columns[[1] + list(range(2,12))]]
```

Out[124]:

| | Neighborhood | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 370 | West Deane Park, Princess Gardens, Martin Grov... | Middle Eastern Restaurant | Farmers Market | Eastern European Restaurant | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room | Ethiopian Restaurant | Event Service | Event Space |
| 377 | Wexford, Maryvale | Auto Garage | Bakery | Sandwich Place | Middle Eastern Restaurant | Wings Joint | Farm | Electronics Store | Empanada Restaurant | Entertainment Service | Escape Room |

- Clusters 3,4,8 are unique to their city as they have only one neighborhood
- Clusters 5,9 has two neighborhoods,each one belonging to different cities.
- Cluster 10 has two neighborhoods both belonging to Toronto
- Cluster 7 has 10 neighborhoods, of which some belong to New York city and the rest belonging to Toronto city
- Cluster 6 has 57 neighborhoods, of which some belong to New York city and the rest belonging to Toronto city
- Cluster 2 has 160 neighborhoods, of which some belong to New York city and the rest belonging to Toronto city
- Cluster 1 has 167 neighborhoods(the maximum), of which some belong to New York city and the rest belonging to Toronto city

As we can see most of the neighbourhoods fall into cluster 1 and 2 due to the high frequency of venues like coffee shops,cafe,gym, parks, bakery, lounges etc.

## Conclusion

We have successfully clustered neighbourhoods of Ney york city and City of Toronto using K-Means machine learning algorithm, location data provided by foursquare and several python libraries like pandas for data wrangling , folium for vizualisation , geopy for getting get coordinates.

These obtained clusters can be used by the people relocating from one city to another city, to find the neighborhoobs with similar amenities to their previous city.

They can be also used for creating business oppurtunities like finding clusters with low frequency of a certain venue and high polulation density.