Segmenting and Clustering Neighborhoods in Toronto Capstone

By: Sian Bhari

Installing & Importing the required libraries.

In [1]:
```
!pip install beautifulsoup4
!pip install lxml
!pip install folium
!pip install pandas
!pip install scikit-learn
!pip install matplotlib
import requests
import pandas as pd
import numpy as np
from bs4 import BeautifulSoup
from sklearn.cluster import KMeans
import matplotlib.cm as cm
import matplotlib.colors as colors
```

```
Requirement already satisfied: beautifulsoup4 in c:\users\sian\appdata\local\programs\python\python39\lib\site-packag
es (4.9.3)
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s (from beautifulsoup4) (2.1)
Requirement already satisfied: lxml in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages (4.6.2)
Requirement already satisfied: folium in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages (0.1
2.1)
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om folium) (2.25.1)
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folium) (1.20.0)
Requirement already satisfied: branca>=0.3.0 in c:\users\sian\appdata\local\programs\python\python39\lib\site-package
s (from folium) (0.4.2)
```

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Requirement already satisfied: jinja2>=2.9 in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages
(from folium) (2.11.3)
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kages (from requests->folium) (4.0.0)
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ckages (from requests->folium) (2020.12.5)
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-packages (from requests->folium) (1.26.3)
Requirement already satisfied: pandas in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages (1.2.
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e-packages (from pandas) (2.8.1)
Requirement already satisfied: pytz>=2017.3 in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages
(from pandas) (2021.1)
Requirement already satisfied: six>=1.5 in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages (fr
om python-dateutil>=2.7.3->pandas) (1.15.0)
Requirement already satisfied: scikit-learn in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages
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Requirement already satisfied: threadpoolctl>=2.0.0 in c:\users\sian\appdata\local\programs\python\python39\lib\site-
packages (from scikit-learn) (2.1.0)
Requirement already satisfied: joblib>=0.11 in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages
(from scikit-learn) (1.0.0)
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s (from scikit-learn) (1.20.0)
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s (from scikit-learn) (1.6.0)
Requirement already satisfied: matplotlib in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages
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kages (from matplotlib) (1.3.1)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.3 in c:\users\sian\appdata\local\programs\pytho
n\python39\lib\site-packages (from matplotlib) (2.4.7)
Requirement already satisfied: numpy>=1.15 in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages
(from matplotlib) (1.20.0)
Requirement already satisfied: pillow>=6.2.0 in c:\users\sian\appdata\local\programs\python\python39\lib\site-package
s (from matplotlib) (8.1.0)
Requirement already satisfied: cycler>=0.10 in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages
```

```
(from matplotlib) (0.10.0)
Requirement already satisfied: six in c:\users\sian\appdata\local\programs\python\python39\lib\site-packages (from cy
cler>=0.10->matplotlib) (1.15.0)
```

Web-scraping the Wikipedia page for the table of postal codes of Canada; using BeautifulSoup Library of Python

In [2]:
```
wiki = requests.get('https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M').text
soup=BeautifulSoup(wiki, 'html.parser')
```

In [3]:
```
from IPython.display import display_html
tab = str(soup.table)
display_html(tab,raw=True)
```

Postal Code	Borough	Neighbourhood
M1A	Not assigned	Not assigned
M2A	Not assigned	Not assigned
M3A	North York	Parkwoods
M4A	North York	Victoria Village
M5A	Downtown Toronto	Regent Park, Harbourfront
M6A	North York	Lawrence Manor, Lawrence Heights
M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government
M8A	Not assigned	Not assigned
M9A	Etobicoke	Islington Avenue, Humber Valley Village
M1B	Scarborough	Malvern, Rouge
M2B	Not assigned	Not assigned
M3B	North York	Don Mills
M4B	East York	Parkview Hill, Woodbine Gardens
M5B	Downtown Toronto	Garden District, Ryerson

M6B	North York	Glencairn
M7B	Not assigned	Not assigned
M8B	Not assigned	Not assigned
M9B	Etobicoke	West Deane Park, Princess Gardens, Martin Grove, Islington, Cloverdale
M1C	Scarborough	Rouge Hill, Port Union, Highland Creek
M2C	Not assigned	Not assigned
M3C	North York	Don Mills
M4C	East York	Woodbine Heights
M5C	Downtown Toronto	St. James Town
M6C	York	Humewood-Cedarvale
M7C	Not assigned	Not assigned
M8C	Not assigned	Not assigned
M9C	Etobicoke	Eringate, Bloordale Gardens, Old Burnhamthorpe, Markland Wood
M1E	Scarborough	Guildwood, Morningside, West Hill
M2E	Not assigned	Not assigned
M3E	Not assigned	Not assigned
M4E	East Toronto	The Beaches
M5E	Downtown Toronto	Berczy Park
M6E	York	Caledonia-Fairbanks
M7E	Not assigned	Not assigned
M8E	Not assigned	Not assigned
M9E	Not assigned	Not assigned
M1G	Scarborough	Woburn
M2G	Not assigned	Not assigned
M3G	Not assigned	Not assigned

M4G	East York	Leaside
M5G	Downtown Toronto	Central Bay Street
M6G	Downtown Toronto	Christie
M7G	Not assigned	Not assigned
M8G	Not assigned	Not assigned
M9G	Not assigned	Not assigned
M1H	Scarborough	Cedarbrae
M2H	North York	Hillcrest Village
M3H	North York	Bathurst Manor, Wilson Heights, Downsview North
M4H	East York	Thorncliffe Park
M5H	Downtown Toronto	Richmond, Adelaide, King
M6H	West Toronto	Dufferin, Dovercourt Village
M7H	Not assigned	Not assigned
M8H	Not assigned	Not assigned
M9H	Not assigned	Not assigned
M1J	Scarborough	Scarborough Village
M2J	North York	Fairview, Henry Farm, Oriole
M3J	North York	Northwood Park, York University
M4J	East York	East Toronto, Broadview North (Old East York)
M5J	Downtown Toronto	Harbourfront East, Union Station, Toronto Islands
M6J	West Toronto	Little Portugal, Trinity
M7J	Not assigned	Not assigned
M8J	Not assigned	Not assigned
M9J	Not assigned	Not assigned

M1K	Scarborough	Kennedy Park, Ionview, East Birchmount Park
M2K	North York	Bayview Village
M3K	North York	Downsview
M4K	East Toronto	The Danforth West, Riverdale
M5K	Downtown Toronto	Toronto Dominion Centre, Design Exchange
M6K	West Toronto	Brockton, Parkdale Village, Exhibition Place
M7K	Not assigned	Not assigned
M8K	Not assigned	Not assigned
M9K	Not assigned	Not assigned
M1L	Scarborough	Golden Mile, Clairlea, Oakridge
M2L	North York	York Mills, Silver Hills
M3L	North York	Downsview
M4L	East Toronto	India Bazaar, The Beaches West
M5L	Downtown Toronto	Commerce Court, Victoria Hotel
M6L	North York	North Park, Maple Leaf Park, Upwood Park
M7L	Not assigned	Not assigned
M8L	Not assigned	Not assigned
M9L	North York	Humber Summit
M1M	Scarborough	Cliffside, Cliffcrest, Scarborough Village West
M2M	North York	Willowdale, Newtonbrook
M3M	North York	Downsview
M4M	East Toronto	Studio District
M5M	North York	Bedford Park, Lawrence Manor East
M6M	York	Del Ray, Mount Dennis, Keelsdale and Silverthorn
M7M	Not assigned	Not assigned

M8M	Not assigned	Not assigned
M9M	North York	Humberlea, Emery
M1N	Scarborough	Birch Cliff, Cliffside West
M2N	North York	Willowdale, Willowdale East
M3N	North York	Downsview
M4N	Central Toronto	Lawrence Park
M5N	Central Toronto	Roselawn
M6N	York	Runnymede, The Junction North
M7N	Not assigned	Not assigned
M8N	Not assigned	Not assigned
M9N	York	Weston
M1P	Scarborough	Dorset Park, Wexford Heights, Scarborough Town Centre
M2P	North York	York Mills West
M3P	Not assigned	Not assigned
M4P	Central Toronto	Davisville North
M5P	Central Toronto	Forest Hill North & West, Forest Hill Road Park
M6P	West Toronto	High Park, The Junction South
M7P	Not assigned	Not assigned
M8P	Not assigned	Not assigned
M9P	Etobicoke	Westmount
M1R	Scarborough	Wexford, Maryvale
M2R	North York	Willowdale, Willowdale West
M3R	Not assigned	Not assigned
M4R	Central Toronto	North Toronto West, Lawrence Park
M5R	Central Toronto	The Annex, North Midtown, Yorkville
M6R	West Toronto	Parkdale, Roncesvalles

M7R	Mississauga	Canada Post Gateway Processing Centre
M8R	Not assigned	Not assigned
M9R	Etobicoke	Kingsview Village, St. Phillips, Martin Grove Gardens, Richview Gardens
M1S	Scarborough	Agincourt
M2S	Not assigned	Not assigned
M3S	Not assigned	Not assigned
M4S	Central Toronto	Davisville
M5S	Downtown Toronto	University of Toronto, Harbord
M6S	West Toronto	Runnymede, Swansea
M7S	Not assigned	Not assigned
M8S	Not assigned	Not assigned
M9S	Not assigned	Not assigned
M1T	Scarborough	Clarks Corners, Tam O'Shanter, Sullivan
M2T	Not assigned	Not assigned
M3T	Not assigned	Not assigned
M4T	Central Toronto	Moore Park, Summerhill East
M5T	Downtown Toronto	Kensington Market, Chinatown, Grange Park
M6T	Not assigned	Not assigned
M7T	Not assigned	Not assigned
M8T	Not assigned	Not assigned
M9T	Not assigned	Not assigned
M1V	Scarborough	Milliken, Agincourt North, Steeles East, L'Amoreaux East
M2V	Not assigned	Not assigned
M3V	Not assigned	Not assigned
M4V	Central Toronto	Summerhill West, Rathnelly, South Hill, Forest Hill SE, Deer Park

M5V	Downtown Toronto	CN Tower, King and Spadina, Railway Lands, Harbourfront West, Bathurst Quay, South Niagara, Island airport
M6V	Not assigned	Not assigned
M7V	Not assigned	Not assigned
M8V	Etobicoke	New Toronto, Mimico South, Humber Bay Shores
M9V	Etobicoke	South Steeles, Silverstone, Humbergate, Jamestown, Mount Olive, Beaumond Heights, Thistletown, Albion Gardens
M1W	Scarborough	Steeles West, L'Amoreaux West
M2W	Not assigned	Not assigned
M3W	Not assigned	Not assigned
M4W	Downtown Toronto	Rosedale
M5W	Downtown Toronto	Stn A PO Boxes
M6W	Not assigned	Not assigned
M7W	Not assigned	Not assigned
M8W	Etobicoke	Alderwood, Long Branch
M9W	Etobicoke	Northwest, West Humber - Clairville
M1X	Scarborough	Upper Rouge
M2X	Not assigned	Not assigned
M3X	Not assigned	Not assigned
M4X	Downtown Toronto	St. James Town, Cabbagetown
M5X	Downtown Toronto	First Canadian Place, Underground city
M6X	Not assigned	Not assigned
M7X	Not assigned	Not assigned
M8X	Etobicoke	The Kingsway, Montgomery Road, Old Mill North
M9X	Not assigned	Not assigned

M1Y	Not assigned	Not assigned
M2Y	Not assigned	Not assigned
M3Y	Not assigned	Not assigned
M4Y	Downtown Toronto	Church and Wellesley
M5Y	Not assigned	Not assigned
M6Y	Not assigned	Not assigned
M7Y	East Toronto	Business reply mail Processing Centre, South Central Letter Processing Plant Toronto
M8Y	Etobicoke	Old Mill South, King's Mill Park, Sunnylea, Humber Bay, Mimico NE, The Queensway East, Royal York South East, Kingsway Park South East
M9Y	Not assigned	Not assigned
M1Z	Not assigned	Not assigned
M2Z	Not assigned	Not assigned
M3Z	Not assigned	Not assigned
M4Z	Not assigned	Not assigned
M5Z	Not assigned	Not assigned
M6Z	Not assigned	Not assigned
M7Z	Not assigned	Not assigned
M8Z	Etobicoke	Mimico NW, The Queensway West, South of Bloor, Kingsway Park South West, Royal York South West
M9Z	Not assigned	Not assigned

The html table is converted to Pandas DataFrame for cleaning and preprocessing.

In [4]:
```
dfs = pd.read_html(tab)
df=dfs[0]
df.head(12)
```

Out[4]:

	Postal Code	Borough	Neighbourhood
0	M1A	Not assigned	Not assigned

	Postal Code	Borough	Neighbourhood
1	M2A	Not assigned	Not assigned
2	M3A	North York	Parkwoods
3	M4A	North York	Victoria Village
4	M5A	Downtown Toronto	Regent Park, Harbourfront
5	M6A	North York	Lawrence Manor, Lawrence Heights
6	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government
7	M8A	Not assigned	Not assigned
8	M9A	Etobicoke	Islington Avenue, Humber Valley Village
9	M1B	Scarborough	Malvern, Rouge
10	M2B	Not assigned	Not assigned
11	M3B	North York	Don Mills

Dropping the rows where Borough is 'Not assigned'

In [5]:
```
df1 = df[df.Borough != 'Not assigned']
```

Combining the neighbourhoods with same Postalcode

In [6]:
```
df2 = df1.groupby(['Postal Code','Borough'], sort=False).agg(', '.join)
df2.reset_index(inplace=True)
```

Replacing the name of the neighbourhoods which are 'Not assigned' with names of Borough

In [7]:
```
df2['Neighbourhood'] = np.where(df2['Neighbourhood'] == 'Not assigned',df2['Borough'], df2['Neighbourhood'])
```

Renaming column names

In [8]:
```
df2.rename(columns = {'Postal Code':'PostalCode'}, inplace = True)
df2.rename(columns = {'Neighbourhood':'Neighborhood'}, inplace = True)
```

```
df2.head(12)
```

Out[8]:

	PostalCode	Borough	Neighborhood
0	M3A	North York	Parkwoods
1	M4A	North York	Victoria Village
2	M5A	Downtown Toronto	Regent Park, Harbourfront
3	M6A	North York	Lawrence Manor, Lawrence Heights
4	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government
5	M9A	Etobicoke	Islington Avenue, Humber Valley Village
6	M1B	Scarborough	Malvern, Rouge
7	M3B	North York	Don Mills
8	M4B	East York	Parkview Hill, Woodbine Gardens
9	M5B	Downtown Toronto	Garden District, Ryerson
10	M6B	North York	Glencairn
11	M9B	Etobicoke	West Deane Park, Princess Gardens, Martin Grov...

In [9]:
```
df2.shape
```

Out[9]:
```
(103, 3)
```

Importing the csv file with the latitudes & longitudes for various neighbourhoods in Canada

In [10]:
```
lat_lon = pd.read_csv('https://cocl.us/Geospatial_data')
lat_lon.head(12)
```

Out[10]:

	Postal Code	Latitude	Longitude
0	M1B	43.806686	-79.194353
1	M1C	43.784535	-79.160497

	Postal Code	Latitude	Longitude
2	M1E	43.763573	-79.188711
3	M1G	43.770992	-79.216917
4	M1H	43.773136	-79.239476
5	M1J	43.744734	-79.239476
6	M1K	43.727929	-79.262029
7	M1L	43.711112	-79.284577
8	M1M	43.716316	-79.239476
9	M1N	43.692657	-79.264848
10	M1P	43.757410	-79.273304
11	M1R	43.750071	-79.295849

Merging the tables for getting the Latitudes & Longitudes for various neighbourhoods in Canada

In [11]:
```
lat_lon.rename(columns={'Postal Code':'PostalCode'},inplace=True)
df3 = pd.merge(df2,lat_lon,on='PostalCode')
df3.head(12)
```

Out[11]:

	PostalCode	Borough	Neighborhood	Latitude	Longitude
0	M3A	North York	Parkwoods	43.753259	-79.329656
1	M4A	North York	Victoria Village	43.725882	-79.315572
2	M5A	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636
3	M6A	North York	Lawrence Manor, Lawrence Heights	43.718518	-79.464763
4	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government	43.662301	-79.389494
5	M9A	Etobicoke	Islington Avenue, Humber Valley Village	43.667856	-79.532242
6	M1B	Scarborough	Malvern, Rouge	43.806686	-79.194353
7	M3B	North York	Don Mills	43.745906	-79.352188
8	M4B	East York	Parkview Hill, Woodbine Gardens	43.706397	-79.309937

	PostalCode	Borough	Neighborhood	Latitude	Longitude
9	M5B	Downtown Toronto	Garden District, Ryerson	43.657162	-79.378937
10	M6B	North York	Glencairn	43.709577	-79.445073
11	M9B	Etobicoke	West Deane Park, Princess Gardens, Martin Grov...	43.650943	-79.554724

Getting all the rows from the data frame which contains Toronto in their Borough.

In [12]:
```
df4 = df3[df3['Borough'].str.contains('Toronto',regex=False)]
df4
```

Out[12]:

	PostalCode	Borough	Neighborhood	Latitude	Longitude
2	M5A	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636
4	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government	43.662301	-79.389494
9	M5B	Downtown Toronto	Garden District, Ryerson	43.657162	-79.378937
15	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
19	M4E	East Toronto	The Beaches	43.676357	-79.293031
20	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306
24	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383
25	M6G	Downtown Toronto	Christie	43.669542	-79.422564
30	M5H	Downtown Toronto	Richmond, Adelaide, King	43.650571	-79.384568
31	M6H	West Toronto	Dufferin, Dovercourt Village	43.669005	-79.442259
36	M5J	Downtown Toronto	Harbourfront East, Union Station, Toronto Islands	43.640816	-79.381752
37	M6J	West Toronto	Little Portugal, Trinity	43.647927	-79.419750
41	M4K	East Toronto	The Danforth West, Riverdale	43.679557	-79.352188
42	M5K	Downtown Toronto	Toronto Dominion Centre, Design Exchange	43.647177	-79.381576
43	M6K	West Toronto	Brockton, Parkdale Village, Exhibition Place	43.636847	-79.428191
47	M4L	East Toronto	India Bazaar, The Beaches West	43.668999	-79.315572

	PostalCode	Borough	Neighborhood	Latitude	Longitude
48	M5L	Downtown Toronto	Commerce Court, Victoria Hotel	43.648198	-79.379817
54	M4M	East Toronto	Studio District	43.659526	-79.340923
61	M4N	Central Toronto	Lawrence Park	43.728020	-79.388790
62	M5N	Central Toronto	Roselawn	43.711695	-79.416936
67	M4P	Central Toronto	Davisville North	43.712751	-79.390197
68	M5P	Central Toronto	Forest Hill North & West, Forest Hill Road Park	43.696948	-79.411307
69	M6P	West Toronto	High Park, The Junction South	43.661608	-79.464763
73	M4R	Central Toronto	North Toronto West, Lawrence Park	43.715383	-79.405678
74	M5R	Central Toronto	The Annex, North Midtown, Yorkville	43.672710	-79.405678
75	M6R	West Toronto	Parkdale, Roncesvalles	43.648960	-79.456325
79	M4S	Central Toronto	Davisville	43.704324	-79.388790
80	M5S	Downtown Toronto	University of Toronto, Harbord	43.662696	-79.400049
81	M6S	West Toronto	Runnymede, Swansea	43.651571	-79.484450
83	M4T	Central Toronto	Moore Park, Summerhill East	43.689574	-79.383160
84	M5T	Downtown Toronto	Kensington Market, Chinatown, Grange Park	43.653206	-79.400049
86	M4V	Central Toronto	Summerhill West, Rathnelly, South Hill, Forest...	43.686412	-79.400049
87	M5V	Downtown Toronto	CN Tower, King and Spadina, Railway Lands, Har...	43.628947	-79.394420
91	M4W	Downtown Toronto	Rosedale	43.679563	-79.377529
92	M5W	Downtown Toronto	Stn A PO Boxes	43.646435	-79.374846
96	M4X	Downtown Toronto	St. James Town, Cabbagetown	43.667967	-79.367675
97	M5X	Downtown Toronto	First Canadian Place, Underground city	43.648429	-79.382280
99	M4Y	Downtown Toronto	Church and Wellesley	43.665860	-79.383160
100	M7Y	East Toronto	Business reply mail Processing Centre, South C...	43.662744	-79.321558

Visualizing all the Neighbourhoods of the above data frame using Folium

In [13]:
```
!jupyter trust Week3CapstoneFinal.ipynb
```

```
Signing notebook: Week3CapstoneFinal.ipynb
```

In [14]:
```
import folium
map_t = folium.Map(location=[43.651070,-79.347015],zoom_start=10)

for lat,lng,borough,neighborhood in zip(df4['Latitude'],df4['Longitude'],df4['Borough'],df4['Neighborhood']):
    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_t)
map_t
```

Out[14]:

Clustering neighbourhoods

In [15]:
```
k=5
toronto_clustering = df4.drop(['PostalCode','Borough','Neighborhood'],1)
kmeans = KMeans(n_clusters = k,random_state=0).fit(toronto_clustering)
kmeans.labels_
df4.insert(0, 'Cluster Labels', kmeans.labels_)
```

In [16]:
```
df4.head(12)
```

Out[16]:

	Cluster Labels	PostalCode	Borough	Neighborhood	Latitude	Longitude
2	0	M5A	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636
4	0	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government	43.662301	-79.389494
9	0	M5B	Downtown Toronto	Garden District, Ryerson	43.657162	-79.378937
15	0	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
19	4	M4E	East Toronto	The Beaches	43.676357	-79.293031
20	0	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306
24	0	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383
25	3	M6G	Downtown Toronto	Christie	43.669542	-79.422564

	Cluster Labels	PostalCode	Borough	Neighborhood	Latitude	Longitude
30	0	M5H	Downtown Toronto	Richmond, Adelaide, King	43.650571	-79.384568
31	1	M6H	West Toronto	Dufferin, Dovercourt Village	43.669005	-79.442259
36	0	M5J	Downtown Toronto	Harbourfront East, Union Station, Toronto Islands	43.640816	-79.381752
37	3	M6J	West Toronto	Little Portugal, Trinity	43.647927	-79.419750

In [17]:

```
map_clusters = folium.Map(location=[43.651070,-79.347015],zoom_start=10)

x = np.arange(k)
ys = [i + x + (i*x)**2 for i in range(k)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

markers_colors = []
for lat, lon, neighbourhood, cluster in zip(df4['Latitude'], df4['Longitude'], df4['Neighborhood'], df4['Cluster Labe
    label = folium.Popup(' 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[17]: