

Peer-graded Assignment: Segmenting and Clustering Neighborhoods in Toronto

Part 1

In [1]:

```
import numpy as np # Library to handle data in a vectorized manner

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

import json # Library to handle JSON files

!conda install -c conda-forge geopy --yes # uncomment this line if you haven't completed the Foursquare API lab
from geopy.geocoders import Nominatim # convert an address into latitude and longitude values

import requests # Library to handle requests
from pandas.io.json import json_normalize # transform 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

!conda install -c conda-forge folium=0.5.0 --yes # uncomment this line if you haven't completed the Foursquare API lab
import folium # map rendering library

print('Libraries imported.')
```

Solving environment: done

==> WARNING: A newer version of conda exists. <==
current version: 4.5.11
latest version: 4.7.12

Please update conda by running

```
$ conda update -n base -c defaults conda
```

Package Plan

environment location: /home/jupyterlab/conda/envs/python

added / updated specs:
- geopy

The following packages will be downloaded:

package	build		
scikit-learn-0.20.1	py36h22eb022_0	5.7 MB	
liblapack-3.8.0	11_openblas	10 KB	conda-forge
scipy-1.3.2	py36h921218d_0	18.0 MB	conda-forge
geographiclib-1.50	py_0	34 KB	conda-forge
libopenblas-0.3.6	h5a2b251_2	7.7 MB	
liblapacke-3.8.0	11_openblas	10 KB	conda-forge
numpy-1.17.3	py36h95a1406_0	5.2 MB	conda-forge
libcbblas-3.8.0	11_openblas	10 KB	conda-forge
libblas-3.8.0	11_openblas	10 KB	conda-forge
geopy-1.20.0	py_0	57 KB	conda-forge
blas-2.11	openblas	10 KB	conda-forge
Total:		36.8 MB	

The following NEW packages will be INSTALLED:

geographiclib:	1.50-py_0	conda-forge
geopy:	1.20.0-py_0	conda-forge

```
libblas:      3.8.0-11_openblas      conda-forge
libcbblas:    3.8.0-11_openblas      conda-forge
liblapack:    3.8.0-11_openblas      conda-forge
liblapacke:   3.8.0-11_openblas      conda-forge
libopenblas:  0.3.6-h5a2b251_2
```

The following packages will be UPDATED:

```
blas:          1.1-openblas      conda-forge --> 2.11-openblas      conda-forge
numpy:         1.16.2-py36_blas_openblash1522bff_0  conda-forge [blas_openblas] --> 1.17.3-py36h95a1406
_0 conda-forge
scipy:         1.2.1-py36_blas_openblash1522bff_0  conda-forge [blas_openblas] --> 1.3.2-py36h921218d_
0 conda-forge
```

The following packages will be DOWNGRADED:

```
scikit-learn: 0.20.1-py36_blas_openblashebf5e3_1200 conda-forge [blas_openblas] --> 0.20.1-py36h22eb022
_0
```

Downloading and Extracting Packages

```
scikit-learn-0.20.1 | 5.7 MB | ##### | 100%
liblapack-3.8.0      | 10 KB | ##### | 100%
scipy-1.3.2          | 18.0 MB | ##### | 100%
geographiclib-1.50   | 34 KB | ##### | 100%
libopenblas-0.3.6    | 7.7 MB | ##### | 100%
liblapacke-3.8.0     | 10 KB | ##### | 100%
numpy-1.17.3         | 5.2 MB | ##### | 100%
libcbblas-3.8.0      | 10 KB | ##### | 100%
libblas-3.8.0        | 10 KB | ##### | 100%
geopy-1.20.0         | 57 KB | ##### | 100%
blas-2.11            | 10 KB | ##### | 100%
```

```
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
Solving environment: done
```

```
==> WARNING: A newer version of conda exists. <==
current version: 4.5.11
latest version: 4.7.12
```

Please update conda by running

```
$ conda update -n base -c defaults conda
```

```
# All requested packages already installed.
```

```
Libraries imported.
```

In [2]:

```
pip install lxml
```

```
Collecting lxml
```

```
  Downloading https://files.pythonhosted.org/packages/ec/be/5ab8abdd8663c0386ec2dd595a5bc0e23330a0549b8a91e32f38c20845b6/lxml-4.4.1-cp36-cp36m-manylinux1_x86_64.whl (5.8MB)
```

```
    |████████████████████████████████████████| 5.8MB 5.0MB/s eta 0:00:01
```

```
Installing collected packages: lxml
```

```
Successfully installed lxml-4.4.1
```

```
Note: you may need to restart the kernel to use updated packages.
```

In [3]:

```
#Fetching the data from the web page
```

```
url = 'https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M'
```

```
toronto_data = pd.read_html(url, header = 0)
```

```
toronto_data = toronto_data[0]
```

```
toronto_data.head()
```

Out[3]:

	Postcode	Borough	Neighbourhood
0	M1A	Not assigned	Not assigned
1	M2A	Not assigned	Not assigned
2	M3A	North York	Parkwoods
3	M4A	North York	Victoria Village
4	M5A	Downtown Toronto	Harbourfront

In [4]:

```
#Creating the neighborhoods data with Borough Name ie, eliminating 'Not assigned observations'
neighborhoods_data = toronto_data[toronto_data.Borough != 'Not assigned']
neighborhoods_data.reset_index(drop = True, inplace = True)
neighborhoods_data.head()
```

Out[4]:

	Postcode	Borough	Neighbourhood
0	M3A	North York	Parkwoods
1	M4A	North York	Victoria Village
2	M5A	Downtown Toronto	Harbourfront
3	M6A	North York	Lawrence Heights
4	M6A	North York	Lawrence Manor

In [19]:

```
#Grouping the Data by postcode, ensuring that all Neighborhoods under the same postcode appear as one observation
neighborhoods_data = neighborhoods_data.groupby(['Postcode', 'Borough'])['Neighbourhood'].apply(', '.join)
neighborhoods_data = neighborhoods_data.reset_index(level = ['Postcode', 'Borough'])
neighborhoods_data.head()
```

Out[19]:

	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

In [6]:

```
#Replacing the 'Neighborhood's with the observation 'Not assigned' their Borough Names
print(neighborhoods_data[neighborhoods_data.Neighbourhood == 'Not assigned'])
neighborhoods_data.loc[(neighborhoods_data.Neighbourhood == 'Not assigned'), 'Neighbourhood']=neighborhoods_data.Borough
neighborhoods_data.head()
```

```
Postcode      Borough Neighbourhood
85      M7A  Queen's Park  Not assigned
```

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

In [7]:

```
neighborhoods_data[neighborhoods_data.Neighbourhood == 'Not assigned']
```

Out[7]:

	Postcode	Borough	Neighbourhood
--	----------	---------	---------------

The above code shows that the Neighbourhoods with 'Not assigned' Observations have been replaced with their Borough Name

In [8]:

```
neighborhoods_data
```


Out[8]:

	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
5	M1J	Scarborough	Scarborough Village
6	M1K	Scarborough	East Birchmount Park,Ionview,Kennedy Park
7	M1L	Scarborough	Clairlea,Golden Mile,Oakridge
8	M1M	Scarborough	Cliffcrest,Cliffside,Scarborough Village West
9	M1N	Scarborough	Birch Cliff,Cliffside West
10	M1P	Scarborough	Dorset Park,Scarborough Town Centre,Wexford He...
11	M1R	Scarborough	Maryvale,Wexford
12	M1S	Scarborough	Agincourt
13	M1T	Scarborough	Clarks Corners,Sullivan,Tam O'Shanter
14	M1V	Scarborough	Agincourt North,L'Amoreaux East,Milliken,Steel...
15	M1W	Scarborough	L'Amoreaux West
16	M1X	Scarborough	Upper Rouge
17	M2H	North York	Hillcrest Village
18	M2J	North York	Fairview,Henry Farm,Oriole
19	M2K	North York	Bayview Village
20	M2L	North York	Silver Hills,York Mills
21	M2M	North York	Newtonbrook,Willowdale
22	M2N	North York	Willowdale South
23	M2P	North York	York Mills West
24	M2R	North York	Willowdale West

	Postcode	Borough	Neighbourhood
25	M3A	North York	Parkwoods
26	M3B	North York	Don Mills North
27	M3C	North York	Flemingdon Park,Don Mills South
28	M3H	North York	Bathurst Manor,Downsview North,Wilson Heights
29	M3J	North York	Northwood Park,York University
30	M3K	North York	CFB Toronto,Downsview East
31	M3L	North York	Downsview West
32	M3M	North York	Downsview Central
33	M3N	North York	Downsview Northwest
34	M4A	North York	Victoria Village
35	M4B	East York	Woodbine Gardens,Parkview Hill
36	M4C	East York	Woodbine Heights
37	M4E	East Toronto	The Beaches
38	M4G	East York	Leaside
39	M4H	East York	Thornccliffe Park
40	M4J	East York	East Toronto
41	M4K	East Toronto	The Danforth West,Riverdale
42	M4L	East Toronto	The Beaches West,India Bazaar
43	M4M	East Toronto	Studio District
44	M4N	Central Toronto	Lawrence Park
45	M4P	Central Toronto	Davisville North
46	M4R	Central Toronto	North Toronto West
47	M4S	Central Toronto	Davisville
48	M4T	Central Toronto	Moore Park,Summerhill East
49	M4V	Central Toronto	Deer Park,Forest Hill SE,Rathnelly,South Hill,...
50	M4W	Downtown Toronto	Rosedale
51	M4X	Downtown Toronto	Cabbagetown,St. James Town

	Postcode	Borough	Neighbourhood
52	M4Y	Downtown Toronto	Church and Wellesley
53	M5A	Downtown Toronto	Harbourfront
54	M5B	Downtown Toronto	Ryerson,Garden District
55	M5C	Downtown Toronto	St. James Town
56	M5E	Downtown Toronto	Berczy Park
57	M5G	Downtown Toronto	Central Bay Street
58	M5H	Downtown Toronto	Adelaide,King,Richmond
59	M5J	Downtown Toronto	Harbourfront East,Toronto Islands,Union Station
60	M5K	Downtown Toronto	Design Exchange,Toronto Dominion Centre
61	M5L	Downtown Toronto	Commerce Court,Victoria Hotel
62	M5M	North York	Bedford Park,Lawrence Manor East
63	M5N	Central Toronto	Roselawn
64	M5P	Central Toronto	Forest Hill North,Forest Hill West
65	M5R	Central Toronto	The Annex,North Midtown,Yorkville
66	M5S	Downtown Toronto	Harbord,University of Toronto
67	M5T	Downtown Toronto	Chinatown,Grange Park,Kensington Market
68	M5V	Downtown Toronto	CN Tower,Bathurst Quay,Island airport,Harbourf...
69	M5W	Downtown Toronto	Stn A PO Boxes 25 The Esplanade
70	M5X	Downtown Toronto	First Canadian Place,Underground city
71	M6A	North York	Lawrence Heights,Lawrence Manor
72	M6B	North York	Glencairn
73	M6C	York	Humewood-Cedarvale
74	M6E	York	Caledonia-Fairbanks
75	M6G	Downtown Toronto	Christie
76	M6H	West Toronto	Dovercourt Village,Dufferin
77	M6J	West Toronto	Little Portugal,Trinity
78	M6K	West Toronto	Brockton,Exhibition Place,Parkdale Village

	Postcode	Borough	Neighbourhood
79	M6L	North York	Downsview,North Park,Upwood Park
80	M6M	York	Del Ray,Keelesdale,Mount Dennis,Silverthorn
81	M6N	York	The Junction North,Runnymede
82	M6P	West Toronto	High Park,The Junction South
83	M6R	West Toronto	Parkdale,Roncesvalles
84	M6S	West Toronto	Runnymede,Swansea
85	M7A	Queen's Park	Queen's Park
86	M7R	Mississauga	Canada Post Gateway Processing Centre
87	M7Y	East Toronto	Business Reply Mail Processing Centre 969 Eastern
88	M8V	Etobicoke	Humber Bay Shores,Mimico South,New Toronto
89	M8W	Etobicoke	Alderwood,Long Branch
90	M8X	Etobicoke	The Kingsway,Montgomery Road,Old Mill North
91	M8Y	Etobicoke	Humber Bay,King's Mill Park,Kingsway Park Sout...
92	M8Z	Etobicoke	Kingsway Park South West,Mimico NW,The Queensw...
93	M9A	Queen's Park	Queen's Park
94	M9B	Etobicoke	Cloverdale,Islington,Martin Grove,Princess Gar...
95	M9C	Etobicoke	Bloordale Gardens,Eringate,Markland Wood,Old B...
96	M9L	North York	Humber Summit
97	M9M	North York	Emery,Humberlea
98	M9N	York	Weston
99	M9P	Etobicoke	Westmount
100	M9R	Etobicoke	Kingsview Village,Martin Grove Gardens,Richvie...
101	M9V	Etobicoke	Albion Gardens,Beaumont Heights,Humbergate,Jam...
102	M9W	Etobicoke	Northwest

Part 2

Downloading the Geospatial_Data

In [9]:

```
url = 'https://cocl.us/Geospatial_data'  
Geospatial_data = pd.read_csv(url)  
Geospatial_data.head()
```

Out[9]:

	Postal Code	Latitude	Longitude
0	M1B	43.806686	-79.194353
1	M1C	43.784535	-79.160497
2	M1E	43.763573	-79.188711
3	M1G	43.770992	-79.216917
4	M1H	43.773136	-79.239476

Renaming the Postal Code to Postcode and Merging the Geospatial_data and the neighborhoods_data by a common variable Postcode

In [10]:

```
Geospatial_data = Geospatial_data.rename(columns = {"Postal Code":"Postcode"})  
Geospatial_data.head()
```

Out[10]:

	Postcode	Latitude	Longitude
0	M1B	43.806686	-79.194353
1	M1C	43.784535	-79.160497
2	M1E	43.763573	-79.188711
3	M1G	43.770992	-79.216917
4	M1H	43.773136	-79.239476

In [11]:

```
combined_data = pd.merge(neighborhoods_data,Geospatial_data)  
combined_data
```

Out[11]:

	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 He...	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,Steel...	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

	Postcode	Borough	Neighbourhood	Latitude	Longitude
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
30	M3K	North York	CFB Toronto,Downsview East	43.737473	-79.464763
31	M3L	North York	Downsview West	43.739015	-79.506944
32	M3M	North York	Downsview Central	43.728496	-79.495697
33	M3N	North York	Downsview Northwest	43.761631	-79.520999
34	M4A	North York	Victoria Village	43.725882	-79.315572
35	M4B	East York	Woodbine Gardens,Parkview Hill	43.706397	-79.309937
36	M4C	East York	Woodbine Heights	43.695344	-79.318389
37	M4E	East Toronto	The Beaches	43.676357	-79.293031
38	M4G	East York	Leaside	43.709060	-79.363452
39	M4H	East York	Thornccliffe Park	43.705369	-79.349372
40	M4J	East York	East Toronto	43.685347	-79.338106
41	M4K	East Toronto	The Danforth West,Riverdale	43.679557	-79.352188
42	M4L	East Toronto	The Beaches West,India Bazaar	43.668999	-79.315572
43	M4M	East Toronto	Studio District	43.659526	-79.340923
44	M4N	Central Toronto	Lawrence Park	43.728020	-79.388790
45	M4P	Central Toronto	Davisville North	43.712751	-79.390197
46	M4R	Central Toronto	North Toronto West	43.715383	-79.405678
47	M4S	Central Toronto	Davisville	43.704324	-79.388790
48	M4T	Central Toronto	Moore Park,Summerhill East	43.689574	-79.383160
49	M4V	Central Toronto	Deer Park,Forest Hill SE,Rathnelly,South Hill,...	43.686412	-79.400049
50	M4W	Downtown Toronto	Rosedale	43.679563	-79.377529
51	M4X	Downtown Toronto	Cabbagetown,St. James Town	43.667967	-79.367675

	Postcode	Borough	Neighbourhood	Latitude	Longitude
52	M4Y	Downtown Toronto	Church and Wellesley	43.665860	-79.383160
53	M5A	Downtown Toronto	Harbourfront	43.654260	-79.360636
54	M5B	Downtown Toronto	Ryerson,Garden District	43.657162	-79.378937
55	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
56	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306
57	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383
58	M5H	Downtown Toronto	Adelaide,King,Richmond	43.650571	-79.384568
59	M5J	Downtown Toronto	Harbourfront East,Toronto Islands,Union Station	43.640816	-79.381752
60	M5K	Downtown Toronto	Design Exchange,Toronto Dominion Centre	43.647177	-79.381576
61	M5L	Downtown Toronto	Commerce Court,Victoria Hotel	43.648198	-79.379817
62	M5M	North York	Bedford Park,Lawrence Manor East	43.733283	-79.419750
63	M5N	Central Toronto	Roselawn	43.711695	-79.416936
64	M5P	Central Toronto	Forest Hill North,Forest Hill West	43.696948	-79.411307
65	M5R	Central Toronto	The Annex,North Midtown,Yorkville	43.672710	-79.405678
66	M5S	Downtown Toronto	Harbord,University of Toronto	43.662696	-79.400049
67	M5T	Downtown Toronto	Chinatown,Grange Park,Kensington Market	43.653206	-79.400049
68	M5V	Downtown Toronto	CN Tower,Bathurst Quay,Island airport,Harbourf...	43.628947	-79.394420
69	M5W	Downtown Toronto	Stn A PO Boxes 25 The Esplanade	43.646435	-79.374846
70	M5X	Downtown Toronto	First Canadian Place,Underground city	43.648429	-79.382280
71	M6A	North York	Lawrence Heights,Lawrence Manor	43.718518	-79.464763
72	M6B	North York	Glencairn	43.709577	-79.445073
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

	Postcode	Borough	Neighbourhood	Latitude	Longitude
79	M6L	North York	Downsview,North Park,Upwood Park	43.713756	-79.490074
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 Sout...	43.636258	-79.498509
92	M8Z	Etobicoke	Kingsway Park South West,Mimico NW,The Queensw...	43.628841	-79.520999
93	M9A	Queen's Park	Queen's Park	43.667856	-79.532242
94	M9B	Etobicoke	Cloverdale,Islington,Martin Grove,Princess Gar...	43.650943	-79.554724
95	M9C	Etobicoke	Bloordale Gardens,Eringate,Markland Wood,Old B...	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,Richvie...	43.688905	-79.554724
101	M9V	Etobicoke	Albion Gardens,Beaumont Heights,Humbergate,Jam...	43.739416	-79.588437
102	M9W	Etobicoke	Northwest	43.706748	-79.594054

Part 3

We begin by Checking the number of unique boroughs

In [12]:

```
print('The dataframe has {} boroughs.'.format(len(combined_data['Borough'].unique())))
```

The dataframe has 11 boroughs.

We then create a data frame of only Toronto Neighbourhoods

In [13]:

```
neighborhoods_toronto = combined_data[combined_data['Borough'].str.contains('Toronto')]  
neighborhoods_toronto.reset_index(drop = True, inplace = True)  
neighborhoods_toronto
```

Out[13]:

	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 Hill,...	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	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

	Postcode	Borough	Neighbourhood	Latitude	Longitude
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, Harbourf...	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

Using the Geopy to get the latitude and Longitude values of Toronto

In [14]:

```
address = 'Toronto, Canada'

geolocator = Nominatim(user_agent="toronto_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geographical coordinate of Toronto are {}, {}'.format(latitude, longitude))
```

The geographical coordinate of Toronto are 43.653963, -79.387207.

In [15]:

```
# create map of Toronto using Latitude and Longitude values
map_toronto = folium.Map(location=[latitude, longitude], zoom_start=10)

# add markers to map
for lat, lng, borough, neighborhood in zip(neighborhoods_toronto['Latitude'], neighborhoods_toronto['Longitude'], neighborhoods_toronto['Borough'], neighborhoods_toronto['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[15]:

Let us cluster the Neighbourhood of West_Toronto

In [24]:

```
west_toronto = neighborhoods_toronto[neighborhoods_toronto['Borough'].str.contains('West')]
west_toronto.reset_index(drop = True, inplace = True)
west_toronto
```

Out[24]:

	Postcode	Borough	Neighbourhood	Latitude	Longitude
0	M6H	West Toronto	Dovercourt Village,Dufferin	43.669005	-79.442259
1	M6J	West Toronto	Little Portugal,Trinity	43.647927	-79.419750
2	M6K	West Toronto	Brockton,Exhibition Place,Parkdale Village	43.636847	-79.428191
3	M6P	West Toronto	High Park,The Junction South	43.661608	-79.464763
4	M6R	West Toronto	Parkdale,Roncesvalles	43.648960	-79.456325
5	M6S	West Toronto	Runnymede,Swansea	43.651571	-79.484450

In [20]:

```
# create map of West Toronto using latitude and longitude values
map_Westtoronto = folium.Map(location=[latitude, longitude], zoom_start=10)

# add markers to map
for lat, lng, borough, neighborhood in zip(west_toronto['Latitude'], west_toronto['Longitude'], west_toronto['Borough'],
west_toronto['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_Westtoronto)

map_Westtoronto
```

Out[20]:

Here below, we are going to start utilizing the Foursquare API to explore the neighborhoods and segment them.

We define the Foursquare Credentials

In [21]:

```
CLIENT_ID = 'F3MJ1QJPRHR3QIUN4UFG0GCMJJM53NC2RXKOGENYKFCDTVOK' # your Foursquare ID
CLIENT_SECRET = '3KXNATR3XEC3KQEIHETHNARIT2H2ZBRJDG2MVZ0VV5TQCZAE0' # your Foursquare Secret
VERSION = '20180605' # Foursquare API version

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

Your credentials:

```
CLIENT_ID: F3MJ1QJPRHR3QIUN4UFG0GCMJJM53NC2RXKOGENYKFCDTVOK
CLIENT_SECRET: 3KXNATR3XEC3KQEIHETHNARIT2H2ZBRJDG2MVZ0VV5TQCZAE0
```

We explore the second neighbourhood in our data

In [28]:

```
west_toronto.loc[0, 'Neighbourhood']
```

Out[28]:

```
'Dovercourt Village,Dufferin'
```

We now get the Neighbourhood Latitude and Longitude values

In [29]:

```
neigh_latitude = west_toronto.loc[0, 'Latitude'] #To get the Neighbourhood Latitude
neigh_longitude = west_toronto.loc[0, 'Longitude'] #To get the Neighbourhood Longitude

neigh_name = west_toronto.loc[0, 'Neighbourhood'] #to get the Neighbourhood name

print('The Latitude and Longitude values of {} are {} and {}'.format (neigh_name, neigh_latitude, neigh_longitude))
```

The Latitude and Longitude values of Dovercourt Village,Dufferin are 43.66900510000001 and -79.4422593

Finding top 100 venues at the Dovercourt Village,Dufferin

In [30]:

```
LIMIT = 100 # limit of number of venues returned by Foursquare API
radius = 500 # define radius
url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&limit={}'.format(
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    neigh_latitude,
    neigh_longitude,
    radius,
    LIMIT)
url
```

Out[30]:

```
'https://api.foursquare.com/v2/venues/explore?&client_id=F3MJ1QJPRHR3QIUN4UFG0GCMJJM53NC2RXKOGENYKFCDTVOK&client_secret=3KXNATR3XEC3KQEIHThNARIT2H2ZBRJDG2MVZOVV5TQCZAE0&v=20180605&ll=43.66900510000001,-79.4422593&radius=500&limit=100'
```

In [31]:

```
results = requests.get(url).json()  
results
```

Out[31]:

```
{'meta': {'code': 200, 'requestId': '5dd38d269388d7001b6d92be'},
 'response': {'headerLocation': 'Davenport',
 'headerFullLocation': 'Davenport, Toronto',
 'headerLocationGranularity': 'neighborhood',
 'totalResults': 16,
 'suggestedBounds': {'ne': {'lat': 43.67350510450001,
 'lng': -79.43604977526607},
 'sw': {'lat': 43.664505095500004, 'lng': -79.44846882473394}},
 'groups': [{'type': 'Recommended Places',
 'name': 'recommended',
 'items': [{'reasons': {'count': 0,
 'items': [{'summary': 'This spot is popular',
 'type': 'general',
 'reasonName': 'globalInteractionReason'}]}],
 'venue': {'id': '5753753b498eeb535c53aed5',
 'name': 'The Greater Good Bar',
 'location': {'address': '229 Geary St',
 'crossStreet': 'at Dufferin St',
 'lat': 43.669409,
 'lng': -79.439267,
 'labeledLatLngs': [{'label': 'display',
 'lat': 43.669409,
 'lng': -79.439267}]},
 'distance': 245,
 'postalCode': 'M6H 2C1',
 'cc': 'CA',
 'city': 'Toronto',
 'state': 'ON',
 'country': 'Canada',
 'formattedAddress': ['229 Geary St (at Dufferin St)',
 'Toronto ON M6H 2C1',
 'Canada']},
 'categories': [{'id': '4bf58dd8d48988d116941735',
 'name': 'Bar',
 'pluralName': 'Bars',
 'shortName': 'Bar',
 'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/nightlife/pub_',
 'suffix': '.png'},
 'primary': True}],
 'photos': {'count': 0, 'groups': []}},
 'referralId': 'e-0-5753753b498eeb535c53aed5-0'}],
```



```
{'reasons': {'count': 0,
  'items': [{ 'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason' } ] },
'venuue': { 'id': '5a5659ab17556229a036b74a',
  'name': 'Parallel',
  'location': { 'address': '217 Geary Ave.',
    'lat': 43.66951635632503,
    'lng': -79.43872770646192,
    'labeledLatLngs': [ { 'label': 'display',
      'lat': 43.66951635632503,
      'lng': -79.43872770646192 } ] },
  'distance': 290,
  'postalCode': 'M6H 2C1',
  'cc': 'CA',
  'city': 'Toronto',
  'state': 'ON',
  'country': 'Canada',
  'formattedAddress': [ '217 Geary Ave.',
    'Toronto ON M6H 2C1',
    'Canada' ] },
'categories': [ { 'id': '4bf58dd8d48988d115941735',
  'name': 'Middle Eastern Restaurant',
  'pluralName': 'Middle Eastern Restaurants',
  'shortName': 'Middle Eastern',
  'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/middleeastern_',
    'suffix': '.png' },
  'primary': True } ],
'photos': { 'count': 0, 'groups': [ ] },
'referralId': 'e-0-5a5659ab17556229a036b74a-1'},
{'reasons': {'count': 0,
  'items': [{ 'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason' } ] },
'venuue': { 'id': '54468744498ed0b9299a6abe',
  'name': 'Planet Fitness Toronto Galleria',
  'location': { 'address': '1245 Dupont Street',
    'crossStreet': 'Dufferin St. & Dupont St',
    'lat': 43.66758797288865,
    'lng': -79.44257365441428,
    'labeledLatLngs': [ { 'label': 'display',
      'lat': 43.66758797288865,
      'lng': -79.44257365441428 } ] },
```

```
'distance': 159,
'postalCode': 'M6H 2A6',
'cc': 'CA',
'city': 'Toronto',
'state': 'ON',
'country': 'Canada',
'formattedAddress': ['1245 Dupont Street (Dufferin St. & Dupont St)',
'Toronto ON M6H 2A6',
'Canada']],
'categories': [{ 'id': '4bf58dd8d48988d175941735',
'name': 'Gym / Fitness Center',
'pluralName': 'Gyms or Fitness Centers',
'shortName': 'Gym / Fitness',
'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/building/gym_',
'suffix': '.png'},
'primary': True}],
'photos': { 'count': 0, 'groups': [] },
'referralId': 'e-0-54468744498ed0b9299a6abe-2'},
{'reasons': { 'count': 0,
'items': [{ 'summary': 'This spot is popular',
'type': 'general',
'reasonName': 'globalInteractionReason' } ] },
'venuue': { 'id': '568333d5498e400ae0f1a732',
'name': 'Blood Brothers Brewing',
'location': { 'address': '165 Geary Ave',
'crossStreet': 'at Barlett Ave N',
'lat': 43.66994369492681,
'lng': -79.43653285503387,
'labeledLatLngs': [{ 'label': 'display',
'lat': 43.66994369492681,
'lng': -79.43653285503387 } ] },
'distance': 472,
'postalCode': 'M6H 2B8',
'cc': 'CA',
'city': 'Toronto',
'state': 'ON',
'country': 'Canada',
'formattedAddress': ['165 Geary Ave (at Barlett Ave N)',
'Toronto ON M6H 2B8',
'Canada']],
'categories': [{ 'id': '50327c8591d4c4b30a586d5d',
'name': 'Brewery',
'pluralName': 'Breweries',
```

```
    'shortName': 'Brewery',
    'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/brewery_',
            'suffix': '.png'},
    'primary': True}],
  'photos': {'count': 0, 'groups': []}},
  'referralId': 'e-0-568333d5498e400ae0f1a732-3'},
  {'reasons': {'count': 0,
    'items': [{'summary': 'This spot is popular',
      'type': 'general',
      'reasonName': 'globalInteractionReason'}]}],
  'venue': {'id': '4bdf2e330ee3a593143c33b0',
    'name': 'Happy Bakery & Pastries',
    'location': {'address': '1245 Dupont St',
      'crossStreet': 'in Galleria Mall',
      'lat': 43.66705039063128,
      'lng': -79.44179124412831,
      'labeledLatLngs': [{'label': 'display',
        'lat': 43.66705039063128,
        'lng': -79.44179124412831}]},
    'distance': 220,
    'postalCode': 'M6H 3A6',
    'cc': 'CA',
    'city': 'Toronto',
    'state': 'ON',
    'country': 'Canada',
    'formattedAddress': ['1245 Dupont St (in Galleria Mall)',
      'Toronto ON M6H 3A6',
      'Canada']},
    'categories': [{'id': '4bf58dd8d48988d16a941735',
      'name': 'Bakery',
      'pluralName': 'Bakeries',
      'shortName': 'Bakery',
      'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/bakery_',
        'suffix': '.png'},
      'primary': True}],
    'photos': {'count': 0, 'groups': []}},
    'referralId': 'e-0-4bdf2e330ee3a593143c33b0-4'},
    {'reasons': {'count': 0,
      'items': [{'summary': 'This spot is popular',
        'type': 'general',
        'reasonName': 'globalInteractionReason'}]}],
    'venue': {'id': '4c717617d97fa143dcf4f8ca',
      'name': 'FreshCo',
```

```
'location': {'address': '1245 Dupont St.',
'crossStreet': 'at Dufferin St.',
'lat': 43.66791838591585,
'lng': -79.44075425394298,
'labeledLatLngs': [{'label': 'display',
'lat': 43.66791838591585,
'lng': -79.44075425394298}]},
'distance': 171,
'postalCode': 'M6H 2A6',
'cc': 'CA',
'city': 'Toronto',
'state': 'ON',
'country': 'Canada',
'formattedAddress': ['1245 Dupont St. (at Dufferin St.)',
'Toronto ON M6H 2A6',
'Canada']},
'categories': [{'id': '52f2ab2ebcbc57f1066b8b46',
'name': 'Supermarket',
'pluralName': 'Supermarkets',
'shortName': 'Supermarket',
'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/food_grocery_',
'suffix': '.png'},
'primary': True}],
'photos': {'count': 0, 'groups': []},
'referralId': 'e-0-4c717617d97fa143dcf4f8ca-5'},
{'reasons': {'count': 0,
'items': [{'summary': 'This spot is popular',
'type': 'general',
'reasonName': 'globalInteractionReason'}]}},
'venue': {'id': '4c3362df452620a1e87d230f',
'name': 'Nova Era Bakery',
'location': {'address': '200 Geary Ave',
'crossStreet': 'btwn Dufferin St. & Dovercourt Rd.',
'lat': 43.66988647609785,
'lng': -79.43758190821525,
'labeledLatLngs': [{'label': 'display',
'lat': 43.66988647609785,
'lng': -79.43758190821525}]},
'distance': 389,
'postalCode': 'M6H 2B9',
'cc': 'CA',
'city': 'Toronto',
'state': 'ON',
```

```
'country': 'Canada',
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'Toronto ON M6H 2B9',
'Canada']],
'categories': [{ 'id': '4bf58dd8d48988d16a941735',
'name': 'Bakery',
'pluralName': 'Bakeries',
'shortName': 'Bakery',
'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/bakery_',
'suffix': '.png'},
'primary': True}],
'photos': { 'count': 0, 'groups': []},
'referralId': 'e-0-4c3362df452620a1e87d230f-6'},
{'reasons': { 'count': 0,
'items': [{ 'summary': 'This spot is popular',
'type': 'general',
'reasonName': 'globalInteractionReason'}]},
'venuue': { 'id': '4b52325ef964a5201b6f27e3',
'name': 'Rehearsal Factory',
'location': { 'address': '330 Geary Ave.',
'crossStreet': 'at Lightbourn Ave.',
'lat': 43.66887675155326,
'lng': -79.44360330056674,
'labeledLatLngs': [{ 'label': 'display',
'lat': 43.66887675155326,
'lng': -79.44360330056674}],
'distance': 109,
'postalCode': 'M6H 2C7',
'cc': 'CA',
'city': 'Toronto',
'state': 'ON',
'country': 'Canada',
'formattedAddress': ['330 Geary Ave. (at Lightbourn Ave.)',
'Toronto ON M6H 2C7',
'Canada']],
'categories': [{ 'id': '4bf58dd8d48988d1e5931735',
'name': 'Music Venue',
'pluralName': 'Music Venues',
'shortName': 'Music Venue',
'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/arts_entertainment/musicvenue_',
'suffix': '.png'},
'primary': True}],
'photos': { 'count': 0, 'groups': []},
```

```
'referralId': 'e-0-4b52325ef964a5201b6f27e3-7'},
{'reasons': {'count': 0,
  'items': [{ 'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason' } ] },
'venu': {'id': '4fc67d32e4b0b0e32cca5b24',
  'name': 'The Sovereign',
  'location': {'address': '1359 Davenport Road',
    'lat': 43.673115708192206,
    'lng': -79.44026498681781,
    'labeledLatLngs': [{ 'label': 'display',
      'lat': 43.673115708192206,
      'lng': -79.44026498681781 } ] },
  'distance': 484,
  'cc': 'CA',
  'city': 'Toronto',
  'state': 'ON',
  'country': 'Canada',
  'formattedAddress': [ '1359 Davenport Road', 'Toronto ON', 'Canada' ] },
'categories': [{ 'id': '4bf58dd8d48988d16d941735',
  'name': 'Café',
  'pluralName': 'Cafés',
  'shortName': 'Café',
  'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/cafe_',
    'suffix': '.png' },
  'primary': True } ] },
'photos': { 'count': 0, 'groups': [ ] },
'referralId': 'e-0-4fc67d32e4b0b0e32cca5b24-8'},
{'reasons': {'count': 0,
  'items': [{ 'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason' } ] },
'venu': {'id': '4bb4b34b8786ef3bc7866533',
  'name': 'Rexall',
  'location': {'address': '1245 Dupont St',
    'crossStreet': 'btwn Dufferin & Emerson',
    'lat': 43.667504,
    'lng': -79.442086,
    'labeledLatLngs': [{ 'label': 'display',
      'lat': 43.667504,
      'lng': -79.442086 } ] },
  'distance': 167,
  'postalCode': 'M6H 2A6',
```

```
'cc': 'CA',
'city': 'Toronto',
'state': 'ON',
'country': 'Canada',
'formattedAddress': ['1245 Dupont St (btwn Dufferin & Emerson)',
'Toronto ON M6H 2A6',
'Canada']],
'categories': [{ 'id': '4bf58dd8d48988d10f951735',
'name': 'Pharmacy',
'pluralName': 'Pharmacies',
'shortName': 'Pharmacy',
'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/pharmacy_',
'suffix': '.png'},
'primary': True}],
'photos': { 'count': 0, 'groups': [] },
'referralId': 'e-0-4bb4b34b8786ef3bc7866533-9'},
{'reasons': { 'count': 0,
'items': [{ 'summary': 'This spot is popular',
'type': 'general',
'reasonName': 'globalInteractionReason' } ] },
'venue': { 'id': '4b157d62f964a5209bad23e3',
'name': 'TD Canada Trust',
'location': { 'address': '1245 Dupont St',
'crossStreet': 'at Dufferin St',
'lat': 43.6679341,
'lng': -79.4416984,
'labeledLatLngs': [{ 'label': 'display',
'lat': 43.6679341,
'lng': -79.4416984 } ] },
'distance': 127,
'postalCode': 'M6H 2A6',
'cc': 'CA',
'city': 'Toronto',
'state': 'ON',
'country': 'Canada',
'formattedAddress': ['1245 Dupont St (at Dufferin St)',
'Toronto ON M6H 2A6',
'Canada']],
'categories': [{ 'id': '4bf58dd8d48988d10a951735',
'name': 'Bank',
'pluralName': 'Banks',
'shortName': 'Bank',
'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/financial_',
```

```
    'suffix': '.png'},
    'primary': True]],
    'photos': {'count': 0, 'groups': []}},
    'referralId': 'e-0-4b157d62f964a5209bad23e3-10'},
    {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason'}]}],
    'venue': {'id': '597a14e63149b944da6ff998',
        'name': 'Food Basics',
        'location': {'address': '830 Lansdowne avenue',
            'crossStreet': 'Dupont and Lansdowne',
            'lat': 43.66683479434923,
            'lng': -79.446812421531,
            'labeledLatLngs': [{'label': 'display',
                'lat': 43.66683479434923,
                'lng': -79.446812421531}]},
        'distance': 439,
        'postalCode': 'M6H 0C3',
        'cc': 'CA',
        'city': 'Toronto',
        'state': 'ON',
        'country': 'Canada',
        'formattedAddress': ['830 Lansdowne avenue (Dupont and Lansdowne)',
            'Toronto ON M6H 0C3',
            'Canada']},
    'categories': [{'id': '52f2ab2ebcbc57f1066b8b46',
        'name': 'Supermarket',
        'pluralName': 'Supermarkets',
        'shortName': 'Supermarket',
        'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/food_grocery_',
            'suffix': '.png'},
        'primary': True}],
    'photos': {'count': 0, 'groups': []}},
    'referralId': 'e-0-597a14e63149b944da6ff998-11'},
    {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason'}]}],
    'venue': {'id': '596ee4bc419a9e73cd9b7ab7',
        'name': 'Shoppers Drug Mart',
        'location': {'address': '1400 Dupont St',
            'crossStreet': 'Lansdowne Avenue',
```



```
'lat': 43.666745,
'lng': -79.447446,
'labeledLatLngs': [{'label': 'display',
  'lat': 43.666745,
  'lng': -79.447446}],
'distance': 487,
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'cc': 'CA',
'city': 'Toronto',
'state': 'ON',
'country': 'Canada',
'formattedAddress': ['1400 Dupont St (Lansdowne Avenue)',
  'Toronto ON M6H 2B2',
  'Canada']],
'categories': [{'id': '4bf58dd8d48988d10f951735',
  'name': 'Pharmacy',
  'pluralName': 'Pharmacies',
  'shortName': 'Pharmacy',
  'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/pharmacy_',
  'suffix': '.png'},
  'primary': True}],
'photos': {'count': 0, 'groups': []}},
'referralId': 'e-0-596ee4bc419a9e73cd9b7ab7-12'},
{'reasons': {'count': 0,
  'items': [{'summary': 'This spot is popular',
  'type': 'general',
  'reasonName': 'globalInteractionReason'}]}],
'venue': {'id': '4c51ca66b6dabe9a06ef5112',
  'name': 'Wallace Emerson Park',
  'location': {'address': '1260 Dufferin St',
  'lat': 43.66693250395496,
  'lng': -79.4394486237563,
  'labeledLatLngs': [{'label': 'display',
  'lat': 43.66693250395496,
  'lng': -79.4394486237563}],
  'distance': 323,
  'postalCode': 'M6H 4C3',
  'cc': 'CA',
  'city': 'Toronto',
  'state': 'ON',
  'country': 'Canada',
  'formattedAddress': ['1260 Dufferin St',
  'Toronto ON M6H 4C3',
```

```
    'Canada']},
  'categories': [{ 'id': '4bf58dd8d48988d163941735',
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    'pluralName': 'Parks',
    'shortName': 'Park',
    'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/parks_outdoors/park_',
      'suffix': '.png'},
    'primary': True}],
  'photos': { 'count': 0, 'groups': []},
  'referralId': 'e-0-4c51ca66b6dabe9a06ef5112-13'},
  { 'reasons': { 'count': 0,
    'items': [{ 'summary': 'This spot is popular',
      'type': 'general',
      'reasonName': 'globalInteractionReason'}]},
    'venue': { 'id': '5998aa934940bc4de5bfdaca',
      'name': 'North Of Brooklyn Pizzeria',
      'location': { 'lat': 43.669467,
        'lng': -79.439335,
        'labeledLatLngs': [{ 'label': 'display',
          'lat': 43.669467,
          'lng': -79.439335}],
        'distance': 241,
        'postalCode': 'M6H',
        'cc': 'CA',
        'city': 'Toronto',
        'state': 'ON',
        'country': 'Canada',
        'formattedAddress': ['Toronto ON M6H', 'Canada']}},
      'categories': [{ 'id': '4bf58dd8d48988d1ca941735',
        'name': 'Pizza Place',
        'pluralName': 'Pizza Places',
        'shortName': 'Pizza',
        'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/pizza_',
          'suffix': '.png'},
        'primary': True}],
        'photos': { 'count': 0, 'groups': []},
        'referralId': 'e-0-5998aa934940bc4de5bfdaca-14'},
        { 'reasons': { 'count': 0,
          'items': [{ 'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason'}]},
            'venue': { 'id': '4bbdeb7df57ba593bd9daeb9',
              'name': 'Coffee Time',
```

```

'location': {'address': '1005 Lansdowne ave',
'crossStreet': 'at Dupont St',
'lat': 43.66683723870163,
'lng': -79.4461966261001,
'labeledLatLngs': [{'label': 'display',
'lat': 43.66683723870163,
'lng': -79.4461966261001}],
'distance': 398,
'cc': 'CA',
'city': 'Toronto',
'state': 'ON',
'country': 'Canada',
'formattedAddress': ['1005 Lansdowne ave (at Dupont St)',
'Toronto ON',
'Canada']},
'categories': [{'id': '4bf58dd8d48988d1e0931735',
'name': 'Coffee Shop',
'pluralName': 'Coffee Shops',
'shortName': 'Coffee Shop',
'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/coffeeshop_',
'suffix': '.png'},
'primary': True}],
'photos': {'count': 0, 'groups': []}},
'referralId': 'e-0-4bbdeb7df57ba593bd9daeb9-15'}]]]]}

```

We now use the `#get_category_type` function to get category of the keys

In [32]:

```

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']

```

We now clean and get the data into a pandas dataframe

In [33]:

```
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.location.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(".")[0] for col in nearby_venues.columns]

nearby_venues.head()
```

Out[33]:

	name	categories	lat	lng
0	The Greater Good Bar	Bar	43.669409	-79.439267
1	Parallel Middle Eastern Restaurant		43.669516	-79.438728
2	Planet Fitness Toronto Galleria	Gym / Fitness Center	43.667588	-79.442574
3	Blood Brothers Brewing	Brewery	43.669944	-79.436533
4	Happy Bakery & Pastries	Bakery	43.667050	-79.441791

We then get the number of venues returned by Foursquare

In [34]:

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

16 venues were returned by Foursquare.

We now repet the process to get all neighbourhoods in west Toronto

In [36]:

```
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)
```

In [38]:

```
westtoronto_venues = getNearbyVenues(names=west_toronto['Neighbourhood'],
                                     latitudes=west_toronto['Latitude'],
                                     longitudes=west_toronto['Longitude']
                                     )
```

Dovercourt Village,Dufferin
Little Portugal,Trinity
Brockton,Exhibition Place,Parkdale Village
High Park,The Junction South
Parkdale,Roncesvalles
Runnymede,Swansea

We check the size and the resulting dataframe of the westtoronto_venues

In [40]:

```
print(westtoronto_venues.shape)
westtoronto_venues.head()
```

(180, 7)

Out[40]:

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Dovercourt Village,Dufferin	43.669005	-79.442259	The Greater Good Bar	43.669409	-79.439267	Bar
1	Dovercourt Village,Dufferin	43.669005	-79.442259	Parallel	43.669516	-79.438728	Middle Eastern Restaurant
2	Dovercourt Village,Dufferin	43.669005	-79.442259	Planet Fitness Toronto Galleria	43.667588	-79.442574	Gym / Fitness Center
3	Dovercourt Village,Dufferin	43.669005	-79.442259	Blood Brothers Brewing	43.669944	-79.436533	Brewery
4	Dovercourt Village,Dufferin	43.669005	-79.442259	Happy Bakery & Pastries	43.667050	-79.441791	Bakery

We groupby Neighbourhood

In [41]:

```
westtoronto_venues.groupby('Neighborhood').count()
```

Out[41]:

	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Neighborhood						
Brockton,Exhibition Place,Parkdale Village	23	23	23	23	23	23
Dovercourt Village,Dufferin	16	16	16	16	16	16
High Park,The Junction South	25	25	25	25	25	25
Little Portugal,Trinity	64	64	64	64	64	64
Parkdale,Roncesvalles	15	15	15	15	15	15
Runnymede,Swansea	37	37	37	37	37	37

We now analyze each neighbourhood in West Toronto

In [42]:

```
# one hot encoding
westtoronto_onehot = pd.get_dummies(westtoronto_venues[['Venue Category']], prefix="", prefix_sep="")

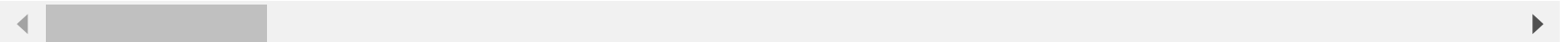
# add neighborhood column back to dataframe
westtoronto_onehot['Neighborhood'] = westtoronto_venues['Neighborhood']

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

westtoronto_onehot.head()
```

Out[42]:

	Neighborhood	Antique Shop	Art Gallery	Arts & Crafts Store	Asian Restaurant	Bakery	Bank	Bar	Bistro	Bookstore	Boutique	Breakfast Spot	Brewery	Burrito Place	(
0	Dovercourt Village,Dufferin	0	0	0	0	0	0	1	0	0	0	0	0	0	
1	Dovercourt Village,Dufferin	0	0	0	0	0	0	0	0	0	0	0	0	0	
2	Dovercourt Village,Dufferin	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	Dovercourt Village,Dufferin	0	0	0	0	0	0	0	0	0	0	0	1	0	
4	Dovercourt Village,Dufferin	0	0	0	0	1	0	0	0	0	0	0	0	0	



We now examine the dataframe using the shape function

In [43]:

```
westtoronto_onehot.shape
```

Out[43]:

(180, 91)

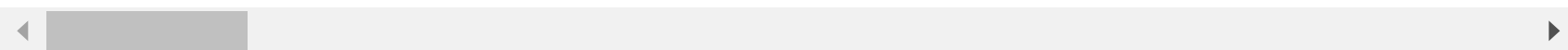
Next, let's group rows by neighborhood and by taking the mean of the frequency of occurrence of each category

In [44]:

```
westtoronto_grouped = westtoronto_onehot.groupby('Neighborhood').mean().reset_index()  
westtoronto_grouped
```

Out[44]:

	Neighborhood	Antique Shop	Art Gallery	Arts & Crafts Store	Asian Restaurant	Bakery	Bank	Bar	Bistro	Bookstore	Boutique	Breakfast Shop
0	Brockton,Exhibition Place,Parkdale Village	0.00	0.000000	0.000000	0.000000	0.086957	0.000000	0.043478	0.000000	0.000000	0.000000	0.086957
1	Dovercourt Village,Dufferin	0.00	0.000000	0.000000	0.000000	0.125000	0.062500	0.062500	0.000000	0.000000	0.000000	0.000000
2	High Park,The Junction South	0.04	0.000000	0.040000	0.000000	0.040000	0.000000	0.080000	0.000000	0.040000	0.000000	0.000000
3	Little Portugal,Trinity	0.00	0.015625	0.000000	0.046875	0.031250	0.000000	0.109375	0.015625	0.000000	0.015625	0.000000
4	Parkdale,Roncesvalles	0.00	0.000000	0.000000	0.000000	0.000000	0.066667	0.066667	0.000000	0.066667	0.000000	0.066667
5	Runnymede,Swansea	0.00	0.000000	0.027027	0.000000	0.000000	0.000000	0.027027	0.000000	0.027027	0.000000	0.000000



In [45]:

```
#We take a look at the shape of the new data  
westtoronto_grouped.shape
```

Out[45]:

```
(6, 91)
```

We print each neighborhood along with the top 5 most common venues

In [46]:

```
num_top_venues = 5

for hood in westtoronto_grouped['Neighborhood']:
    print("-----"+hood+"-----")
    temp = westtoronto_grouped[westtoronto_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')
```

----Brockton,Exhibition Place,Parkdale Village----

	venue	freq
0	Breakfast Spot	0.09
1	Coffee Shop	0.09
2	Bakery	0.09
3	Café	0.09
4	Performing Arts Venue	0.04

----Dovercourt Village,Dufferin----

	venue	freq
0	Supermarket	0.12
1	Pharmacy	0.12
2	Bakery	0.12
3	Café	0.06
4	Gym / Fitness Center	0.06

----High Park,The Junction South----

	venue	freq
0	Mexican Restaurant	0.08
1	Bar	0.08
2	Thai Restaurant	0.08
3	Café	0.08
4	Antique Shop	0.04

----Little Portugal,Trinity----

	venue	freq
0	Bar	0.11
1	Coffee Shop	0.06
2	Restaurant	0.05
3	Asian Restaurant	0.05
4	New American Restaurant	0.03

----Parkdale,Roncesvalles----

	venue	freq
0	Coffee Shop	0.13
1	Gift Shop	0.13
2	Bookstore	0.07
3	Cuban Restaurant	0.07
4	Dessert Shop	0.07

```
----Runnymede, Swansea----  
      venue  freq  
0    Coffee Shop  0.08  
1         Café  0.08  
2    Pizza Place  0.05  
3 Italian Restaurant  0.05  
4   Sushi Restaurant  0.05
```

We then put the data into a Pandas Data Frame

In [47]:

```
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 [48]:

```
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'] = westtoronto_grouped['Neighborhood']

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

neighborhoods_venues_sorted.head()
```

Out[48]:

	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	Brockton,Exhibition Place,Parkdale Village	Breakfast Spot	Coffee Shop	Bakery	Café	Gym	Grocery Store	Restaurant	Climbing Gym	Caribbean Restaurant	Pet Store
1	Dovercourt Village,Dufferin	Pharmacy	Bakery	Supermarket	Brewery	Middle Eastern Restaurant	Music Venue	Park	Pizza Place	Coffee Shop	Café
2	High Park,The Junction South	Café	Thai Restaurant	Bar	Mexican Restaurant	Antique Shop	Gastropub	Italian Restaurant	Furniture / Home Store	Fried Chicken Joint	Flower Market
3	Little Portugal,Trinity	Bar	Coffee Shop	Restaurant	Asian Restaurant	French Restaurant	Men's Store	Pizza Place	Café	New American Restaurant	Bakery
4	Parkdale,Roncesvalles	Gift Shop	Coffee Shop	Dog Run	Dessert Shop	Eastern European Restaurant	Italian Restaurant	Bank	Bar	Bookstore	Cuban Restaurant

Let us Cluster the Neighbourhoods

Let's create a new dataframe that includes the cluster as well as the top 10 venues for each neighborhood.

In [88]:

```
# set number of clusters
kclusters = 5

toronto_grouped_clustering = westtoronto_grouped.drop('Neighborhood', 1)

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

neighborhoods_venues_sorted.head()
```

Out[88]:

	Cluster_Labels	Postcode	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
0	3	3	3	Brockton, Exhibition Place, Parkdale Village	Breakfast Spot	Coffee Shop	Bakery	Café	Gym	Grocery Store	Restaurant
1	2	2	2	Dovercourt Village, Dufferin	Pharmacy	Bakery	Supermarket	Brewery	Middle Eastern Restaurant	Music Venue	
2	4	4	4	High Park, The Junction South	Café	Thai Restaurant	Bar	Mexican Restaurant	Antique Shop	Gastropub	Italian Restaurant
3	1	1	1	Little Portugal, Trinity	Bar	Coffee Shop	Restaurant	Asian Restaurant	French Restaurant	Men's Store	Fast Food
4	0	0	0	Parkdale, Roncesvalles	Gift Shop	Coffee Shop	Dog Run	Dessert Shop	Eastern European Restaurant	Italian Restaurant	



In []: