Capstone Project

This notebook will be used for the capstone project.

PART I. SCRAPPING

In [41]:

```
import pandas as pd
import numpy as np
```

In [42]:

```
print("Hello Capstone Project Course!")
```

```
Hello Capstone Project Course!
```

In [43]:

```
# Initial dataframe with the postal codes

url = 'https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M'
pc = pd.read_html(url)

pc_df = pc[0]

pc_df.head()
```

Out[43]:

	Postal Code	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	Regent Park, Harbourfront

In [44]:

```
# Drop rows with Borough not assigned
pc_df.drop( pc_df[ pc_df['Borough'] == 'Not assigned' ].index,inplace=True)
pc_df.reset_index()
pc_df.head()
```

Out[44]:

	Postal Code	Borough	Neighbourhood
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

In [45]:

```
# if the neighborhood is not assigned, we set its value equal to the district
for index, row in pc_df.iterrows():
    if row['Neighbourhood'] == 'Not assigned':
        pc_df.at[index, "Neighbourhood"] = row['Borough']
pc_df.head()
```

Out[45]:

	Postal Code	Borough	Neighbourhood
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

Rename the last column:

In [46]:

```
pc_df.rename(columns={'Neighbourhood': 'Neighborhood'},inplace=True)
pc_df.head()
```

Out[46]:

	Postal Code	Borough	Neighborhood
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

In [47]:

```
pc_df.shape
```

Out[47]:

```
(103, 3)
```

PART II. GEOESPACIAL DATA

In [48]:

```
import urllib.request
url = 'http://cocl.us/Geospatial_data'
filename = 'Geospatial_data.csv'
urllib.request.urlretrieve(url, filename)

# Geospatial data dataframe
gs_df = pd.read_csv(filename)

gs_df.head()
```

Out[48]:

	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

In [49]:

```
# merge the dataframes by Postal Code (inner join)
final_df = pd.merge(left=pc_df,right=gs_df, left_on='Postal Code', right_on='Postal Co
final_df.head()
```

Out[49]:

	Postal Code	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

In [50]:

```
final_df.shape
```

Out[50]:

```
(103, 5)
```

PART III. ANALYSIS

1. Explore Dataset

In [51]:

```
# remove districts that do not contain the word Toronto
toronto_data = final_df[final_df['Borough'].str.contains('Toronto', regex=False)].rese
toronto_data.head()
```

Out[51]:

	Postal Code	Borough	Neighborhood	Latitude	Longitude
0	M5A	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636
1	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government	43.662301	-79.389494
2	M5B	Downtown Toronto	Garden District, Ryerson	43.657162	-79.378937
3	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
4	M4E	East Toronto	The Beaches	43.676357	-79.293031

In [52]:

```
toronto_data.shape
```

Out[52]:

```
(39, 5)
```

Libraries needed

In [53]:

```
import json # library to handle JSON files

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

import requests # library to handle requests
from pandas.io.json import json_normalize # tranform JSON file into a pandas datafram

# 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
import folium # map rendering library
```

geographic coordinates of Toronto

In [54]:

```
address = 'Toronto, Canada'

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

```
The geograpical coordinate of Toronto are 43.6534817, -79.3839347.
```

Neighbourhoods in Toronto

In [55]:

```
# create map of Toronto using latitude and longitude values
map_toronto = folium.Map(location=[latitude, longitude], zoom_start=11)

# add markers to map
for lat, lng, label in zip(toronto_data['Latitude'], toronto_data['Longitude'], toront
    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[55]: Make this Notebook Trusted to load map: File -> Trust Notebook

Credentials and version for the Foursquare API.

In [99]:

```
CLIENT_ID = '*****************' # your Foursquare ID
CLIENT_SECRET = '*****************' # your Foursquare Secret
VERSION = '20180605' # Foursquare API version
LIMIT = 100 # A default Foursquare API limit value
```

2. Explore Neighborhoods in Toronto

In [57]:

```
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_secre
            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
    nearby_venues.columns = ['Neighborhood',
                  'Neighborhood Latitude',
                  'Neighborhood Longitude',
                  'Venue',
                  'Venue Latitude',
                  'Venue Longitude',
                  'Venue Category']

    return(nearby_venues)
```

Create a new dataframe with the venue data

In [58]:

```
toronto_venues = getNearbyVenues(names=toronto_data['Neighborhood'],
                                 latitudes=toronto_data['Latitude'],
                                 longitudes=toronto_data['Longitude']
                                )
```

In [59]:

```
toronto_venues.head()
```

Out[59]:

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

Size of the new dataframe

In [60]:

```
toronto_venues.shape
```

Out[60]:

```
(1608, 7)
```

How many venues were returned for each neighborhood:

In [61]:

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

Out[61]:

	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Neighborhood						
Berczy Park	56	56	56	56	56	56
Brockton, Parkdale Village, Exhibition Place	22	22	22	22	22	22
Business reply mail Processing Centre, South Central Letter Processing Plant Toronto	16	16	16	16	16	16
CN Tower, King and Spadina, Railway Lands, Harbourfront West, Bathurst Quay, South Niagara, Island airport	16	16	16	16	16	16
Central Bay Street	62	62	62	62	62	62
Christie	16	16	16	16	16	16
Church and Wellesley	79	79	79	79	79	79
Commerce Court, Victoria Hotel	100	100	100	100	100	100
Davisville	36	36	36	36	36	36
Davisville North	9	9	9	9	9	9
Dufferin, Dovercourt Village	15	15	15	15	15	15
First Canadian Place, Underground city	100	100	100	100	100	100
Forest Hill North & West, Forest Hill Road Park	4	4	4	4	4	4
Garden District, Ryerson	100	100	100	100	100	100
Harbourfront East, Union Station, Toronto Islands	100	100	100	100	100	100
High Park, The Junction South	26	26	26	26	26	26
India Bazaar, The Beaches West	20	20	20	20	20	20
Kensington Market, Chinatown, Grange Park	62	62	62	62	62	62
Lawrence Park	4	4	4	4	4	4
Little Portugal, Trinity	43	43	43	43	43	43
Moore Park, Summerhill East	3	3	3	3	3	3
North Toronto West, Lawrence Park	17	17	17	17	17	17
Parkdale, Roncesvalles	14	14	14	14	14	14
Queen's Park, Ontario Provincial Government	36	36	36	36	36	36
Regent Park, Harbourfront	46	46	46	46	46	46
Richmond, Adelaide, King	96	96	96	96	96	96
Rosedale	4	4	4	4	4	4
Roselawn	3	3	3	3	3	3
Runnymede, Swansea	33	33	33	33	33	33
St. James Town	79	79	79	79	79	79
St. James Town, Cabbagetown	46	46	46	46	46	46
Stn A PO Boxes	96	96	96	96	96	96
Studio District	37	37	37	37	37	37
Summerhill West, Rathnelly, South Hill, Forest Hill SE, Deer Park	14	14	14	14	14	14
The Annex, North Midtown, Yorkville	19	19	19	19	19	19
The Beaches	5	5	5	5	5	5
The Danforth West, Riverdale	42	42	42	42	42	42
Toronto Dominion Centre, Design Exchange	100	100	100	100	100	100
University of Toronto, Harbord	32	32	32	32	32	32

How many unique categories can be curated from all the returned venues

In [62]:

```
print('There are {} uniques categories.'.format(len(toronto_venues['Venue Category'].u
```

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

3. Analyze Each Neighborhood

In [63]:

```
# one hot encoding
toronto_onehot = pd.get_dummies(toronto_venues[['Venue Category']], prefix="", prefix_

# 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[63]:

	Yoga Studio	Adult Boutique	Airport	Airport Food Court	Airport Gate	Airport Lounge	Airport Service	Airport Terminal	American Restaurant	Antique Shop	...	Theater
0	0	0	0	0	0	0	0	0	0	0	...	0
1	0	0	0	0	0	0	0	0	0	0	...	0
2	0	0	0	0	0	0	0	0	0	0	...	0
3	0	0	0	0	0	0	0	0	0	0	...	0
4	0	0	0	0	0	0	0	0	0	0	...	0

5 rows × 235 columns

Size of the dataframe

In [64]:

```
toronto_onehot.shape
```

Out[64]:

```
(1608, 235)
```

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

In [65]:

```
toronto_grouped = toronto_onehot.groupby('Neighborhood').mean().reset_index()
toronto_grouped
```

Out[65]:

	Neighborhood	Yoga Studio	Adult Boutique	Airport	Airport Food Court	Airport Gate	Airport Lounge	Airport Service	Airport Terminal	American Restaurant	...
0	Berczy Park	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
1	Brockton, Parkdale Village, Exhibition Place	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
2	Business reply mail Processing Centre, South C...	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
3	CN Tower, King and Spadina, Railway Lands, Har...	0.000000	0.000000	0.0625	0.0625	0.0625	0.125	0.125	0.125	0.000000	...
4	Central Bay Street	0.016129	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
5	Christie	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
6	Church and Wellesley	0.025316	0.012658	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.012658	...
7	Commerce Court, Victoria Hotel	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.040000	...
8	Davisville	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
9	Davisville North	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
10	Dufferin, Dovercourt Village	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
11	First Canadian Place, Underground city	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.030000	...
12	Forest Hill North & West, Forest Hill Road Park	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
13	Garden District, Ryerson	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
14	Harbourfront East, Union Station, Toronto Islands	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
15	High Park, The Junction South	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
16	India Bazaar, The Beaches West	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
17	Kensington Market, Chinatown, Grange Park	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
18	Lawrence Park	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
19	Little Portugal, Trinity	0.023256	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
20	Moore Park, Summerhill East	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
21	North Toronto West, Lawrence Park	0.058824	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
22	Parkdale, Roncesvalles	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
23	Queen's Park, Ontario Provincial Government	0.027778	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
24	Regent Park, Harbourfront	0.021739	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
25	Richmond, Adelaide, King	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.020833	...
26	Rosedale	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
27	Roselawn	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
28	Runnymede, Swansea	0.030303	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
29	St. James Town	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.037975	...
30	St. James Town, Cabbagetown	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
31	Stn A PO Boxes	0.010417	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.010417	...
32	Studio District	0.027027	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.054054	...
33	Summerhill West, Rathnelly, South Hill, Forest...	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.071429	...
34	The Annex, North Midtown, Yorkville	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
35	The Beaches	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...
36	The Danforth West, Riverdale	0.023810	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.023810	...
37	Toronto Dominion Centre, Design Exchange	0.000000	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.030000	...
38	University of Toronto, Harbord	0.031250	0.000000	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000000	...

39 rows × 235 columns

In [66]:

```
toronto_grouped.shape
```

Out[66]:

```
(39, 235)
```

New dataframe selecting only the relevant characteristics

In [67]:

```
gym_df = toronto_grouped[['Neighborhood','Gym']]
gym_df.head()
```

Out[67]:

	Neighborhood	Gym
0	Berczy Park	0.000000
1	Brockton, Parkdale Village, Exhibition Place	0.045455
2	Business reply mail Processing Centre, South C...	0.000000
3	CN Tower, King and Spadina, Railway Lands, Har...	0.000000
4	Central Bay Street	0.000000

4. Cluster Neighborhoods

K-Means clustering

Let's start by finding the best value of k. We will use the elbow method.

In [68]:

```
gym_df_clustering = gym_df.drop('Neighborhood', 1)
```

In [69]:

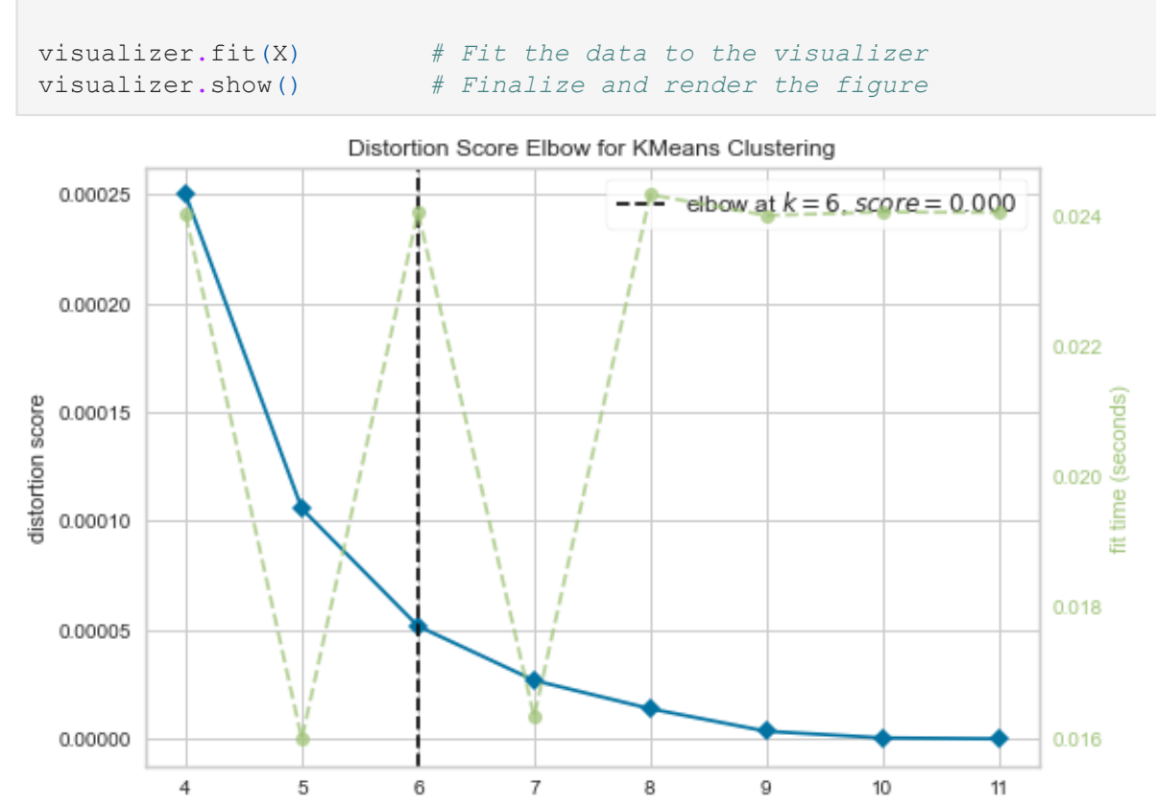
```
#!conda install -c districtdatalabs yellowbrick
```

In [70]:

```
#!pip install yellowbrick
```

In [71]:

```
from sklearn.cluster import KMeans
from sklearn.datasets import make_blobs

from yellowbrick.cluster import KElbowVisualizer

# Generate synthetic dataset with 8 random clusters
X = gym_df_clustering

# Instantiate the clustering model and visualizer
model = KMeans()
visualizer = KElbowVisualizer(model, k=(4,12))

visualizer.fit(X)        # Fit the data to the visualizer
visualizer.show()        # Finalize and render the figure
```



Out[71]:

```
<AxesSubplot:title={'center':'Distortion Score Elbow for KMeans Clustering'}, xlabel
='k', ylabel='distortion score'>
```

From the graph above we see that the best value is **k = 6**

In [72]:

```
# number of clusters
kclusters = 6

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

# labels
kmeans.labels_[0:10]
```

Out[72]:

```
array([0, 2, 0, 0, 0, 0, 0, 2, 5, 0])
```

In [73]:

```
# insert the labels
gym_df.insert(0, 'Cluster Labels', kmeans.labels_)
```

add latitud and longitude

In [74]:

```
final_gym_df = pd.merge(left=final_df,right=gym_df, left_on='Neighborhood', right_on=
final_gym_df.head()
```

Out[74]:

	Postal Code	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	Gym
0	M5A	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636	0	0.000000
1	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government	43.662301	-79.389494	1	0.027778
2	M5B	Downtown Toronto	Garden District, Ryerson	43.657162	-79.378937	3	0.010000
3	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418	4	0.025316
4	M4E	East Toronto	The Beaches	43.676357	-79.293031	0	0.000000

Visualize the clusters

In [75]:

```
# 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(final_gym_df['Latitude'], final_gym_df['Longitude'],
    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[75]: Make this Notebook Trusted to load map: File -> Trust Notebook

5. Examine Clusters

In [76]:

```
final_gym_df.loc[final_gym_df['Cluster Labels'] == 0]
```

Out[76]:

	Postal Code	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	Gym
0	M5A	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636	0	0.0
4	M4E	East Toronto	The Beaches	43.676357	-79.293031	0	0.0
5	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306	0	0.0
6	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383	0	0.0
7	M6G	Downtown Toronto	Christie	43.669542	-79.422564	0	0.0
9	M6H	West Toronto	Dufferin, Dovercourt Village	43.669005	-79.442259	0	0.0
10	M5J	Downtown Toronto	Harbourfront East, Union Station, Toronto Islands	43.640816	-79.381752	0	0.0
11	M6J	West Toronto	Little Portugal, Trinity	43.647927	-79.419750	0	0.0
12	M4K	East Toronto	The Danforth West, Riverdale	43.679557	-79.352188	0	0.0
17	M4M	East Toronto	Studio District	43.659526	-79.340923	0	0.0
18	M4N	Central Toronto	Lawrence Park	43.728020	-79.388790	0	0.0
19	M5N	Central Toronto	Roselawn	43.711695	-79.416936	0	0.0
20	M4P	Central Toronto	Davisville North	43.712751	-79.390197	0	0.0
21	M5P	Central Toronto	Forest Hill North & West, Forest Hill Road Park	43.696948	-79.411307	0	0.0
22	M6P	West Toronto	High Park, The Junction South	43.661608	-79.464763	0	0.0
23	M4R	Central Toronto	North Toronto West, Lawrence Park	43.715383	-79.405678	0	0.0
24	M5R	Central Toronto	The Annex, North Midtown, Yorkville	43.672710	-79.405678	0	0.0
25	M6R	West Toronto	Parkdale, Roncesvalles	43.648960	-79.456325	0	0.0
27	M5S	Downtown Toronto	University of Toronto, Harbord	43.662696	-79.400049	0	0.0
29	M4T	Central Toronto	Moore Park, Summerhill East	43.689574	-79.383160	0	0.0
30	M5T	Downtown Toronto	Kensington Market, Chinatown, Grange Park	43.653206	-79.400049	0	0.0
31	M4V	Central Toronto	Summerhill West, Rathnelly, South Hill, Forest...	43.686412	-79.400049	0	0.0
32	M5V	Downtown Toronto	CN Tower, King and Spadina, Railway Lands, Har...	43.628947	-79.394420	0	0.0
33	M4W	Downtown Toronto	Rosedale	43.679563	-79.377529	0	0.0
35	M4X	Downtown Toronto	St. James Town, Cabbagetown	43.667967	-79.367675	0	0.0
37	M4Y	Downtown Toronto	Church and Wellesley	43.665860	-79.383160	0	0.0
38	M7Y	East Toronto	Business reply mail Processing Centre, South C...	43.662744	-79.321558	0	0.0

In [77]:

```
final_gym_df.loc[final_gym_df['Cluster Labels'] == 1]
```

Out[77]:

	Postal Code	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	Gym
1	M7A	Downtown Toronto	Queen's Park, Ontario Provincial Government	43.662301	-79.389494	1	0.027778
8	M5H	Downtown Toronto	Richmond, Adelaide, King	43.650571	-79.384568	1	0.031250
28	M6S	West Toronto	Runnymede, Swansea	43.651571	-79.484450	1	0.030303

In [78]:

```
final_gym_df.loc[final_gym_df['Cluster Labels'] == 2]
```

Out[78]:

	Postal Code	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	Gym
14	M6K	West Toronto	Brockton, Parkdale Village, Exhibition Place	43.636847	-79.428191	2	0.045455
16	M5L	Downtown Toronto	Commerce Court, Victoria Hotel	43.648198	-79.379817	2	0.040000
36	M5X	Downtown Toronto	First Canadian Place, Underground city	43.648429	-79.382280	2	0.040000

In [79]:

```
final_gym_df.loc[final_gym_df['Cluster Labels'] == 3]
```

Out[79]:

	Postal Code	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	Gym
2	M5B	Downtown Toronto	Garden District, Ryerson	43.657162	-79.378937	3	0.01
13	M5K	Downtown Toronto	Toronto Dominion Centre, Design Exchange	43.647177	-79.381576	3	0.01

In [80]:

```
final_gym_df.loc[final_gym_df['Cluster Labels'] == 4]
```

Out[80]:

[illegible]

Visualization

Number of elements per cluster and average of gyms per cluster

In [82]:

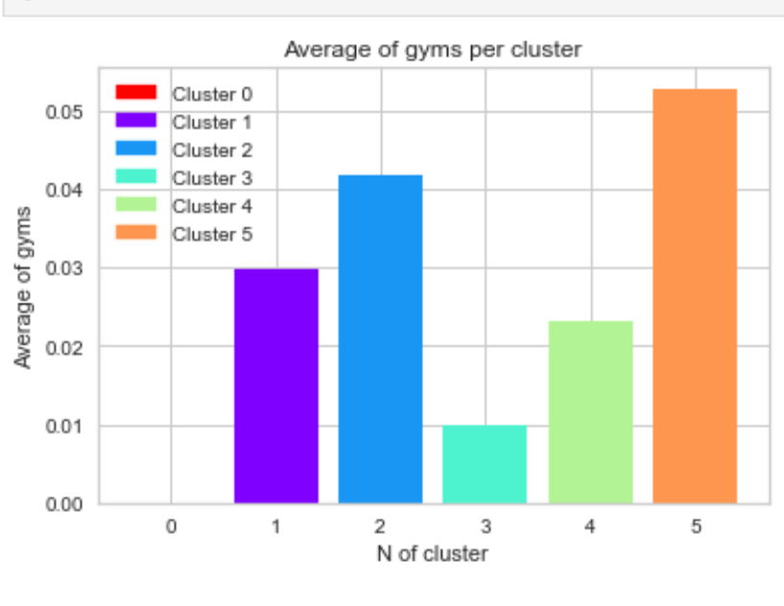
```
%matplotlib inline
import matplotlib.pyplot as plot

listaMedias = []
listaCantidades = []
for n in range(0,6):
    listaMedias.append(final_gym_df.loc[final_gym_df['Cluster Labels'] == n]['Gym'].me
    listaCantidades.append(len(final_gym_df.loc[final_gym_df['Cluster Labels'] == n].

print(listaMedias)
print(listaCantidades)
```

```
[0.0, 0.029776936026936027, 0.04181818181818182, 0.01, 0.02307489451476793, 0.05277777
777777778]
[27, 3, 3, 2, 2, 2]
```

Plot the average number of gyms per cluster

In [97]:

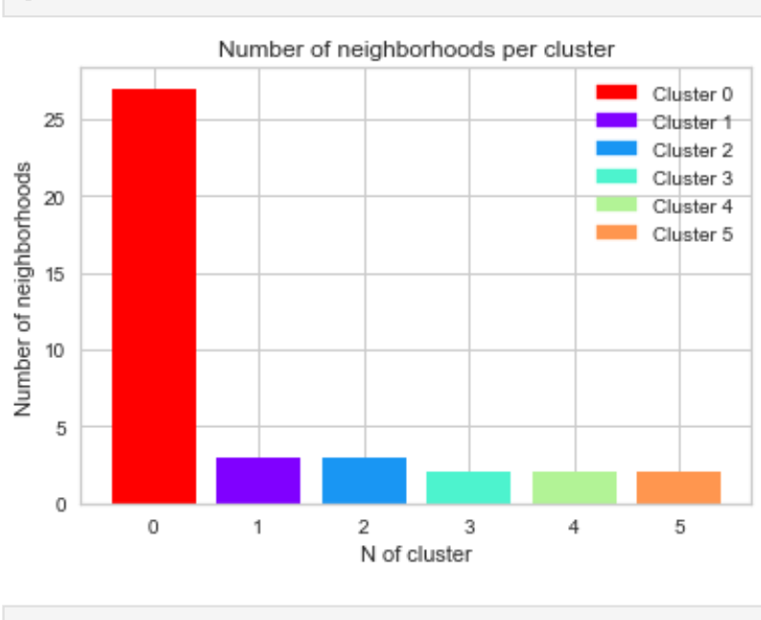
```
%matplotlib inline
import matplotlib.pyplot as plt


x = [0,1,2,3,4,5]

color = ['#ff0000', '#8000ff', '#1996f3', '#4df3ce', '#b2f396', '#ff964f' ]


plt.bar(x,listaMedias,color=color)

plot.title('Average of gyms per cluster')
plot.xlabel('N of cluster')
plot.ylabel('Average of gyms')


colors = {'Cluster 0':'red', 'Cluster 1':'#8000ff', 'Cluster 2':'#1996f3','Cluster 3'
         'Cluster 4':'#b2f396','Cluster 5':'#ff964f'}
labels = list(colors.keys())
handles = [plt.Rectangle((0,0),1,1, color=colors[label]) for label in labels]
plt.legend(handles, labels)



plot.show()
```



Plot the number of elements per cluster

In [98]:

```
x = [0,1,2,3,4,5]

color = ['#ff0000', '#8000ff', '#1996f3', '#4df3ce', '#b2f396', '#ff964f']

plt.bar(x,listaCantidades,color=color)

plot.title('Number of neighborhoods per cluster')
plot.xlabel('N of cluster')
plot.ylabel('Number of neighborhoods')

colors = {'Cluster 0':'red', 'Cluster 1':'#8000ff', 'Cluster 2':'#1996f3','Cluster 3'
         'Cluster 4':'#b2f396','Cluster 5':'#ff964f'}
labels = list(colors.keys())
handles = [plt.Rectangle((0,0),1,1, color=colors[label]) for label in labels]
plt.legend(handles, labels)

plot.show()
```



In [ ]: