Beginning of Part 1

import required library

In [1]:
```
import pandas as pd
```

In [2]:
```
import sys
!{sys.executable} -m pip install folium
```

```
Collecting folium
  Downloading https://files.pythonhosted.org/packages/72/ff/004bfe344150a064e558cb2aede
aa02ecbf75e60e148a55a9198f0c41765/folium-0.10.0-py2.py3-none-any.whl (91kB)
     |████████████████████████████████| 92kB 11.6MB/s eta 0:00:01
Collecting branca>=0.3.0 (from folium)
  Downloading https://files.pythonhosted.org/packages/63/36/1c93318e9653f4e414a2e0c3b98
fc898b4970e939afeedeee6075dd3b703/branca-0.3.1-py3-none-any.whl
Requirement already satisfied: numpy in /opt/conda/envs/Python36/lib/python3.6/site-pac
kages (from folium) (1.15.4)
Requirement already satisfied: jinja2>=2.9 in /opt/conda/envs/Python36/lib/python3.6/si
te-packages (from folium) (2.10)
Requirement already satisfied: requests in /opt/conda/envs/Python36/lib/python3.6/site-
packages (from folium) (2.21.0)
Requirement already satisfied: six in /opt/conda/envs/Python36/lib/python3.6/site-packa
ges (from branca>=0.3.0->folium) (1.12.0)
Requirement already satisfied: MarkupSafe>=0.23 in /opt/conda/envs/Python36/lib/python
3.6/site-packages (from jinja2>=2.9->folium) (1.1.0)
Requirement already satisfied: idna<2.9,>=2.5 in /opt/conda/envs/Python36/lib/python3.
6/site-packages (from requests->folium) (2.8)
Requirement already satisfied: chardet<3.1.0,>=3.0.2 in /opt/conda/envs/Python36/lib/py
thon3.6/site-packages (from requests->folium) (3.0.4)
Requirement already satisfied: certifi>=2017.4.17 in /opt/conda/envs/Python36/lib/pytho
n3.6/site-packages (from requests->folium) (2019.6.16)
Requirement already satisfied: urllib3<1.25,>=1.21.1 in /opt/conda/envs/Python36/lib/py
thon3.6/site-packages (from requests->folium) (1.24.1)
Installing collected packages: branca, folium
Successfully installed branca-0.3.1 folium-0.10.0
```

Define the Wiki URL

In [3]:
```
URL = "https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M"
```

Read the wiki

In [4]:
```
df = pd.read_html(URL)[0]
```

Only process the cells that have an assigned borough. Ignore cells with a borough that is Not assigned

In [5]:
```
df = df[df.Borough != 'Not assigned']
```

for each similar postcode, combine corresponding neighbourhood in one row with the neighborhoods separated with a comma

In [6]:
```
df = df.groupby(['Postcode', 'Borough'])['Neighbourhood']
df = df.apply(list).apply(lambda x:', '.join(x))
df = df.to_frame().reset_index()
df.head()
```

Out[6]:

	Postcode	Borough	Neighbourhood
0	M1B	Scarborough	Rouge, Malvern
1	M1C	Scarborough	Highland Creek, Rouge Hill, Port Union
2	M1E	Scarborough	Guildwood, Morningside, West Hill
3	M1G	Scarborough	Woburn
4	M1H	Scarborough	Cedarbrae

If a cell has a borough but a Not assigned neighborhood, then the neighborhood will be the same as the borough

In [7]:
```
for index, row in df.iterrows():
    if row['Neighbourhood'] == 'Not assigned':
        row['Neighbourhood'] = row['Borough']
```

Use the .shape method to print the number of rows of your dataframe

In [8]:
```
df.shape
```

Out[8]:
```
(103, 3)
```

Beginning of Part 2

Read a csv file that has the geographical coordinates of each postal code

In [9]:
```
file=pd.read_csv("https://cocl.us/Geospatial_data")
```

Rename Postal Code to Postcode and combine the excel file data with dataframe based on Postcode

In [12]:
```
file.columns = ['Postcode', 'Latitude', 'Longitude']
df = pd.merge(file, df, on='Postcode')
df
```

Out[12]:

	Postcode	Latitude	Longitude	Latitude_x	Longitude_x	Latitude_y	Longitude_y	Borough	Neighb
0	M1B	43.806686	-79.194353	43.806686	-79.194353	43.806686	-79.194353	Scarborough	Rouge
1	M1C	43.784535	-79.160497	43.784535	-79.160497	43.784535	-79.160497	Scarborough	Highla Rouge
2	M1E	43.763573	-79.188711	43.763573	-79.188711	43.763573	-79.188711	Scarborough	G Mo
3	M1G	43.770992	-79.216917	43.770992	-79.216917	43.770992	-79.216917	Scarborough	
4	M1H	43.773136	-79.239476	43.773136	-79.239476	43.773136	-79.239476	Scarborough	C
5	M1J	43.744734	-79.239476	43.744734	-79.239476	43.744734	-79.239476	Scarborough	Sca
6	M1K	43.727929	-79.262029	43.727929	-79.262029	43.727929	-79.262029	Scarborough	East B Park Kenı
7	M1L	43.711112	-79.284577	43.711112	-79.284577	43.711112	-79.284577	Scarborough	Clairle Mile,
8	M1M	43.716316	-79.239476	43.716316	-79.239476	43.716316	-79.239476	Scarborough	Sca Vil
9	M1N	43.692657	-79.264848	43.692657	-79.264848	43.692657	-79.264848	Scarborough	I Cliff
10	M1P	43.757410	-79.273304	43.757410	-79.273304	43.757410	-79.273304	Scarborough	Do Sca Tow W
11	M1R	43.750072	-79.295849	43.750072	-79.295849	43.750072	-79.295849	Scarborough	
12	M1S	43.794200	-79.262029	43.794200	-79.262029	43.794200	-79.262029	Scarborough	
13	M1T	43.781638	-79.304302	43.781638	-79.304302	43.781638	-79.304302	Scarborough	Clarks Sull
14	M1V	43.815252	-79.284577	43.815252	-79.284577	43.815252	-79.284577	Scarborough	Agincc L'A East
15	M1W	43.799525	-79.318389	43.799525	-79.318389	43.799525	-79.318389	Scarborough	L'A
16	M1X	43.836125	-79.205636	43.836125	-79.205636	43.836125	-79.205636	Scarborough	Upp
17	M2H	43.803762	-79.363452	43.803762	-79.363452	43.803762	-79.363452	North York	Hillcre
18	M2J	43.778517	-79.346556	43.778517	-79.346556	43.778517	-79.346556	North York	Fairvi Fa
19	M2K	43.786947	-79.385975	43.786947	-79.385975	43.786947	-79.385975	North York	Bayvie
20	M2L	43.757490	-79.374714	43.757490	-79.374714	43.757490	-79.374714	North York	Silver
21	M2M	43.789053	-79.408493	43.789053	-79.408493	43.789053	-79.408493	North York	New W
22	M2N	43.770120	-79.408493	43.770120	-79.408493	43.770120	-79.408493	North York	W
23	M2P	43.752758	-79.400049	43.752758	-79.400049	43.752758	-79.400049	North York	York I

	Postcode	Latitude	Longitude	Latitude_x	Longitude_x	Latitude_y	Longitude_y	Borough	Neighb
24	M2R	43.782736	-79.442259	43.782736	-79.442259	43.782736	-79.442259	North York	Willow
25	M3A	43.753259	-79.329656	43.753259	-79.329656	43.753259	-79.329656	North York	P
26	M3B	43.745906	-79.352188	43.745906	-79.352188	43.745906	-79.352188	North York	Don M
27	M3C	43.725900	-79.340923	43.725900	-79.340923	43.725900	-79.340923	North York	Fl Park,
28	M3H	43.754328	-79.442259	43.754328	-79.442259	43.754328	-79.442259	North York	Bathu D Nor
29	M3J	43.767980	-79.487262	43.767980	-79.487262	43.767980	-79.487262	North York	Northw York
...	...	...	...	...	...	...	...	...	
73	M6C	43.693781	-79.428191	43.693781	-79.428191	43.693781	-79.428191	York	Hu
74	M6E	43.689026	-79.453512	43.689026	-79.453512	43.689026	-79.453512	York	C
75	M6G	43.669542	-79.422564	43.669542	-79.422564	43.669542	-79.422564	Downtown Toronto	
76	M6H	43.669005	-79.442259	43.669005	-79.442259	43.669005	-79.442259	West Toronto	D Village
77	M6J	43.647927	-79.419750	43.647927	-79.419750	43.647927	-79.419750	West Toronto	Little
78	M6K	43.636847	-79.428191	43.636847	-79.428191	43.636847	-79.428191	West Toronto	Exhibit Parkda
79	M6L	43.713756	-79.490074	43.713756	-79.490074	43.713756	-79.490074	North York	D N Upv
80	M6M	43.691116	-79.476013	43.691116	-79.476013	43.691116	-79.476013	York	K Mou S
81	M6N	43.673185	-79.487262	43.673185	-79.487262	43.673185	-79.487262	York	The Ru
82	M6P	43.661608	-79.464763	43.661608	-79.464763	43.661608	-79.464763	West Toronto	High Junct
83	M6R	43.648960	-79.456325	43.648960	-79.456325	43.648960	-79.456325	West Toronto	Ror
84	M6S	43.651571	-79.484450	43.651571	-79.484450	43.651571	-79.484450	West Toronto	Ru
85	M7A	43.662301	-79.389494	43.662301	-79.389494	43.662301	-79.389494	Queen's Park	Que
86	M7R	43.636966	-79.615819	43.636966	-79.615819	43.636966	-79.615819	Mississauga	Ca P
87	M7Y	43.662744	-79.321558	43.662744	-79.321558	43.662744	-79.321558	East Toronto	Busin Mail P C

	Postcode	Latitude	Longitude	Latitude_x	Longitude_x	Latitude_y	Longitude_y	Borough	Neighb
88	M8V	43.605647	-79.501321	43.605647	-79.501321	43.605647	-79.501321	Etobicoke	Hu Shore S
89	M8W	43.602414	-79.543484	43.602414	-79.543484	43.602414	-79.543484	Etobicoke	A Lo
90	M8X	43.653654	-79.506944	43.653654	-79.506944	43.653654	-79.506944	Etobicoke	The Mc Roa
91	M8Y	43.636258	-79.498509	43.636258	-79.498509	43.636258	-79.498509	Etobicoke	Hu King's Kings
92	M8Z	43.628841	-79.520999	43.628841	-79.520999	43.628841	-79.520999	Etobicoke	Kings Sc Mimicc
93	M9A	43.667856	-79.532242	43.667856	-79.532242	43.667856	-79.532242	Etobicoke	Islingtc
94	M9B	43.650943	-79.554724	43.650943	-79.554724	43.650943	-79.554724	Etobicoke	C Islingt Grove
95	M9C	43.643515	-79.577201	43.643515	-79.577201	43.643515	-79.577201	Etobicoke	Markla
96	M9L	43.756303	-79.565963	43.756303	-79.565963	43.756303	-79.565963	North York	Humbe
97	M9M	43.724766	-79.532242	43.724766	-79.532242	43.724766	-79.532242	North York	H
98	M9N	43.706876	-79.518188	43.706876	-79.518188	43.706876	-79.518188	York	
99	M9P	43.696319	-79.532242	43.696319	-79.532242	43.696319	-79.532242	Etobicoke	W
100	M9R	43.688905	-79.554724	43.688905	-79.554724	43.688905	-79.554724	Etobicoke	Villa Grove
101	M9V	43.739416	-79.588437	43.739416	-79.588437	43.739416	-79.588437	Etobicoke	Albion E
102	M9W	43.706748	-79.594054	43.706748	-79.594054	43.706748	-79.594054	Etobicoke	Humb

103 rows × 9 columns

Reorder columms to match the required format of the dataframe

In [13]:
```
df = df[['Postcode', 'Borough', 'Neighbourhood', 'Latitude', 'Longitude']]
df
```

Out[13]:

	Postcode	Borough	Neighbourhood	Latitude	Longitude
0	M1B	Scarborough	Rouge, Malvern	43.806686	-79.194353
1	M1C	Scarborough	Highland Creek, Rouge Hill, Port Union	43.784535	-79.160497
2	M1E	Scarborough	Guildwood, Morningside, West Hill	43.763573	-79.188711
3	M1G	Scarborough	Woburn	43.770992	-79.216917
4	M1H	Scarborough	Cedarbrae	43.773136	-79.239476
5	M1J	Scarborough	Scarborough Village	43.744734	-79.239476
6	M1K	Scarborough	East Birchmount Park, Ionview, Kennedy Park	43.727929	-79.262029
7	M1L	Scarborough	Clairlea, Golden Mile, Oakridge	43.711112	-79.284577
8	M1M	Scarborough	Cliffcrest, Cliffside, Scarborough Village West	43.716316	-79.239476
9	M1N	Scarborough	Birch Cliff, Cliffside West	43.692657	-79.264848
10	M1P	Scarborough	Dorset Park, Scarborough Town Centre, Wexford ...	43.757410	-79.273304
11	M1R	Scarborough	Maryvale, Wexford	43.750072	-79.295849
12	M1S	Scarborough	Agincourt	43.794200	-79.262029
13	M1T	Scarborough	Clarks Corners, Sullivan, Tam O'Shanter	43.781638	-79.304302
14	M1V	Scarborough	Agincourt North, L'Amoreaux East, Milliken, St...	43.815252	-79.284577
15	M1W	Scarborough	L'Amoreaux West	43.799525	-79.318389
16	M1X	Scarborough	Upper Rouge	43.836125	-79.205636
17	M2H	North York	Hillcrest Village	43.803762	-79.363452
18	M2J	North York	Fairview, Henry Farm, Oriole	43.778517	-79.346556
19	M2K	North York	Bayview Village	43.786947	-79.385975
20	M2L	North York	Silver Hills, York Mills	43.757490	-79.374714
21	M2M	North York	Newtonbrook, Willowdale	43.789053	-79.408493
22	M2N	North York	Willowdale South	43.770120	-79.408493
23	M2P	North York	York Mills West	43.752758	-79.400049
24	M2R	North York	Willowdale West	43.782736	-79.442259
25	M3A	North York	Parkwoods	43.753259	-79.329656
26	M3B	North York	Don Mills North	43.745906	-79.352188
27	M3C	North York	Flemingdon Park, Don Mills South	43.725900	-79.340923
28	M3H	North York	Bathurst Manor, Downsview North, Wilson Heights	43.754328	-79.442259
29	M3J	North York	Northwood Park, York University	43.767980	-79.487262
...	...	...	...	...	...
73	M6C	York	Humewood-Cedarvale	43.693781	-79.428191
74	M6E	York	Caledonia-Fairbanks	43.689026	-79.453512
75	M6G	Downtown Toronto	Christie	43.669542	-79.422564
76	M6H	West Toronto	Dovercourt Village, Dufferin	43.669005	-79.442259
77	M6J	West Toronto	Little Portugal, Trinity	43.647927	-79.419750
78	M6K	West Toronto	Brockton, Exhibition Place, Parkdale Village	43.636847	-79.428191
79	M6L	North York	Downsview, North Park, Upwood Park	43.713756	-79.490074

	Postcode	Borough	Neighbourhood	Latitude	Longitude
80	M6M	York	Del Ray, Keelesdale, Mount Dennis, Silverthorn	43.691116	-79.476013
81	M6N	York	The Junction North, Runnymede	43.673185	-79.487262
82	M6P	West Toronto	High Park, The Junction South	43.661608	-79.464763
83	M6R	West Toronto	Parkdale, Roncesvalles	43.648960	-79.456325
84	M6S	West Toronto	Runnymede, Swansea	43.651571	-79.484450
85	M7A	Queen's Park	Queen's Park	43.662301	-79.389494
86	M7R	Mississauga	Canada Post Gateway Processing Centre	43.636966	-79.615819
87	M7Y	East Toronto	Business Reply Mail Processing Centre 969 Eastern	43.662744	-79.321558
88	M8V	Etobicoke	Humber Bay Shores, Mimico South, New Toronto	43.605647	-79.501321
89	M8W	Etobicoke	Alderwood, Long Branch	43.602414	-79.543484
90	M8X	Etobicoke	The Kingsway, Montgomery Road, Old Mill North	43.653654	-79.506944
91	M8Y	Etobicoke	Humber Bay, King's Mill Park, Kingsway Park So...	43.636258	-79.498509
92	M8Z	Etobicoke	Kingsway Park South West, Mimico NW, The Queen...	43.628841	-79.520999
93	M9A	Etobicoke	Islington Avenue	43.667856	-79.532242
94	M9B	Etobicoke	Cloverdale, Islington, Martin Grove, Princess ...	43.650943	-79.554724
95	M9C	Etobicoke	Bloordale Gardens, Eringate, Markland Wood, Ol...	43.643515	-79.577201
96	M9L	North York	Humber Summit	43.756303	-79.565963
97	M9M	North York	Emery, Humberlea	43.724766	-79.532242
98	M9N	York	Weston	43.706876	-79.518188
99	M9P	Etobicoke	Westmount	43.696319	-79.532242
100	M9R	Etobicoke	Kingsview Village, Martin Grove Gardens, Richv...	43.688905	-79.554724
101	M9V	Etobicoke	Albion Gardens, Beaumond Heights, Humbergate, ...	43.739416	-79.588437
102	M9W	Etobicoke	Northwest	43.706748	-79.594054

103 rows × 5 columns

Beginning of Part 3

Import necessary Libraries

In [14]:

```
import folium
from geopy.geocoders import Nominatim

import requests # library to handle requests
import pandas as pd # library for data analsysis
import numpy as np # library to handle data in a vectorized manner
import random # library for random number generation

!conda install -c conda-forge geopy --yes
from geopy.geocoders import Nominatim # module to convert an address into latitude and l
ongitude values

# libraries for displaying images
from IPython.display import Image
from IPython.core.display import HTML

# tranforming json file into a pandas dataframe library
from pandas.io.json import json_normalize

!conda install -c conda-forge folium=0.5.0 --yes
import folium # plotting library

print('Folium installed')
print('Libraries imported.')
```

```
Solving environment: done

## Package Plan ##

  environment location: /opt/conda/envs/Python36

  added / updated specs:
    - geopy


The following packages will be downloaded:

    package                    |            build
    ---------------------------|-----------------
    ca-certificates-2019.9.11  |       hecc5488_0         144 KB  conda-forge
    geographiclib-1.49         |             py_0          32 KB  conda-forge
    certifi-2019.9.11          |           py36_0         147 KB  conda-forge
    geopy-1.20.0               |             py_0          57 KB  conda-forge
    openssl-1.1.1c             |       h516909a_0         2.1 MB  conda-forge
    ------------------------------------------------------------
                                           Total:         2.5 MB

The following NEW packages will be INSTALLED:

    geographiclib:   1.49-py_0         conda-forge
    geopy:           1.20.0-py_0       conda-forge

The following packages will be UPDATED:

    ca-certificates: 2019.5.15-1                  --> 2019.9.11-hecc5488_0 conda-forge
    certifi:         2019.6.16-py36_1             --> 2019.9.11-py36_0     conda-forge

The following packages will be DOWNGRADED:

    openssl:         1.1.1c-h7b6447c_1            --> 1.1.1c-h516909a_0    conda-forge


Downloading and Extracting Packages
ca-certificates-2019 | 144 KB    | ##################################### | 100%
geographiclib-1.49   | 32 KB     | ##################################### | 100%
certifi-2019.9.11    | 147 KB    | ##################################### | 100%
geopy-1.20.0         | 57 KB     | ##################################### | 100%
openssl-1.1.1c       | 2.1 MB    | ##################################### | 100%
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
Solving environment: done

## Package Plan ##

  environment location: /opt/conda/envs/Python36

  added / updated specs:
    - folium=0.5.0


The following packages will be downloaded:

    package                    |            build
    ---------------------------|-----------------
    vincent-0.4.4              |             py_1          28 KB  conda-forge
```

```
    altair-3.2.0               |           py36_0         770 KB  conda-forge
    folium-0.5.0               |             py_0          45 KB  conda-forge
    branca-0.3.1               |             py_0          25 KB  conda-forge
    ------------------------------------------------------------
                                           Total:         868 KB

The following NEW packages will be INSTALLED:

    altair:  3.2.0-py36_0 conda-forge
    branca:  0.3.1-py_0   conda-forge
    folium:  0.5.0-py_0   conda-forge
    vincent: 0.4.4-py_1   conda-forge


Downloading and Extracting Packages
vincent-0.4.4        | 28 KB     | ##################################### | 100%
altair-3.2.0         | 770 KB    | ##################################### | 100%
folium-0.5.0         | 45 KB     | ##################################### | 100%
branca-0.3.1         | 25 KB     | ##################################### | 100%
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
Folium installed
Libraries imported.
```

Extract the data with only boroughs that contain the word Toronto

In [17]:
```
Toronto_data = df[df['Borough'].str.contains("Toronto")].reset_index(drop=True)
Toronto_data
```

Out[17]:

	Postcode	Borough	Neighbourhood	Latitude	Longitude
0	M4E	East Toronto	The Beaches	43.676357	-79.293031
1	M4K	East Toronto	The Danforth West, Riverdale	43.679557	-79.352188
2	M4L	East Toronto	The Beaches West, India Bazaar	43.668999	-79.315572
3	M4M	East Toronto	Studio District	43.659526	-79.340923
4	M4N	Central Toronto	Lawrence Park	43.728020	-79.388790
5	M4P	Central Toronto	Davisville North	43.712751	-79.390197
6	M4R	Central Toronto	North Toronto West	43.715383	-79.405678
7	M4S	Central Toronto	Davisville	43.704324	-79.388790
8	M4T	Central Toronto	Moore Park, Summerhill East	43.689574	-79.383160
9	M4V	Central Toronto	Deer Park, Forest Hill SE, Rathnelly, South Hi...	43.686412	-79.400049
10	M4W	Downtown Toronto	Rosedale	43.679563	-79.377529
11	M4X	Downtown Toronto	Cabbagetown, St. James Town	43.667967	-79.367675
12	M4Y	Downtown Toronto	Church and Wellesley	43.665860	-79.383160
13	M5A	Downtown Toronto	Harbourfront, Regent Park	43.654260	-79.360636
14	M5B	Downtown Toronto	Ryerson, Garden District	43.657162	-79.378937
15	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
16	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306
17	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383
18	M5H	Downtown Toronto	Adelaide, King, Richmond	43.650571	-79.384568
19	M5J	Downtown Toronto	Harbourfront East, Toronto Islands, Union Station	43.640816	-79.381752
20	M5K	Downtown Toronto	Design Exchange, Toronto Dominion Centre	43.647177	-79.381576
21	M5L	Downtown Toronto	Commerce Court, Victoria Hotel	43.648198	-79.379817
22	M5N	Central Toronto	Roselawn	43.711695	-79.416936
23	M5P	Central Toronto	Forest Hill North, Forest Hill West	43.696948	-79.411307
24	M5R	Central Toronto	The Annex, North Midtown, Yorkville	43.672710	-79.405678
25	M5S	Downtown Toronto	Harbord, University of Toronto	43.662696	-79.400049
26	M5T	Downtown Toronto	Chinatown, Grange Park, Kensington Market	43.653206	-79.400049
27	M5V	Downtown Toronto	CN Tower, Bathurst Quay, Island airport, Harbo...	43.628947	-79.394420
28	M5W	Downtown Toronto	Stn A PO Boxes 25 The Esplanade	43.646435	-79.374846
29	M5X	Downtown Toronto	First Canadian Place, Underground city	43.648429	-79.382280
30	M6G	Downtown Toronto	Christie	43.669542	-79.422564
31	M6H	West Toronto	Dovercourt Village, Dufferin	43.669005	-79.442259
32	M6J	West Toronto	Little Portugal, Trinity	43.647927	-79.419750
33	M6K	West Toronto	Brockton, Exhibition Place, Parkdale Village	43.636847	-79.428191
34	M6P	West Toronto	High Park, The Junction South	43.661608	-79.464763
35	M6R	West Toronto	Parkdale, Roncesvalles	43.648960	-79.456325
36	M6S	West Toronto	Runnymede, Swansea	43.651571	-79.484450
37	M7Y	East Toronto	Business Reply Mail Processing Centre 969 Eastern	43.662744	-79.321558

Use geopy library to get the latitude and longitude values of Toronto City.

In [18]:
```
address = 'Toronto, Ontario'
geolocator = Nominatim(user_agent="ny_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geograpical coordinate of Toronto City are {}, {}.'.format(latitude, longitud
e))
```

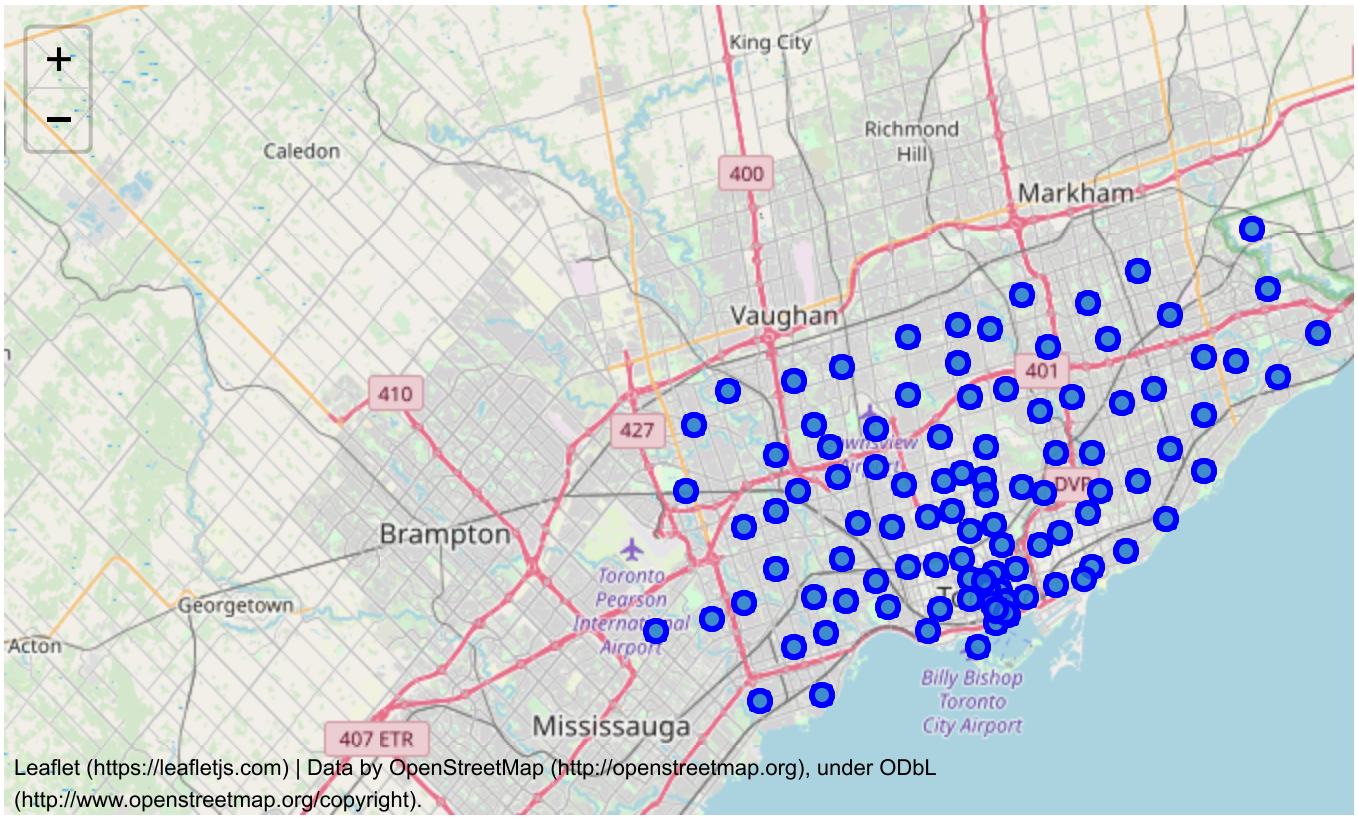
```
The geograpical coordinate of Toronto City are 43.653963, -79.387207.
```

Create map of Toronto using latitude and longitude values

In [19]:
```
map_toronto = folium.Map(location=[latitude, longitude], zoom_start=11)
map_canada = folium.Map(location=[latitude, longitude], zoom_start=10)
```

In [70]:
```
# add markers to map
for lat, lng, borough, neighborhood in zip(df['Latitude'], df['Longitude'], df['Borough'
], df['Neighbourhood']):
    label = '{}, {}'.format(neighborhood, borough)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_canada)
map_canada
```

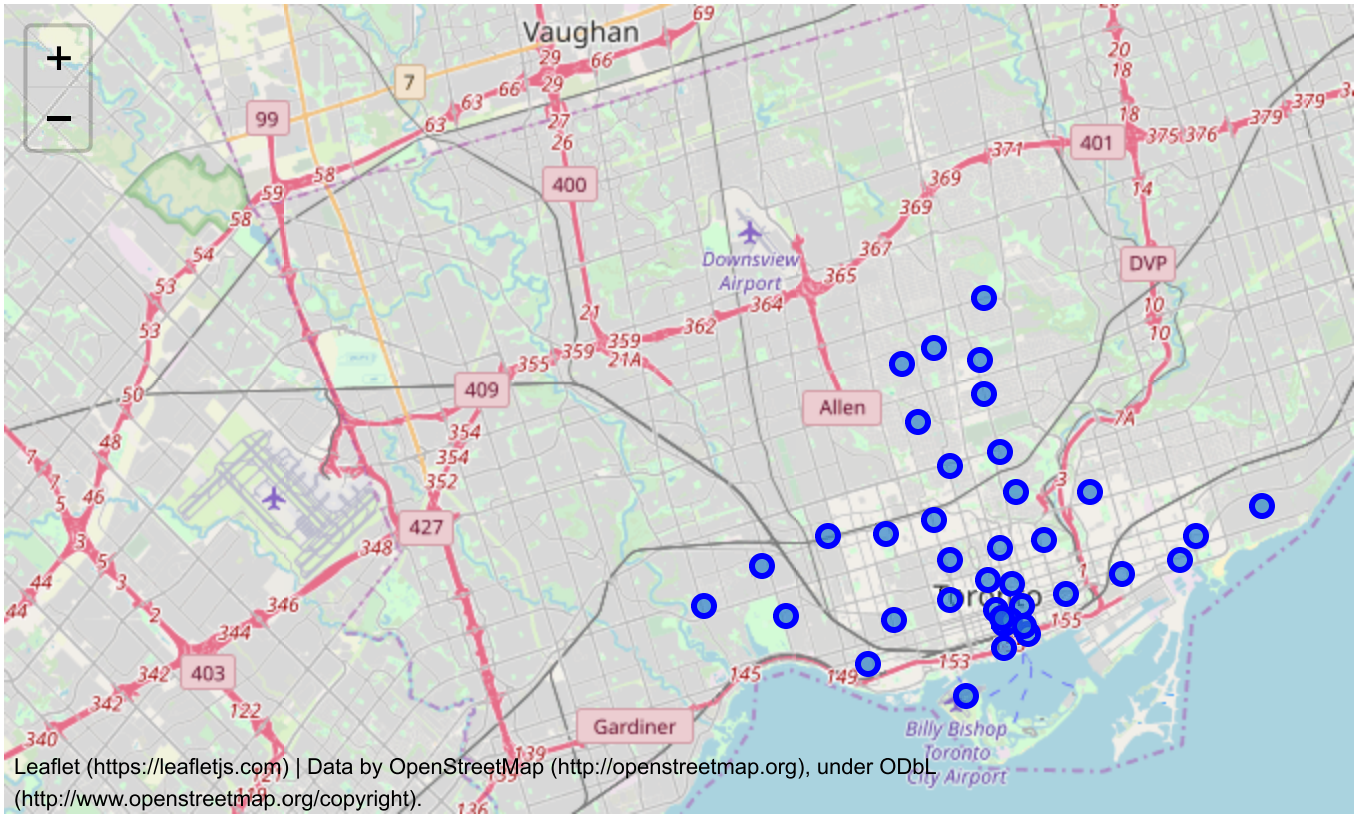
Out[70]:



Create a map of Toronto with neighborhoods superimposed on top.

In [21]:
```
# add markers to map
for lat, lng, borough, neighborhood in zip(Toronto_data['Latitude'], Toronto_data['Longitude'], Toronto_data['Borough'], Toronto_data['Neighbourhood']):
    label = '{}, {}'.format(neighborhood, borough)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_toronto)

map_toronto
```

Out[21]:



Define Foursquare Credentials and Version

In [22]:
```
CLIENT_ID = 'NI0EGYNNZJYZEKTUUZUO32HRMSU1MZPNGL4KNMYAMJQZUDQE' # your Foursquare ID
CLIENT_SECRET = 'R03BB0YK2ZUO00CWT2AY1NDW4UYJICPNBZOZC1IQN3ZMXFRI' # your Foursquare Secret
VERSION = '20180605' # Foursquare API version

print('Your credentails:')
print('CLIENT_ID: ' + CLIENT_ID)
print('CLIENT_SECRET:' + CLIENT_SECRET)
```

```
Your credentails:
CLIENT_ID: NI0EGYNNZJYZEKTUUZUO32HRMSU1MZPNGL4KNMYAMJQZUDQE
CLIENT_SECRET:R03BB0YK2ZUO00CWT2AY1NDW4UYJICPNBZOZC1IQN3ZMXFRI
```

Let's explore the first neighborhood in our dataframe.

Get the neighborhood's name

In [23]:
```
Toronto_data.loc[0, 'Neighbourhood']
```

Out[23]:
```
'The Beaches'
```

Get the neighborhood's latitude and longitude values.

In [24]:
```
neighborhood_latitude = Toronto_data.loc[0, 'Latitude'] # neighborhood latitude value
neighborhood_longitude = Toronto_data.loc[0, 'Longitude'] # neighborhood longitude value

neighborhood_name = Toronto_data.loc[0, 'Neighbourhood'] # neighborhood name

print('Latitude and longitude values of {} are {}, {}.'.format(neighborhood_name,
                                                               neighborhood_latitude,
                                                               neighborhood_longitude))
```

```
Latitude and longitude values of The Beaches are 43.67635739999999, -79.2930312.
```

Now, let's get the top 100 venues that are in The beaches within a radius of 500 meters.

In [25]:
```
LIMIT = 100 # limit of number of venues returned by Foursquare API
radius = 500 # define radius
# create url
url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&
ll={},{}&radius={}&limit={}'.format(
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    neighborhood_latitude,
    neighborhood_longitude,
    radius,
    LIMIT)
# display URL
url
```

Out[25]:
```
'https://api.foursquare.com/v2/venues/explore?&client_id=NI0EGYNNZJYZEKTUUZUO32HRMSU1MZ
PNGL4KNMYAMJQZUDQE&client_secret=R03BB0YK2ZUO00CWT2AY1NDW4UYJICPNBZOZC1IQN3ZMXFRI&v=201
80605&ll=43.67635739999999,-79.2930312&radius=500&limit=100'
```

Send the GET request and examine the resutls

In [26]:
```
results = requests.get(url).json()
results
```

Out[26]:

```
{'meta': {'code': 200, 'requestId': '5d7e0a04a30619002cf50bbc'},
 'response': {'headerLocation': 'The Beaches',
  'headerFullLocation': 'The Beaches, Toronto',
  'headerLocationGranularity': 'neighborhood',
  'totalResults': 4,
  'suggestedBounds': {'ne': {'lat': 43.680857404499996,
    'lng': -79.28682091449052},
   'sw': {'lat': 43.67185739549999, 'lng': -79.29924148550948}},
  'groups': [{'type': 'Recommended Places',
    'name': 'recommended',
    'items': [{'reasons': {'count': 0,
       'items': [{'summary': 'This spot is popular',
         'type': 'general',
         'reasonName': 'globalInteractionReason'}]},
      'venue': {'id': '4bd461bc77b29c74a07d9282',
       'name': 'Glen Manor Ravine',
       'location': {'address': 'Glen Manor',
        'crossStreet': 'Queen St.',
        'lat': 43.67682094413784,
        'lng': -79.29394208780985,
        'labeledLatLngs': [{'label': 'display',
          'lat': 43.67682094413784,
          'lng': -79.29394208780985}],
        'distance': 89,
        'cc': 'CA',
        'city': 'Toronto',
        'state': 'ON',
        'country': 'Canada',
        'formattedAddress': ['Glen Manor (Queen St.)',
         'Toronto ON',
         'Canada']},
       'categories': [{'id': '4bf58dd8d48988d159941735',
         'name': 'Trail',
         'pluralName': 'Trails',
         'shortName': 'Trail',
         'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/parks_outdoors/hiki
ngtrail_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-4bd461bc77b29c74a07d9282-0'},
     {'reasons': {'count': 0,
       'items': [{'summary': 'This spot is popular',
         'type': 'general',
         'reasonName': 'globalInteractionReason'}]},
      'venue': {'id': '4ad4c062f964a52011f820e3',
       'name': 'The Big Carrot Natural Food Market',
       'location': {'address': '125 Southwood Dr',
        'lat': 43.678879,
        'lng': -79.297734,
        'labeledLatLngs': [{'label': 'display',
          'lat': 43.678879,
          'lng': -79.297734}],
        'distance': 471,
        'postalCode': 'M4E 0B8',
        'cc': 'CA',
        'city': 'Toronto',
        'state': 'ON',
        'country': 'Canada',
        'formattedAddress': ['125 Southwood Dr',
         'Toronto ON M4E 0B8',
```

```
          'Canada']},
        'categories': [{'id': '50aa9e744b90af0d42d5de0e',
          'name': 'Health Food Store',
          'pluralName': 'Health Food Stores',
          'shortName': 'Health Food Store',
          'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/food_grocery
_',
           'suffix': '.png'},
          'primary': True}],
        'photos': {'count': 0, 'groups': []},
        'venuePage': {'id': '75150878'}},
       'referralId': 'e-0-4ad4c062f964a52011f820e3-1'},
      {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
          'type': 'general',
          'reasonName': 'globalInteractionReason'}]},
       'venue': {'id': '4b8daea1f964a520480833e3',
        'name': 'Grover Pub and Grub',
        'location': {'address': '676 Kingston Rd.',
         'crossStreet': 'at Main St.',
         'lat': 43.679181434941015,
         'lng': -79.29721535878515,
         'labeledLatLngs': [{'label': 'display',
           'lat': 43.679181434941015,
           'lng': -79.29721535878515}],
         'distance': 460,
         'postalCode': 'M4E 1R4',
         'cc': 'CA',
         'city': 'Toronto',
         'state': 'ON',
         'country': 'Canada',
         'formattedAddress': ['676 Kingston Rd. (at Main St.)',
          'Toronto ON M4E 1R4',
          'Canada']},
        'categories': [{'id': '4bf58dd8d48988d11b941735',
          'name': 'Pub',
          'pluralName': 'Pubs',
          'shortName': 'Pub',
          'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/nightlife/pub_',
           'suffix': '.png'},
          'primary': True}],
        'photos': {'count': 0, 'groups': []}},
       'referralId': 'e-0-4b8daea1f964a520480833e3-2'},
      {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
          'type': 'general',
          'reasonName': 'globalInteractionReason'}]},
       'venue': {'id': '4df91c4bae60f95f82229ad5',
        'name': 'Upper Beaches',
        'location': {'lat': 43.68056321147582,
         'lng': -79.2928688743688,
         'labeledLatLngs': [{'label': 'display',
           'lat': 43.68056321147582,
           'lng': -79.2928688743688}],
         'distance': 468,
         'cc': 'CA',
         'city': 'Toronto',
         'state': 'ON',
         'country': 'Canada',
         'formattedAddress': ['Toronto ON', 'Canada']},
        'categories': [{'id': '4f2a25ac4b909258e854f55f',
          'name': 'Neighborhood',
```

```
          'pluralName': 'Neighborhoods',
          'shortName': 'Neighborhood',
          'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/parks_outdoors/neig
hborhood_',
           'suffix': '.png'},
          'primary': True}],
        'photos': {'count': 0, 'groups': []}},
       'referralId': 'e-0-4df91c4bae60f95f82229ad5-3'}]}]}}
```

Define get_category_type function

In [27]:
```
# function that extracts the category of the venue
def get_category_type(row):
    try:
        categories_list = row['categories']
    except:
        categories_list = row['venue.categories']

    if len(categories_list) == 0:
        return None
    else:
        return categories_list[0]['name']
```

Clean the json and structure it into a *pandas* dataframe

In [28]:
```
venues = results['response']['groups'][0]['items']

nearby_venues = json_normalize(venues) # flatten JSON

# filter columns
filtered_columns = ['venue.name', 'venue.categories', 'venue.location.lat', 'venue.locat
ion.lng']
nearby_venues =nearby_venues.loc[:, filtered_columns]

# filter the category for each row
nearby_venues['venue.categories'] = nearby_venues.apply(get_category_type, axis=1)

# clean columns
nearby_venues.columns = [col.split(".")[-1] for col in nearby_venues.columns]

print('{} venues were returned by Foursquare.'.format(nearby_venues.shape[0]))
```

```
4 venues were returned by Foursquare.
```

Let's create a function to repeat the same process to all the neighborhoods in Toronto

In [29]:
```
def getNearbyVenues(names, latitudes, longitudes, radius=500):

    venues_list=[]
    for name, lat, lng in zip(names, latitudes, longitudes):
        print(name)

        # create the API request URL
        url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&limit={}'.format(
            CLIENT_ID,
            CLIENT_SECRET,
            VERSION,
            lat,
            lng,
            radius,
            LIMIT)

        # make the GET request
        results = requests.get(url).json()["response"]['groups'][0]['items']

        # return only relevant information for each nearby venue
        venues_list.append([(
            name,
            lat,
            lng,
            v['venue']['name'],
            v['venue']['location']['lat'],
            v['venue']['location']['lng'],
            v['venue']['categories'][0]['name']) for v in results])

    nearby_venues = pd.DataFrame([item for venue_list in venues_list for item in venue_list])
    nearby_venues.columns = ['Neighborhood',
                  'Neighborhood Latitude',
                  'Neighborhood Longitude',
                  'Venue',
                  'Venue Latitude',
                  'Venue Longitude',
                  'Venue Category']

    return(nearby_venues)
```

run the above function on each neighborhood and create a new dataframe called *Toronto_venues

In [30]:
```
Toronto_venues = getNearbyVenues(names=Toronto_data['Neighbourhood'],
                                 latitudes=Toronto_data['Latitude'],
                                 longitudes=Toronto_data['Longitude']
                                )
```

```
The Beaches
The Danforth West, Riverdale
The Beaches West, India Bazaar
Studio District
Lawrence Park
Davisville North
North Toronto West
Davisville
Moore Park, Summerhill East
Deer Park, Forest Hill SE, Rathnelly, South Hill, Summerhill West
Rosedale
Cabbagetown, St. James Town
Church and Wellesley
Harbourfront, Regent Park
Ryerson, Garden District
St. James Town
Berczy Park
Central Bay Street
Adelaide, King, Richmond
Harbourfront East, Toronto Islands, Union Station
Design Exchange, Toronto Dominion Centre
Commerce Court, Victoria Hotel
Roselawn
Forest Hill North, Forest Hill West
The Annex, North Midtown, Yorkville
Harbord, University of Toronto
Chinatown, Grange Park, Kensington Market
CN Tower, Bathurst Quay, Island airport, Harbourfront West, King and Spadina, Railway L
ands, South Niagara
Stn A PO Boxes 25 The Esplanade
First Canadian Place, Underground city
Christie
Dovercourt Village, Dufferin
Little Portugal, Trinity
Brockton, Exhibition Place, Parkdale Village
High Park, The Junction South
Parkdale, Roncesvalles
Runnymede, Swansea
Business Reply Mail Processing Centre 969 Eastern
```

Let's check the size of the resulting dataframe

In [31]:
```
print(Toronto_venues.shape)
Toronto_venues.head()
```

```
(1706, 7)
```

Out[31]:

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	The Beaches	43.676357	-79.293031	Glen Manor Ravine	43.676821	-79.293942	Trail
1	The Beaches	43.676357	-79.293031	The Big Carrot Natural Food Market	43.678879	-79.297734	Health Food Store
2	The Beaches	43.676357	-79.293031	Grover Pub and Grub	43.679181	-79.297215	Pub
3	The Beaches	43.676357	-79.293031	Upper Beaches	43.680563	-79.292869	Neighborhood
4	The Danforth West, Riverdale	43.679557	-79.352188	Pantheon	43.677621	-79.351434	Greek Restaurant

Let's check how many venues were returned for each neighborhood

In [32]:
```
Toronto_venues.groupby('Neighborhood').count()
```

Out[32]:

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Adelaide, King, Richmond	100	100	100	100	100	100
Berczy Park	55	55	55	55	55	55
Brockton, Exhibition Place, Parkdale Village	21	21	21	21	21	21
Business Reply Mail Processing Centre 969 Eastern	17	17	17	17	17	17
CN Tower, Bathurst Quay, Island airport, Harbourfront West, King and Spadina, Railway Lands, South Niagara	16	16	16	16	16	16
Cabbagetown, St. James Town	45	45	45	45	45	45
Central Bay Street	87	87	87	87	87	87
Chinatown, Grange Park, Kensington Market	100	100	100	100	100	100
Christie	16	16	16	16	16	16
Church and Wellesley	87	87	87	87	87	87
Commerce Court, Victoria Hotel	100	100	100	100	100	100
Davisville	39	39	39	39	39	39
Davisville North	7	7	7	7	7	7
Deer Park, Forest Hill SE, Rathnelly, South Hill, Summerhill West	15	15	15	15	15	15
Design Exchange, Toronto Dominion Centre	100	100	100	100	100	100
Dovercourt Village, Dufferin	14	14	14	14	14	14
First Canadian Place, Underground city	100	100	100	100	100	100
Forest Hill North, Forest Hill West	4	4	4	4	4	4
Harbord, University of Toronto	35	35	35	35	35	35
Harbourfront East, Toronto Islands, Union Station	100	100	100	100	100	100
Harbourfront, Regent Park	51	51	51	51	51	51
High Park, The Junction South	23	23	23	23	23	23
Lawrence Park	3	3	3	3	3	3
Little Portugal, Trinity	64	64	64	64	64	64
Moore Park, Summerhill East	1	1	1	1	1	1
North Toronto West	24	24	24	24	24	24
Parkdale, Roncesvalles	15	15	15	15	15	15
Rosedale	5	5	5	5	5	5
Roselawn	3	3	3	3	3	3
Runnymede, Swansea	34	34	34	34	34	34
Ryerson, Garden District	100	100	100	100	100	100
St. James Town	100	100	100	100	100	100
Stn A PO Boxes 25 The Esplanade	96	96	96	96	96	96

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Studio District	38	38	38	38	38	38
The Annex, North Midtown, Yorkville	23	23	23	23	23	23
The Beaches	4	4	4	4	4	4
The Beaches West, India Bazaar	20	20	20	20	20	20
The Danforth West, Riverdale	44	44	44	44	44	44

Let's find out how many unique categories can be curated from all the returned venues

In [33]:
```
print('There are {} uniques categories.'.format(len(Toronto_venues['Venue Category'].unique())))
```

```
There are 235 uniques categories.
```

Analyze Each Neighborhood

In [34]:
```
# one hot encoding
Toronto_onehot = pd.get_dummies(Toronto_venues[['Venue Category']], prefix="", prefix_sep="")

# add neighborhood column back to dataframe
Toronto_onehot['Neighborhood'] = Toronto_venues['Neighborhood']

# move neighborhood column to the first column
fixed_columns = [Toronto_onehot.columns[-1]] + list(Toronto_onehot.columns[:-1])
Toronto_onehot = Toronto_onehot[fixed_columns]

Toronto_onehot.head()
```

Out[34]:

	Yoga Studio	Afghan Restaurant	Airport	Airport Food Court	Airport Lounge	Airport Service	Airport Terminal	American Restaurant	Antique Shop	Aquarium	...	T Resta
0	0	0	0	0	0	0	0	0	0	0	...	
1	0	0	0	0	0	0	0	0	0	0	...	
2	0	0	0	0	0	0	0	0	0	0	...	
3	0	0	0	0	0	0	0	0	0	0	...	
4	0	0	0	0	0	0	0	0	0	0	...	

5 rows × 235 columns

let's examine the new dataframe size.

In [35]:
```
Toronto_onehot.shape
```

Out[35]:
```
(1706, 235)
```

Next, let's group rows by neighborhood and by taking the mean of the frequency of occurrence of each category

In [36]:
```
Toronto_grouped = Toronto_onehot.groupby('Neighborhood').mean().reset_index()
Toronto_grouped
```

Out[36]:

	Neighborhood	Yoga Studio	Afghan Restaurant	Airport	Airport Food Court	Airport Lounge	Airport Service	Airport Terminal	American Restaurant	Antique Shop
0	Adelaide, King, Richmond	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.030000	0.000000
1	Berczy Park	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
2	Brockton, Exhibition Place, Parkdale Village	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
3	Business Reply Mail Processing Centre 969 Eastern	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
4	CN Tower, Bathurst Quay, Island airport, Harbo...	0.000000	0.000000	0.0625	0.0625	0.125	0.1875	0.125	0.000000	0.000000
5	Cabbagetown, St. James Town	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
6	Central Bay Street	0.011494	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.011494	0.000000
7	Chinatown, Grange Park, Kensington Market	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
8	Christie	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
9	Church and Wellesley	0.011494	0.011494	0.0000	0.0000	0.000	0.0000	0.000	0.011494	0.000000
10	Commerce Court, Victoria Hotel	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.040000	0.000000
11	Davisville	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.025641	0.000000
12	Davisville North	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
13	Deer Park, Forest Hill SE, Rathnelly, South Hi...	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.066667	0.000000
14	Design Exchange, Toronto Dominion Centre	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.030000	0.000000
15	Dovercourt Village, Dufferin	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
16	First Canadian Place, Underground city	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.030000	0.000000
17	Forest Hill North, Forest Hill West	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000

	Neighborhood	Yoga Studio	Afghan Restaurant	Airport	Airport Food Court	Airport Lounge	Airport Service	Airport Terminal	American Restaurant	Antique Shop
18	Harbord, University of Toronto	0.028571	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
19	Harbourfront East, Toronto Islands, Union Station	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
20	Harbourfront, Regent Park	0.019608	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.019608
21	High Park, The Junction South	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.043478
22	Lawrence Park	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
23	Little Portugal, Trinity	0.015625	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
24	Moore Park, Summerhill East	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
25	North Toronto West	0.041667	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
26	Parkdale, Roncesvalles	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
27	Rosedale	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
28	Roselawn	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
29	Runnymede, Swansea	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
30	Ryerson, Garden District	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.010000	0.000000
31	St. James Town	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.020000	0.000000
32	Stn A PO Boxes 25 The Esplanade	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.010417
33	Studio District	0.026316	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.052632	0.000000
34	The Annex, North Midtown, Yorkville	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.043478	0.000000
35	The Beaches	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
36	The Beaches West, India Bazaar	0.000000	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.000000	0.000000
37	The Danforth West, Riverdale	0.022727	0.000000	0.0000	0.0000	0.000	0.0000	0.000	0.022727	0.000000

38 rows × 235 columns

Let's confirm the new size

In [37]:
```
Toronto_grouped.shape
```

Out[37]:
```
(38, 235)
```

Let's print each neighborhood along with the top 10 most common venues

In [38]:

```
num_top_venues = 10

for hood in Toronto_grouped['Neighborhood']:
    print("----"+hood+"----")
    temp = Toronto_grouped[Toronto_grouped['Neighborhood'] == hood].T.reset_index()
    temp.columns = ['venue','freq']
    temp = temp.iloc[1:]
    temp['freq'] = temp['freq'].astype(float)
    temp = temp.round({'freq': 2})
    print(temp.sort_values('freq', ascending=False).reset_index(drop=True).head(num_top_
venues))
    print('\n')
```

```
----Adelaide, King, Richmond----
                venue  freq
0          Coffee Shop  0.08
1                 Café  0.05
2           Steakhouse  0.04
3                  Bar  0.04
4      Thai Restaurant  0.03
5         Burger Joint  0.03
6                Hotel  0.03
7       Cosmetics Shop  0.03
8           Restaurant  0.03
9  American Restaurant  0.03


----Berczy Park----
                venue  freq
0         Coffee Shop  0.07
1        Cocktail Bar  0.05
2                Café  0.04
3         Cheese Shop  0.04
4            Beer Bar  0.04
5  Seafood Restaurant  0.04
6              Bakery  0.04
7      Farmers Market  0.04
8          Steakhouse  0.04
9            Creperie  0.02


----Brockton, Exhibition Place, Parkdale Village----
                    venue  freq
0          Breakfast Spot  0.10
1                   Café  0.10
2             Coffee Shop  0.10
3                  Bakery  0.05
4      Italian Restaurant  0.05
5    Caribbean Restaurant  0.05
6                 Stadium  0.05
7  Furniture / Home Store  0.05
8            Climbing Gym  0.05
9                     Bar  0.05


----Business Reply Mail Processing Centre 969 Eastern----
                  venue  freq
0    Light Rail Station  0.12
1            Comic Shop  0.06
2         Auto Workshop  0.06
3      Recording Studio  0.06
4            Restaurant  0.06
5        Farmers Market  0.06
6  Fast Food Restaurant  0.06
7         Burrito Place  0.06
8            Skate Park  0.06
9            Smoke Shop  0.06


----CN Tower, Bathurst Quay, Island airport, Harbourfront West, King and Spadina, Railw
ay Lands, South Niagara----
                venue  freq
0     Airport Service  0.19
1      Airport Lounge  0.12
```

```
2    Airport Terminal  0.12
3         Coffee Shop  0.06
4     Harbor / Marina  0.06
5    Sculpture Garden  0.06
6       Boat or Ferry  0.06
7            Boutique  0.06
8               Plane  0.06
9  Airport Food Court  0.06


----Cabbagetown, St. James Town----
                venue  freq
0         Coffee Shop  0.09
1          Restaurant  0.07
2         Pizza Place  0.04
3  Italian Restaurant  0.04
4                 Pub  0.04
5              Market  0.04
6              Bakery  0.04
7  Chinese Restaurant  0.04
8           Pet Store  0.04
9                Café  0.04


----Central Bay Street----
                       venue  freq
0                Coffee Shop  0.14
1                       Café  0.06
2         Italian Restaurant  0.05
3             Sandwich Place  0.05
4               Burger Joint  0.03
5             Ice Cream Shop  0.03
6  Middle Eastern Restaurant  0.03
7                Salad Place  0.02
8                        Spa  0.02
9         Chinese Restaurant  0.02


----Chinatown, Grange Park, Kensington Market----
                           venue  freq
0                           Café  0.07
1  Vegetarian / Vegan Restaurant  0.06
2                            Bar  0.05
3                         Bakery  0.04
4          Vietnamese Restaurant  0.04
5             Chinese Restaurant  0.04
6           Dumpling Restaurant  0.04
7             Mexican Restaurant  0.04
8                   Coffee Shop  0.03
9        Comfort Food Restaurant  0.02


----Christie----
                venue  freq
0                Café  0.19
1       Grocery Store  0.19
2                Park  0.12
3   Convenience Store  0.06
4         Coffee Shop  0.06
5           Nightclub  0.06
6          Baby Store  0.06
7               Diner  0.06
```

```
8  Athletics & Sports  0.06
9  Italian Restaurant  0.06


----Church and Wellesley----
                 venue  freq
0          Coffee Shop  0.07
1              Gay Bar  0.06
2  Japanese Restaurant  0.06
3     Sushi Restaurant  0.05
4           Restaurant  0.03
5         Burger Joint  0.02
6          Men's Store  0.02
7                Hotel  0.02
8                  Pub  0.02
9      Bubble Tea Shop  0.02


----Commerce Court, Victoria Hotel----
                 venue  freq
0          Coffee Shop  0.11
1                Café  0.06
2                Hotel  0.06
3           Restaurant  0.05
4  American Restaurant  0.04
5            Gastropub  0.03
6   Seafood Restaurant  0.03
7                  Gym  0.03
8        Deli / Bodega  0.03
9           Steakhouse  0.03


----Davisville----
                venue  freq
0        Dessert Shop  0.08
1      Sandwich Place  0.08
2    Sushi Restaurant  0.05
3         Pizza Place  0.05
4                 Gym  0.05
5     Thai Restaurant  0.05
6  Italian Restaurant  0.05
7         Coffee Shop  0.05
8               Café  0.05
9        Gourmet Shop  0.03


----Davisville North----
                           venue  freq
0               Food & Drink Shop  0.14
1                  Clothing Store  0.14
2                  Breakfast Spot  0.14
3                  Sandwich Place  0.14
4                           Hotel  0.14
5                             Gym  0.14
6                            Park  0.14
7                   Movie Theater  0.00
8             Monument / Landmark  0.00
9  Molecular Gastronomy Restaurant  0.00


----Deer Park, Forest Hill SE, Rathnelly, South Hill, Summerhill West----
                 venue  freq
```

```
0                  Pub  0.13
1          Coffee Shop  0.13
2         Liquor Store  0.07
3           Bagel Shop  0.07
4           Restaurant  0.07
5   Light Rail Station  0.07
6           Sports Bar  0.07
7  Fried Chicken Joint  0.07
8          Supermarket  0.07
9     Sushi Restaurant  0.07


----Design Exchange, Toronto Dominion Centre----
                 venue  freq
0          Coffee Shop  0.12
1                Café  0.08
2               Hotel  0.06
3          Restaurant  0.05
4        Deli / Bodega  0.03
5  American Restaurant  0.03
6              Bakery  0.03
7                 Bar  0.03
8           Gastropub  0.03
9   Italian Restaurant  0.03


----Dovercourt Village, Dufferin----
                      venue  freq
0                    Bakery  0.14
1                  Pharmacy  0.14
2                Supermarket  0.14
3                Music Venue  0.07
4  Middle Eastern Restaurant  0.07
5                      Café  0.07
6                       Bar  0.07
7                      Bank  0.07
8                   Brewery  0.07
9       Gym / Fitness Center  0.07


----First Canadian Place, Underground city----
              venue  freq
0       Coffee Shop  0.10
1             Café  0.08
2            Hotel  0.05
3        Steakhouse  0.04
4        Restaurant  0.04
5     Deli / Bodega  0.03
6              Gym  0.03
7      Burger Joint  0.03
8              Bar  0.03
9  Asian Restaurant  0.03


----Forest Hill North, Forest Hill West----
                      venue  freq
0                     Trail  0.25
1                  Bus Line  0.25
2          Sushi Restaurant  0.25
3             Jewelry Store  0.25
4               Yoga Studio  0.00
5               Music Venue  0.00
```

```
6   Mediterranean Restaurant  0.00
7                 Men's Store  0.00
8          Mexican Restaurant  0.00
9  Middle Eastern Restaurant  0.00


----Harbord, University of Toronto----
                   venue  freq
0                  Café  0.14
1          Sandwich Place  0.06
2              Restaurant  0.06
3               Bookstore  0.06
4    Japanese Restaurant  0.06
5                    Bar  0.06
6                 Bakery  0.06
7  College Arts Building  0.03
8           Noodle House  0.03
9              Nightclub  0.03


----Harbourfront East, Toronto Islands, Union Station----
                 venue  freq
0          Coffee Shop  0.13
1                Hotel  0.05
2             Aquarium  0.05
3                 Café  0.04
4  Fried Chicken Joint  0.03
5       Scenic Lookout  0.03
6              Brewery  0.03
7                  Bar  0.02
8     Baseball Stadium  0.02
9          Pizza Place  0.02


----Harbourfront, Regent Park----
                  venue  freq
0           Coffee Shop  0.18
1                  Park  0.06
2                  Café  0.06
3                Bakery  0.06
4                   Pub  0.06
5  Gym / Fitness Center  0.04
6    Mexican Restaurant  0.04
7        Breakfast Spot  0.04
8            Restaurant  0.04
9               Theater  0.04


----High Park, The Junction South----
                      venue  freq
0          Mexican Restaurant  0.09
1                       Café  0.09
2             Thai Restaurant  0.04
3                 Flea Market  0.04
4  Cajun / Creole Restaurant  0.04
5        Fried Chicken Joint  0.04
6                  Bookstore  0.04
7     Furniture / Home Store  0.04
8       Fast Food Restaurant  0.04
9                  Gastropub  0.04
```

```
----Lawrence Park----
                       venue  freq
0                       Park  0.33
1                   Bus Line  0.33
2                Swim School  0.33
3                Yoga Studio  0.00
4                     Museum  0.00
5          Martial Arts Dojo  0.00
6   Mediterranean Restaurant  0.00
7                Men's Store  0.00
8         Mexican Restaurant  0.00
9  Middle Eastern Restaurant  0.00


----Little Portugal, Trinity----
                    venue  freq
0                     Bar  0.12
1            Coffee Shop  0.05
2       Asian Restaurant  0.05
3            Pizza Place  0.03
4                   Café  0.03
5  Vietnamese Restaurant  0.03
6              Boutique  0.03
7          Cocktail Bar  0.03
8            Restaurant  0.03
9      French Restaurant  0.03


----Moore Park, Summerhill East----
                        venue  freq
0                  Playground   1.0
1                 Music Venue   0.0
2                      Market   0.0
3           Martial Arts Dojo   0.0
4    Mediterranean Restaurant   0.0
5                 Men's Store   0.0
6           Mexican Restaurant   0.0
7   Middle Eastern Restaurant   0.0
8           Miscellaneous Shop   0.0
9  Modern European Restaurant   0.0


----North Toronto West----
                  venue  freq
0  Sporting Goods Shop  0.08
1       Clothing Store  0.08
2          Coffee Shop  0.08
3          Yoga Studio  0.04
4            Gift Shop  0.04
5   Mexican Restaurant  0.04
6                 Café  0.04
7                  Spa  0.04
8   Salon / Barbershop  0.04
9   Chinese Restaurant  0.04


----Parkdale, Roncesvalles----
                         venue  freq
0               Breakfast Spot  0.13
1                    Gift Shop  0.13
2                  Coffee Shop  0.07
3                         Bank  0.07
```

```
4  Eastern European Restaurant  0.07
5                   Restaurant  0.07
6                      Dog Run  0.07
7                Movie Theater  0.07
8           Italian Restaurant  0.07
9                 Dessert Shop  0.07


----Rosedale----
                       venue  freq
0                       Park   0.4
1                 Playground   0.2
2                   Building   0.2
3                      Trail   0.2
4    New American Restaurant   0.0
5   Mediterranean Restaurant   0.0
6                 Men's Store   0.0
7         Mexican Restaurant   0.0
8  Middle Eastern Restaurant   0.0
9         Miscellaneous Shop   0.0


----Roselawn----
                       venue  freq
0                     Garden  0.33
1    Health & Beauty Service  0.33
2                Music Venue  0.33
3                Yoga Studio  0.00
4          Martial Arts Dojo  0.00
5   Mediterranean Restaurant  0.00
6                 Men's Store  0.00
7         Mexican Restaurant  0.00
8  Middle Eastern Restaurant  0.00
9         Miscellaneous Shop  0.00


----Runnymede, Swansea----
                       venue  freq
0                       Café  0.09
1                Coffee Shop  0.09
2           Sushi Restaurant  0.06
3                Pizza Place  0.06
4         Italian Restaurant  0.06
5  Latin American Restaurant  0.03
6                  Gastropub  0.03
7                  Bookstore  0.03
8              Smoothie Shop  0.03
9              Burrito Place  0.03


----Ryerson, Garden District----
                       venue  freq
0             Clothing Store  0.08
1                Coffee Shop  0.08
2                       Café  0.03
3  Middle Eastern Restaurant  0.03
4             Cosmetics Shop  0.03
5                    Theater  0.02
6            Bubble Tea Shop  0.02
7        Sporting Goods Shop  0.02
8                  Bookstore  0.02
9                 Restaurant  0.02
```

```
----St. James Town----
                venue  freq
0         Coffee Shop  0.07
1                Café  0.06
2               Hotel  0.05
3          Restaurant  0.05
4  Italian Restaurant  0.04
5              Bakery  0.03
6      Breakfast Spot  0.03
7      Clothing Store  0.03
8        Cocktail Bar  0.03
9            Beer Bar  0.03


----Stn A PO Boxes 25 The Esplanade----
                venue  freq
0         Coffee Shop  0.10
1          Restaurant  0.04
2                Café  0.04
3  Seafood Restaurant  0.03
4  Italian Restaurant  0.03
5            Beer Bar  0.03
6               Hotel  0.03
7        Cocktail Bar  0.03
8              Bakery  0.02
9         Cheese Shop  0.02


----Studio District----
                      venue  freq
0                      Café  0.11
1               Coffee Shop  0.08
2         Italian Restaurant  0.05
3        American Restaurant  0.05
4                    Bakery  0.05
5               Fish Market  0.03
6         Chinese Restaurant  0.03
7               Cheese Shop  0.03
8  Middle Eastern Restaurant  0.03
9                     Diner  0.03


----The Annex, North Midtown, Yorkville----
            venue  freq
0     Coffee Shop  0.13
1  Sandwich Place  0.13
2            Café  0.13
3     Pizza Place  0.09
4  History Museum  0.04
5       BBQ Joint  0.04
6        Pharmacy  0.04
7             Pub  0.04
8            Park  0.04
9    Burger Joint  0.04


----The Beaches----
                      venue  freq
0          Health Food Store  0.25
1                        Pub  0.25
```

```
2                    Trail  0.25
3             Music Venue  0.00
4                  Market  0.00
5         Martial Arts Dojo  0.00
6   Mediterranean Restaurant  0.00
7               Men's Store  0.00
8        Mexican Restaurant  0.00
9  Middle Eastern Restaurant  0.00


----The Beaches West, India Bazaar----
                 venue  freq
0                 Park  0.10
1       Sandwich Place  0.10
2          Pizza Place  0.05
3   Italian Restaurant  0.05
4    Fish & Chips Shop  0.05
5         Burger Joint  0.05
6        Burrito Place  0.05
7  Fast Food Restaurant  0.05
8    Food & Drink Shop  0.05
9         Liquor Store  0.05


----The Danforth West, Riverdale----
                     venue  freq
0         Greek Restaurant  0.20
1              Coffee Shop  0.09
2       Italian Restaurant  0.07
3          Ice Cream Shop  0.05
4   Furniture / Home Store  0.05
5                Bookstore  0.05
6                     Café  0.02
7              Sports Bar  0.02
8  Fruit & Vegetable Store  0.02
9                     Spa  0.02
```

Let's put that into a *pandas* dataframe

First, let's write a function to sort the venues in descending order.

In [39]:
```
def return_most_common_venues(row, num_top_venues):
    row_categories = row.iloc[1:]
    row_categories_sorted = row_categories.sort_values(ascending=False)

    return row_categories_sorted.index.values[0:num_top_venues]
```

Now let's create the new dataframe and display the top 10 venues for each neighborhood.

In [40]:
```
num_top_venues = 10

indicators = ['st', 'nd', 'rd']

# create columns according to number of top venues
columns = ['Neighborhood']
for ind in np.arange(num_top_venues):
    try:
        columns.append('{}{} Most Common Venue'.format(ind+1, indicators[ind]))
    except:
        columns.append('{}th Most Common Venue'.format(ind+1))

# create a new dataframe
neighborhoods_venues_sorted = pd.DataFrame(columns=columns)
neighborhoods_venues_sorted['Neighborhood'] = Toronto_grouped['Neighborhood']

for ind in np.arange(Toronto_grouped.shape[0]):
    neighborhoods_venues_sorted.iloc[ind, 1:] = return_most_common_venues(Toronto_groupe
d.iloc[ind, :], num_top_venues)

neighborhoods_venues_sorted.head()
```

Out[40]:

	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
0	Adelaide, King, Richmond	Coffee Shop	Café	Steakhouse	Bar	Hotel	Cosmetics Shop	Burger Joint	American Restaurant
1	Berczy Park	Coffee Shop	Cocktail Bar	Steakhouse	Cheese Shop	Café	Farmers Market	Beer Bar	Bakery
2	Brockton, Exhibition Place, Parkdale Village	Breakfast Spot	Café	Coffee Shop	Furniture / Home Store	Convenience Store	Burrito Place	Restaurant	Stadium
3	Business Reply Mail Processing Centre 969 Eastern	Light Rail Station	Farmers Market	Restaurant	Burrito Place	Auto Workshop	Spa	Fast Food Restaurant	Garden Center
4	CN Tower, Bathurst Quay, Island airport, Harbo...	Airport Service	Airport Lounge	Airport Terminal	Harbor / Marina	Sculpture Garden	Airport	Airport Food Court	Boutique

Cluster Neighborhoods

In [41]:
```
# import k-means from clustering stage
from sklearn.cluster import KMeans

# set number of clusters
kclusters = 5

Toronto_grouped_clustering = Toronto_grouped.drop('Neighborhood', 1)
Toronto_grouped_clustering
# run k-means clustering
kmeans = KMeans(n_clusters=kclusters, random_state=0).fit(Toronto_grouped_clustering)
# check cluster labels generated for each row in the dataframe
kmeans.labels_
```

Out[41]:
```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       3, 0, 1, 0, 0, 4, 2, 0, 0, 0, 0, 0, 0, 0, 0, 0], dtype=int32)
```

In [42]:
```
# add clustering labels
neighborhoods_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)
```

In [43]:
```
neighborhoods_venues_sorted
```

Out[43]:

	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 M Comm Ve
0	0	Adelaide, King, Richmond	Coffee Shop	Café	Steakhouse	Bar	Hotel	Cosmetics Shop	Burger
1	0	Berczy Park	Coffee Shop	Cocktail Bar	Steakhouse	Cheese Shop	Café	Farmers Market	Beer
2	0	Brockton, Exhibition Place, Parkdale Village	Breakfast Spot	Café	Coffee Shop	Furniture / Home Store	Convenience Store	Burrito Place	Restau
3	0	Business Reply Mail Processing Centre 969 Eastern	Light Rail Station	Farmers Market	Restaurant	Burrito Place	Auto Workshop	Spa	Fast F Restau
4	0	CN Tower, Bathurst Quay, Island airport, Harbo...	Airport Service	Airport Lounge	Airport Terminal	Harbor / Marina	Sculpture Garden	Airport	Airport F C
5	0	Cabbagetown, St. James Town	Coffee Shop	Restaurant	Chinese Restaurant	Pizza Place	Café	Market	Pet S
6	0	Central Bay Street	Coffee Shop	Café	Sandwich Place	Italian Restaurant	Middle Eastern Restaurant	Ice Cream Shop	Burger
7	0	Chinatown, Grange Park, Kensington Market	Café	Vegetarian / Vegan Restaurant	Bar	Bakery	Dumpling Restaurant	Mexican Restaurant	Vietnan Restau
8	0	Christie	Grocery Store	Café	Park	Diner	Convenience Store	Restaurant	Baby S
9	0	Church and Wellesley	Coffee Shop	Japanese Restaurant	Gay Bar	Sushi Restaurant	Restaurant	Pub	Men's S
10	0	Commerce Court, Victoria Hotel	Coffee Shop	Café	Hotel	Restaurant	American Restaurant	Italian Restaurant	
11	0	Davisville	Dessert Shop	Sandwich Place	Italian Restaurant	Café	Gym	Coffee Shop	Restau
12	0	Davisville North	Gym	Park	Sandwich Place	Breakfast Spot	Clothing Store	Food & Drink Shop	H
13	0	Deer Park, Forest Hill SE, Rathnelly, South Hi...	Coffee Shop	Pub	Bagel Shop	Restaurant	Vietnamese Restaurant	Liquor Store	Superma
14	0	Design Exchange, Toronto Dominion Centre	Coffee Shop	Café	Hotel	Restaurant	Bar	Bakery	Gastro
15	0	Dovercourt Village, Dufferin	Pharmacy	Supermarket	Bakery	Middle Eastern Restaurant	Music Venue	Park	

	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 M Comm Ve
16	0	First Canadian Place, Underground city	Coffee Shop	Café	Hotel	Restaurant	Steakhouse	Bar	Gastro
17	0	Forest Hill North, Forest Hill West	Trail	Jewelry Store	Sushi Restaurant	Bus Line	Wings Joint	Diner	Fa Restau
18	0	Harbord, University of Toronto	Café	Restaurant	Bar	Japanese Restaurant	Sandwich Place	Bookstore	Ba
19	0	Harbourfront East, Toronto Islands, Union Station	Coffee Shop	Aquarium	Hotel	Café	Scenic Lookout	Fried Chicken Joint	Brev
20	0	Harbourfront, Regent Park	Coffee Shop	Café	Pub	Bakery	Park	Gym / Fitness Center	Mex Restau
21	0	High Park, The Junction South	Mexican Restaurant	Café	Grocery Store	Furniture / Home Store	Music Venue	Diner	Disc S
22	3	Lawrence Park	Park	Bus Line	Swim School	Wings Joint	Diner	Falafel Restaurant	Event Sp
23	0	Little Portugal, Trinity	Bar	Asian Restaurant	Coffee Shop	Boutique	Restaurant	Café	Pizza P
24	1	Moore Park, Summerhill East	Playground	Wings Joint	Dessert Shop	Falafel Restaurant	Event Space	Ethiopian Restaurant	Electro S
25	0	North Toronto West	Coffee Shop	Clothing Store	Sporting Goods Shop	Park	Salon / Barbershop	Burger Joint	Restau
26	0	Parkdale, Roncesvalles	Breakfast Spot	Gift Shop	Bookstore	Dog Run	Italian Restaurant	Restaurant	
27	4	Rosedale	Park	Playground	Trail	Building	Wings Joint	Dim Sum Restaurant	Event Sp
28	2	Roselawn	Health & Beauty Service	Music Venue	Garden	Falafel Restaurant	Event Space	Ethiopian Restaurant	Electro S
29	0	Runnymede, Swansea	Coffee Shop	Café	Pizza Place	Italian Restaurant	Sushi Restaurant	Food	
30	0	Ryerson, Garden District	Coffee Shop	Clothing Store	Middle Eastern Restaurant	Café	Cosmetics Shop	Sporting Goods Shop	Fast F Restau
31	0	St. James Town	Coffee Shop	Café	Hotel	Restaurant	Italian Restaurant	Cocktail Bar	Ba
32	0	Stn A PO Boxes 25 The Esplanade	Coffee Shop	Café	Restaurant	Beer Bar	Seafood Restaurant	Hotel	It Restau
33	0	Studio District	Café	Coffee Shop	Bakery	American Restaurant	Italian Restaurant	Cheese Shop	Statio S

	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 M Comm Ve
34	0	The Annex, North Midtown, Yorkville	Coffee Shop	Sandwich Place	Café	Pizza Place	Park	Burger Joint	In Restau
35	0	The Beaches	Health Food Store	Trail	Pub	Wings Joint	Donut Shop	Diner	Disc S
36	0	The Beaches West, India Bazaar	Park	Sandwich Place	Pet Store	Pub	Burger Joint	Burrito Place	Fast F Restau
37	0	The Danforth West, Riverdale	Greek Restaurant	Coffee Shop	Italian Restaurant	Bookstore	Furniture / Home Store	Ice Cream Shop	Pizza P

In [44]:
```
Toronto_merged = Toronto_data
Toronto_merged
```

Out[44]:

	Postcode	Borough	Neighbourhood	Latitude	Longitude
0	M4E	East Toronto	The Beaches	43.676357	-79.293031
1	M4K	East Toronto	The Danforth West, Riverdale	43.679557	-79.352188
2	M4L	East Toronto	The Beaches West, India Bazaar	43.668999	-79.315572
3	M4M	East Toronto	Studio District	43.659526	-79.340923
4	M4N	Central Toronto	Lawrence Park	43.728020	-79.388790
5	M4P	Central Toronto	Davisville North	43.712751	-79.390197
6	M4R	Central Toronto	North Toronto West	43.715383	-79.405678
7	M4S	Central Toronto	Davisville	43.704324	-79.388790
8	M4T	Central Toronto	Moore Park, Summerhill East	43.689574	-79.383160
9	M4V	Central Toronto	Deer Park, Forest Hill SE, Rathnelly, South Hi...	43.686412	-79.400049
10	M4W	Downtown Toronto	Rosedale	43.679563	-79.377529
11	M4X	Downtown Toronto	Cabbagetown, St. James Town	43.667967	-79.367675
12	M4Y	Downtown Toronto	Church and Wellesley	43.665860	-79.383160
13	M5A	Downtown Toronto	Harbourfront, Regent Park	43.654260	-79.360636
14	M5B	Downtown Toronto	Ryerson, Garden District	43.657162	-79.378937
15	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
16	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306
17	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383
18	M5H	Downtown Toronto	Adelaide, King, Richmond	43.650571	-79.384568
19	M5J	Downtown Toronto	Harbourfront East, Toronto Islands, Union Station	43.640816	-79.381752
20	M5K	Downtown Toronto	Design Exchange, Toronto Dominion Centre	43.647177	-79.381576
21	M5L	Downtown Toronto	Commerce Court, Victoria Hotel	43.648198	-79.379817
22	M5N	Central Toronto	Roselawn	43.711695	-79.416936
23	M5P	Central Toronto	Forest Hill North, Forest Hill West	43.696948	-79.411307
24	M5R	Central Toronto	The Annex, North Midtown, Yorkville	43.672710	-79.405678
25	M5S	Downtown Toronto	Harbord, University of Toronto	43.662696	-79.400049
26	M5T	Downtown Toronto	Chinatown, Grange Park, Kensington Market	43.653206	-79.400049
27	M5V	Downtown Toronto	CN Tower, Bathurst Quay, Island airport, Harbo...	43.628947	-79.394420
28	M5W	Downtown Toronto	Stn A PO Boxes 25 The Esplanade	43.646435	-79.374846
29	M5X	Downtown Toronto	First Canadian Place, Underground city	43.648429	-79.382280
30	M6G	Downtown Toronto	Christie	43.669542	-79.422564
31	M6H	West Toronto	Dovercourt Village, Dufferin	43.669005	-79.442259
32	M6J	West Toronto	Little Portugal, Trinity	43.647927	-79.419750
33	M6K	West Toronto	Brockton, Exhibition Place, Parkdale Village	43.636847	-79.428191
34	M6P	West Toronto	High Park, The Junction South	43.661608	-79.464763
35	M6R	West Toronto	Parkdale, Roncesvalles	43.648960	-79.456325
36	M6S	West Toronto	Runnymede, Swansea	43.651571	-79.484450
37	M7Y	East Toronto	Business Reply Mail Processing Centre 969 Eastern	43.662744	-79.321558

In [62]:
```
Toronto_merged.insert(0, 'Cluster Labels', kmeans.labels_)
Toronto_merged
```

Out[62]:

	Cluster Labels	Postcode	Borough	Neighbourhood	Latitude	Longitude
0	0	M4E	East Toronto	The Beaches	43.676357	-79.293031
1	0	M4K	East Toronto	The Danforth West, Riverdale	43.679557	-79.352188
2	0	M4L	East Toronto	The Beaches West, India Bazaar	43.668999	-79.315572
3	0	M4M	East Toronto	Studio District	43.659526	-79.340923
4	0	M4N	Central Toronto	Lawrence Park	43.728020	-79.388790
5	0	M4P	Central Toronto	Davisville North	43.712751	-79.390197
6	0	M4R	Central Toronto	North Toronto West	43.715383	-79.405678
7	0	M4S	Central Toronto	Davisville	43.704324	-79.388790
8	0	M4T	Central Toronto	Moore Park, Summerhill East	43.689574	-79.383160
9	0	M4V	Central Toronto	Deer Park, Forest Hill SE, Rathnelly, South Hi...	43.686412	-79.400049
10	0	M4W	Downtown Toronto	Rosedale	43.679563	-79.377529
11	0	M4X	Downtown Toronto	Cabbagetown, St. James Town	43.667967	-79.367675
12	0	M4Y	Downtown Toronto	Church and Wellesley	43.665860	-79.383160
13	0	M5A	Downtown Toronto	Harbourfront, Regent Park	43.654260	-79.360636
14	0	M5B	Downtown Toronto	Ryerson, Garden District	43.657162	-79.378937
15	0	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
16	0	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306
17	0	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383
18	0	M5H	Downtown Toronto	Adelaide, King, Richmond	43.650571	-79.384568
19	0	M5J	Downtown Toronto	Harbourfront East, Toronto Islands, Union Station	43.640816	-79.381752
20	0	M5K	Downtown Toronto	Design Exchange, Toronto Dominion Centre	43.647177	-79.381576
21	0	M5L	Downtown Toronto	Commerce Court, Victoria Hotel	43.648198	-79.379817
22	3	M5N	Central Toronto	Roselawn	43.711695	-79.416936
23	0	M5P	Central Toronto	Forest Hill North, Forest Hill West	43.696948	-79.411307
24	1	M5R	Central Toronto	The Annex, North Midtown, Yorkville	43.672710	-79.405678
25	0	M5S	Downtown Toronto	Harbord, University of Toronto	43.662696	-79.400049
26	0	M5T	Downtown Toronto	Chinatown, Grange Park, Kensington Market	43.653206	-79.400049
27	4	M5V	Downtown Toronto	CN Tower, Bathurst Quay, Island airport, Harbo...	43.628947	-79.394420
28	2	M5W	Downtown Toronto	Stn A PO Boxes 25 The Esplanade	43.646435	-79.374846

	Cluster Labels	Postcode	Borough	Neighbourhood	Latitude	Longitude
29	0	M5X	Downtown Toronto	First Canadian Place, Underground city	43.648429	-79.382280
30	0	M6G	Downtown Toronto	Christie	43.669542	-79.422564
31	0	M6H	West Toronto	Dovercourt Village, Dufferin	43.669005	-79.442259
32	0	M6J	West Toronto	Little Portugal, Trinity	43.647927	-79.419750
33	0	M6K	West Toronto	Brockton, Exhibition Place, Parkdale Village	43.636847	-79.428191
34	0	M6P	West Toronto	High Park, The Junction South	43.661608	-79.464763
35	0	M6R	West Toronto	Parkdale, Roncesvalles	43.648960	-79.456325
36	0	M6S	West Toronto	Runnymede, Swansea	43.651571	-79.484450
37	0	M7Y	East Toronto	Business Reply Mail Processing Centre 969 Eastern	43.662744	-79.321558

Finally, let's visualize the resulting clusters

In [63]:
```
Toronto_merged
```

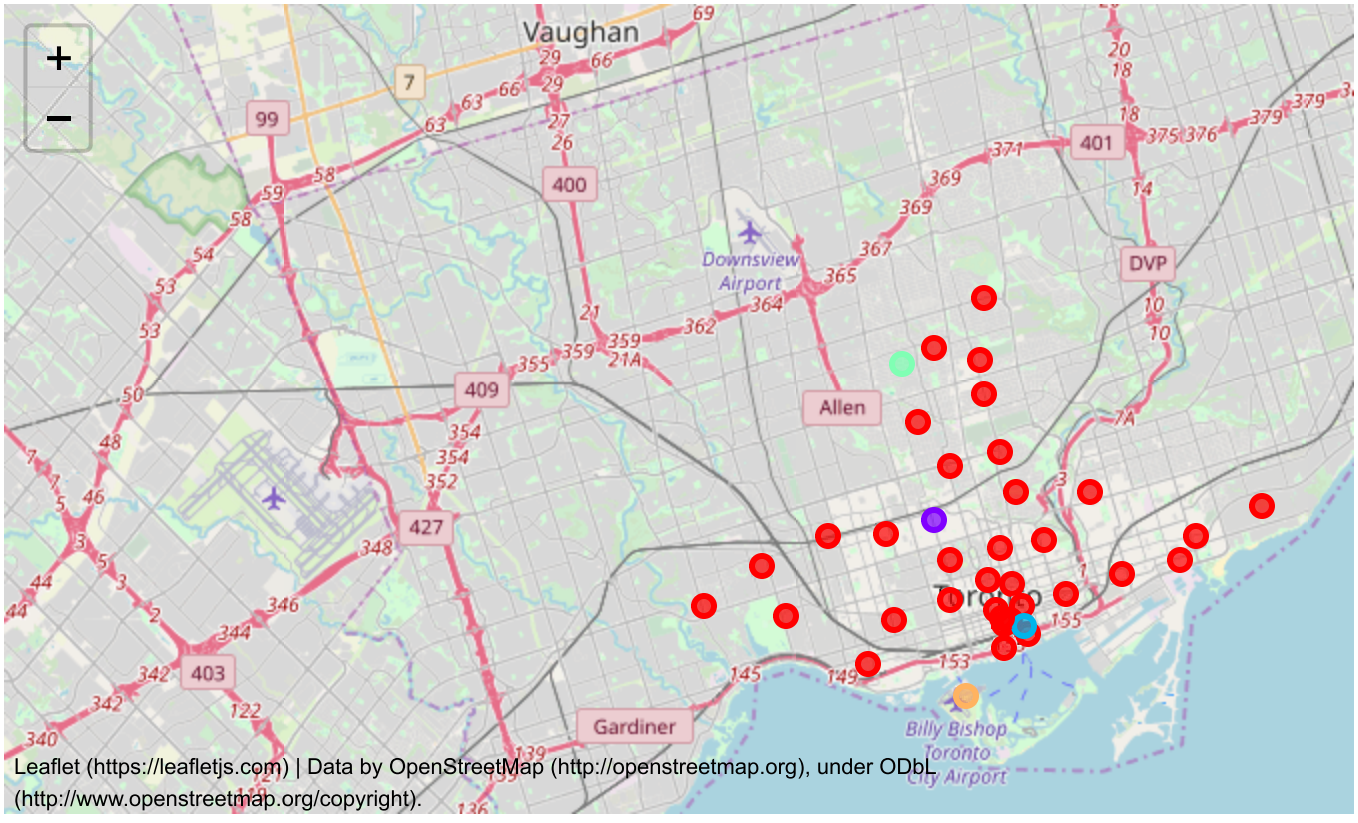
Out[63]:

	Cluster Labels	Postcode	Borough	Neighbourhood	Latitude	Longitude
0	0	M4E	East Toronto	The Beaches	43.676357	-79.293031
1	0	M4K	East Toronto	The Danforth West, Riverdale	43.679557	-79.352188
2	0	M4L	East Toronto	The Beaches West, India Bazaar	43.668999	-79.315572
3	0	M4M	East Toronto	Studio District	43.659526	-79.340923
4	0	M4N	Central Toronto	Lawrence Park	43.728020	-79.388790
5	0	M4P	Central Toronto	Davisville North	43.712751	-79.390197
6	0	M4R	Central Toronto	North Toronto West	43.715383	-79.405678
7	0	M4S	Central Toronto	Davisville	43.704324	-79.388790
8	0	M4T	Central Toronto	Moore Park, Summerhill East	43.689574	-79.383160
9	0	M4V	Central Toronto	Deer Park, Forest Hill SE, Rathnelly, South Hi...	43.686412	-79.400049
10	0	M4W	Downtown Toronto	Rosedale	43.679563	-79.377529
11	0	M4X	Downtown Toronto	Cabbagetown, St. James Town	43.667967	-79.367675
12	0	M4Y	Downtown Toronto	Church and Wellesley	43.665860	-79.383160
13	0	M5A	Downtown Toronto	Harbourfront, Regent Park	43.654260	-79.360636
14	0	M5B	Downtown Toronto	Ryerson, Garden District	43.657162	-79.378937
15	0	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
16	0	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306
17	0	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383
18	0	M5H	Downtown Toronto	Adelaide, King, Richmond	43.650571	-79.384568
19	0	M5J	Downtown Toronto	Harbourfront East, Toronto Islands, Union Station	43.640816	-79.381752
20	0	M5K	Downtown Toronto	Design Exchange, Toronto Dominion Centre	43.647177	-79.381576
21	0	M5L	Downtown Toronto	Commerce Court, Victoria Hotel	43.648198	-79.379817
22	3	M5N	Central Toronto	Roselawn	43.711695	-79.416936
23	0	M5P	Central Toronto	Forest Hill North, Forest Hill West	43.696948	-79.411307
24	1	M5R	Central Toronto	The Annex, North Midtown, Yorkville	43.672710	-79.405678
25	0	M5S	Downtown Toronto	Harbord, University of Toronto	43.662696	-79.400049
26	0	M5T	Downtown Toronto	Chinatown, Grange Park, Kensington Market	43.653206	-79.400049
27	4	M5V	Downtown Toronto	CN Tower, Bathurst Quay, Island airport, Harbo...	43.628947	-79.394420
28	2	M5W	Downtown Toronto	Stn A PO Boxes 25 The Esplanade	43.646435	-79.374846

	Cluster Labels	Postcode	Borough	Neighbourhood	Latitude	Longitude
29	0	M5X	Downtown Toronto	First Canadian Place, Underground city	43.648429	-79.382280
30	0	M6G	Downtown Toronto	Christie	43.669542	-79.422564
31	0	M6H	West Toronto	Dovercourt Village, Dufferin	43.669005	-79.442259
32	0	M6J	West Toronto	Little Portugal, Trinity	43.647927	-79.419750
33	0	M6K	West Toronto	Brockton, Exhibition Place, Parkdale Village	43.636847	-79.428191
34	0	M6P	West Toronto	High Park, The Junction South	43.661608	-79.464763
35	0	M6R	West Toronto	Parkdale, Roncesvalles	43.648960	-79.456325
36	0	M6S	West Toronto	Runnymede, Swansea	43.651571	-79.484450
37	0	M7Y	East Toronto	Business Reply Mail Processing Centre 969 Eastern	43.662744	-79.321558

In [64]:
```
# Matplotlib and associated plotting modules
import matplotlib.cm as cm
import matplotlib.colors as colors

# create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i + x + (i*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(Toronto_merged['Latitude'], Toronto_merged['Longitude'
], Toronto_merged['Neighbourhood'], Toronto_merged['Cluster Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters)

map_clusters
```

Out[64]:



Examine Clusters

cluster 1

In [65]:
```
Toronto_merged.loc[Toronto_merged['Cluster Labels'] == 0, Toronto_merged.columns[[1] + list(range(5, Toronto_merged.shape[1]))]]
```

Out[65]:

	Postcode	Longitude
0	M4E	-79.293031
1	M4K	-79.352188
2	M4L	-79.315572
3	M4M	-79.340923
4	M4N	-79.388790
5	M4P	-79.390197
6	M4R	-79.405678
7	M4S	-79.388790
8	M4T	-79.383160
9	M4V	-79.400049
10	M4W	-79.377529
11	M4X	-79.367675
12	M4Y	-79.383160
13	M5A	-79.360636
14	M5B	-79.378937
15	M5C	-79.375418
16	M5E	-79.373306
17	M5G	-79.387383
18	M5H	-79.384568
19	M5J	-79.381752
20	M5K	-79.381576
21	M5L	-79.379817
23	M5P	-79.411307
25	M5S	-79.400049
26	M5T	-79.400049
29	M5X	-79.382280
30	M6G	-79.422564
31	M6H	-79.442259
32	M6J	-79.419750
33	M6K	-79.428191
34	M6P	-79.464763
35	M6R	-79.456325
36	M6S	-79.484450
37	M7Y	-79.321558

cluster 2

In [66]:
```
Toronto_merged.loc[Toronto_merged['Cluster Labels'] == 1, Toronto_merged.columns[[1] + list(range(5, Toronto_merged.shape[1]))]]
```

Out[66]:

	Postcode	Longitude
24	M5R	-79.405678

cluster 3

In [67]:
```
Toronto_merged.loc[Toronto_merged['Cluster Labels'] == 2, Toronto_merged.columns[[1] + list(range(5, Toronto_merged.shape[1]))]]
```

Out[67]:

	Postcode	Longitude
28	M5W	-79.374846

Cluster 4

In [68]:
```
Toronto_merged.loc[Toronto_merged['Cluster Labels'] == 3, Toronto_merged.columns[[1] + list(range(5, Toronto_merged.shape[1]))]]
```

Out[68]:

	Postcode	Longitude
22	M5N	-79.416936

Cluster 5

In [69]:
```
Toronto_merged.loc[Toronto_merged['Cluster Labels'] == 4, Toronto_merged.columns[[1] + list(range(5, Toronto_merged.shape[1]))]]
```

Out[69]:

	Postcode	Longitude
27	M5V	-79.39442

In [ ]:
```

```