Coursera Capstone Project
IBM Applied Data Science

Dipak Jani

Topics Cover in the Presentation

- Introduction
- Business Problem
- **Procedure for implementing the setting of Objectives**

➢Resources Use

➢Data Sourcing

➢Implicate Data Science and Machine Learning

- Analysis and Results
- Discussion
- Conclusion

Introduction

- **Introduction**
- This is the part of the Capstone Project for the IBM Data Science Professional Certificate.
- In this document, I have to setup hypothetical business scenario using Neighbourhoods of the large city to analyse and search suitable location for the set criteria.
- I have to apply Machine Learning/Data science methods to meet my set objectives described in the next section.

Business Problem - 1

- **Business Background:**
- XYZ. Ltd is a business in Hampshire, UK, distributing Asian food ingredients to the Local Small Shops and Supermarkets in UK. It owns its own warehouse and packing facility, sourcing ingredients mainly from South East Asia and South America.
- They have food processing facility in Gujarat, India and Distribution facility in Dubai for Middle East and African markets.
- XYZ is now looking for Organic Growth on the North American Continent and have identified Toronto, Canada for expansion, targeting both wholesale and retail sectors.
- Toronto was selected, on bases of
  - Presence of a large Indian, Pakistani and Chinese communities
  - Stable socio-economic and political systems
  - Close Trade and Political relations with UK.
  - Close proximity and amicable trade relations with USA for future expansion into USA.

Business Problem - 2

- **Business Objectives:**
- To select a site to set up a Supermarket where,
- There are other small and large businesses, to obtain a good foot fall.
- Ideally based around Central Toronto for easy access from all neighbourhoods of Toronto.
- With good public transport links and good Car Parking facilities.
- I will use internet search to source the relevant data. I will then analyse the data and convey my interpretations and suggestions to XYZ.

Procedure for implementing the setting of Objectives

- **Resources Use:**
- Install Python-3 on Jupyter Notebook using Mac/Windows operating system.
- Install all standard libraries for Python.
- Install BeautifulSoup, Geocoder, Request, Folium, Jason and other software as require.
- Test, Jupyter Notebook, Foursquare and Github are functioning properly

Data Sourcing

- **Data Sourcing:**
- Source Toronto Neighbourhood data with its location in Toronto

  https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M,

- Geocoding data for linking Longitude and Latitude to the Neighbourhoods.

  http://cocl.us/Geospatial_data and Geocoder
- Sourcing Venue data using Foursquare.
- Internet search for Asian population in Toronto, socio/economic data of Neighbourhoods

  https://en.wikipedia.org/wiki/Demographics_of_Toronto -- Use for reference and gather the information.

Download and Scrape Data-1

n [3]:
```
url = requests.get('https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M').text
soup = BeautifulSoup(url,'lxml')
```

n [4]:
```
table_post = soup.find('table')
fields = table_post.find_all('td')

postcode = []
borough = []
neighborhood = []

for i in range(0, len(fields), 3):
    postcode.append(fields[i].text.strip())
    borough.append(fields[i+1].text.strip())
    neighborhood.append(fields[i+2].text.strip())

df_pc = pd.DataFrame(data=[postcode, borough, neighborhood]).transpose()
df_pc.columns = ['Postcode', 'Borough', 'Neighborhood']
df_pc.head()
```

ut[4]:

	Postcode	Borough	Neighborhood
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

Download and Scrape Data-

n [3]:
```
url = requests.get('https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M').text
soup = BeautifulSoup(url,'lxml')
```

n [4]:
```
table_post = soup.find('table')
fields = table_post.find_all('td')

postcode = []
borough = []
neighborhood = []

for i in range(0, len(fields), 3):
    postcode.append(fields[i].text.strip())
    borough.append(fields[i+1].text.strip())
    neighborhood.append(fields[i+2].text.strip())

df_pc = pd.DataFrame(data=[postcode, borough, neighborhood]).transpose()
df_pc.columns = ['Postcode', 'Borough', 'Neighborhood']
df_pc.head()
```

ut[4]:

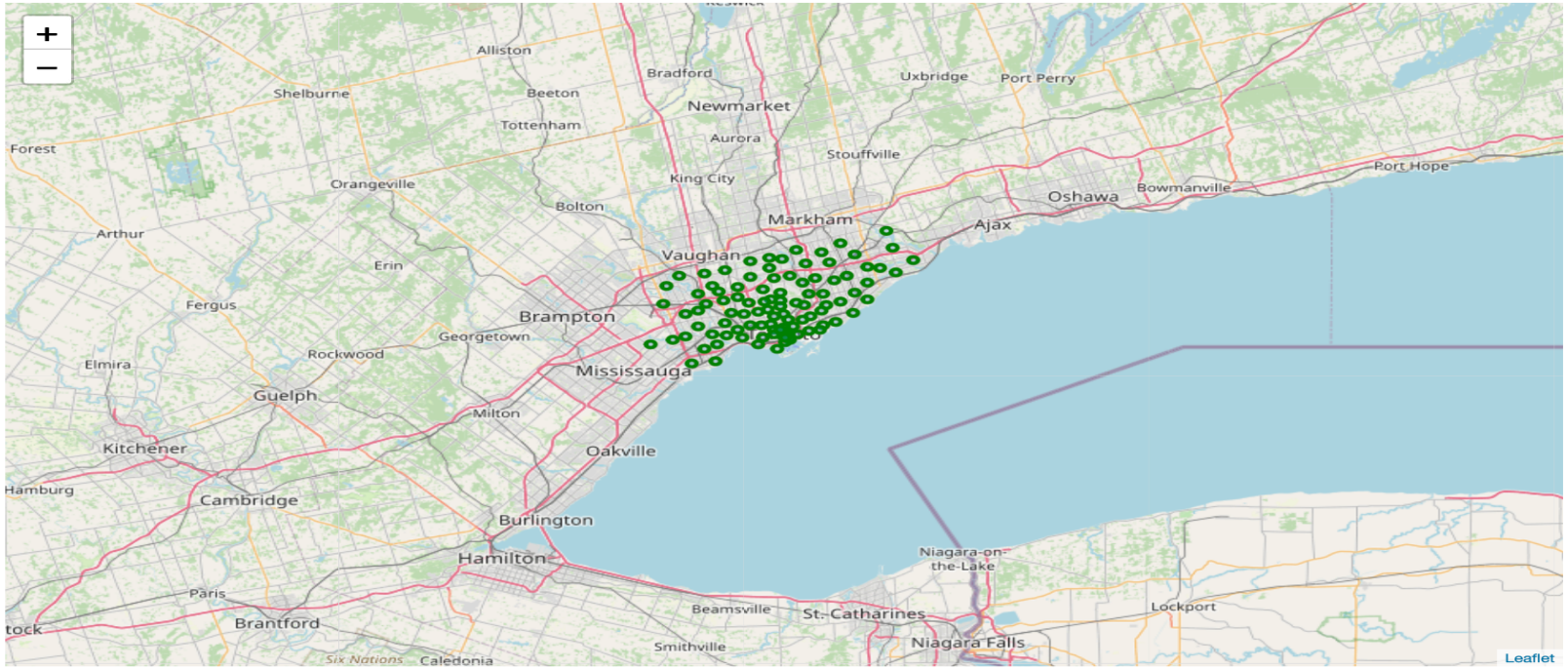
	Postcode	Borough	Neighborhood
0	M1A	Not assigned	Not assigned
1	M2A	Not assigned	Not assigned
2	M3A	North York	Parkwoods
3	M4A	North York	Victoria Village
4	M5A	Downtown Toronto	Regent Park, Harbourfront

Geocoding data for linking Longitude and Latitude to the Neighbourhoods

```
# 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(df_tor['Latitude'], df_tor['Longitude'], df_tor['Borough'], df_tor['Neighb
orhood']):
    label = '{}, {}'.format(neighborhood, borough)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=3,
        popup=label,
        color='green',
        fill=True,
        fill_color='#3199cc',
        fill_opacity=0.3,
        parse_html=False).add_to(map_toronto)

map_toronto
```



Sourcing Venue data using Foursquare

```
neighborhood_latitude = downtownTor_data.loc[0, 'Latitude'] # neighborhood latitude value
neighborhood_longitude = downtownTor_data.loc[0, 'Longitude'] # neighborhood longitude value

neighborhood_name = downtownTor_data.loc[0, 'Neighborhood'] # neighborhood name

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

```
Latitude and longitude values of Lawrence Park are 43.7280205, -79.3887901.
```

```
# type your answer here
LIMIT = 200 # limit of number of venues returned by Foursquare API

radius = 1000 # define radius

 # create URL
url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&limit={}'.
format(
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    neighborhood_latitude,
    neighborhood_longitude,
    radius,
    LIMIT)
url # display URL
```

```
'https://api.foursquare.com/v2/venues/explore?&client_id=H3MVVRNSF40I5ZQ4YOPIP43NJMAKZAPJSFTOC5MTWEK0M0YH&client_sec
ret=AXBX3WO1L5PQ322TCBCDX45MZUNS1VPLYU11KICDVZQ0IVN2&v=20180605&ll=43.7280205,-79.3887901&radius=1000&limit=200'
```

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

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

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

Clean the json data and structure it into a pandas dataframe

```
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(".")[-1] for col in nearby_venues.columns]

nearby_venues.head()
```

```
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:3: FutureWarning: pandas.io.json.json_normalize is de
precated, use pandas.json_normalize instead
  This is separate from the ipykernel package so we can avoid doing imports until
```

	name	categories	lat	lng
0	Lawrence Park Ravine	Park	43.726963	-79.394382
1	Granite Club	Gym / Fitness Center	43.733043	-79.381986
2	Tim Hortons	Coffee Shop	43.727324	-79.379563
3	Granite Club President's Lounge	Café	43.733005	-79.382059
4	Glendon Bookstore	Bookstore	43.727024	-79.378976

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

```
10 venues were returned by Foursquare.
```

Clean and organize Venue and Categories Data
Merged Venue data with Neighborhood data – Table

Check how many venues were returned for each neighbourhood

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Davisville	35	35	35	35	35	35
Davisville North	8	8	8	8	8	8
Forest Hill North & West, Forest Hill Road Park	4	4	4	4	4	4
Lawrence Park	3	3	3	3	3	3
Moore Park, Summerhill East	1	1	1	1	1	1
North Toronto West, Lawrence Park	19	19	19	19	19	19
Roselawn	4	4	4	4	4	4
Summerhill West, Rathnelly, South Hill, Forest Hill SE, Deer Park	17	17	17	17	17	17
The Annex, North Midtown, Yorkville	20	20	20	20	20	20

Apply One Hot for making dataset suitable for analysis

	Neighborhood	American Restaurant	BBQ Joint	Bagel Shop	Bank	Breakfast Spot	Brewery	Burger Joint	Bus Line	Café	...	Supermarket	Sushi Restaurant	Swim School	Tennis Court	Rest
0	Davisville	0.000000	0.00	0.000000	0.000000	0.000	0.028571	0.00	0.000000	0.057143	...	0.000000	0.057143	0.000000	0.0	0.(
1	Davisville North	0.000000	0.00	0.000000	0.000000	0.125	0.000000	0.00	0.000000	0.000000	...	0.000000	0.000000	0.000000	0.0	0.(
2	Forest Hill North & West, Forest Hill Road Park	0.000000	0.00	0.000000	0.000000	0.000	0.000000	0.00	0.000000	0.000000	...	0.000000	0.250000	0.000000	0.0	0.(
3	Lawrence Park	0.000000	0.00	0.000000	0.000000	0.000	0.000000	0.00	0.333333	0.000000	...	0.000000	0.000000	0.333333	0.0	0.(
4	Moore Park, Summerhill East	0.000000	0.00	0.000000	0.000000	0.000	0.000000	0.00	0.000000	0.000000	...	0.000000	0.000000	0.000000	1.0	0.(
5	North Toronto West, Lawrence Park	0.000000	0.00	0.000000	0.000000	0.000	0.000000	0.00	0.000000	0.052632	...	0.000000	0.000000	0.000000	0.0	0.(
6	Roselawn	0.000000	0.00	0.000000	0.000000	0.000	0.000000	0.00	0.000000	0.000000	...	0.000000	0.000000	0.000000	0.0	0.(

Top 10 venues for each neighbourhood

	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	Davisville	Dessert Shop	Pizza Place	Sandwich Place	Gym	Italian Restaurant	Café	Sushi Restaurant	Coffee Shop	Pharmacy	Park
1	Davisville North	Hotel	Sandwich Place	Park	Breakfast Spot	Gym	Department Store	Food & Drink Shop	Garden	Flower Shop	Fried Chicken Joint
2	Forest Hill North & West, Forest Hill Road Park	Trail	Park	Jewelry Store	Sushi Restaurant	Yoga Studio	Fried Chicken Joint	Farmers Market	Fast Food Restaurant	Flower Shop	Food & Drink Shop
3	Lawrence Park	Bus Line	Park	Swim School	Yoga Studio	Fast Food Restaurant	Flower Shop	Food & Drink Shop	Fried Chicken Joint	Garden	Gas Station
4	Moore Park, Summerhill East	Tennis Court	Yoga Studio	Gas Station	Farmers Market	Fast Food Restaurant	Flower Shop	Food & Drink Shop	Fried Chicken Joint	Garden	Gourmet Shop

k-means to cluster the neighborhood into 5 clusters

```
# set number of clusters
kclusters = 5

centrepark_grouped_clustering = centrepark_grouped.drop('Neighborhood', 1)

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

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

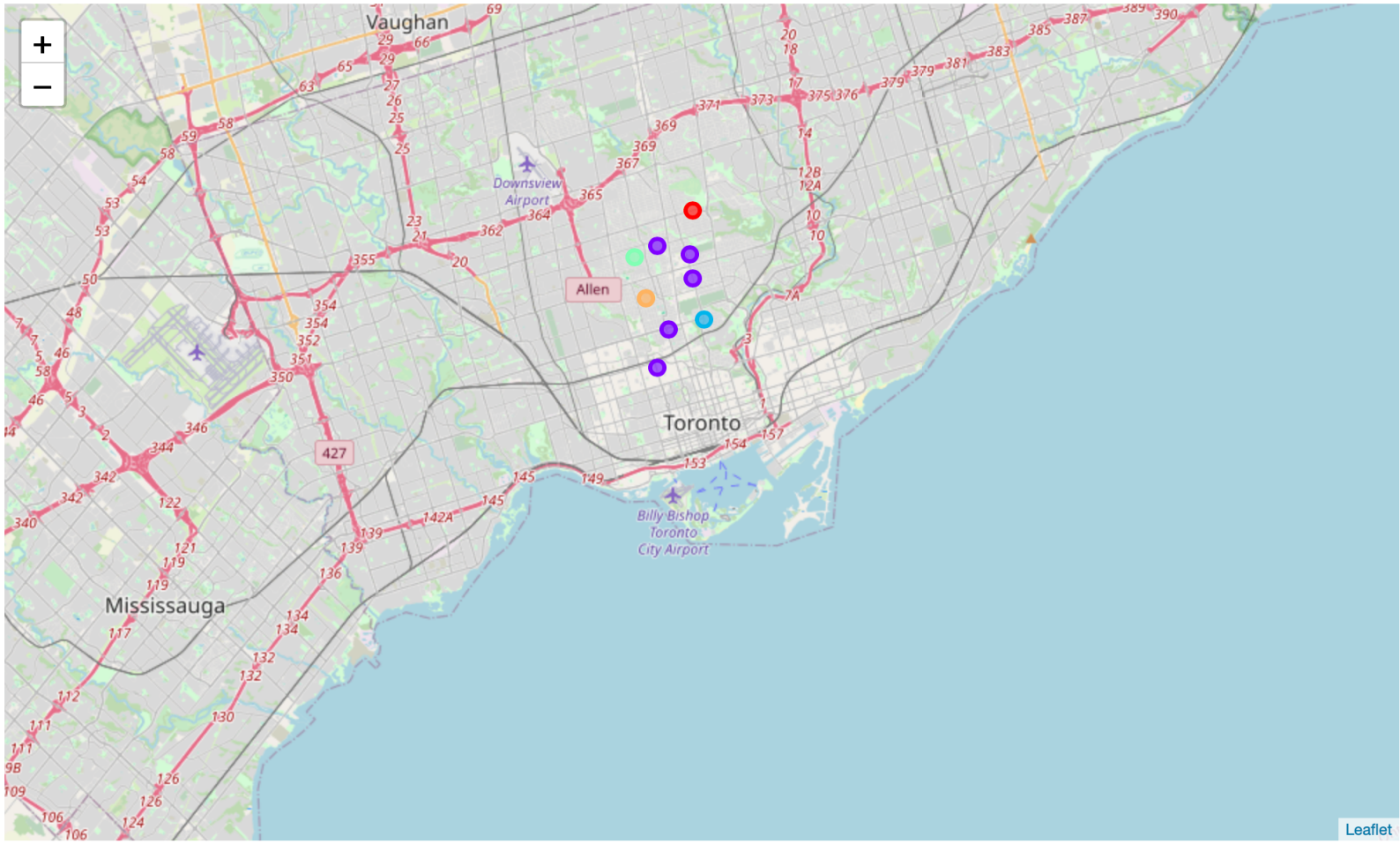
```
array([1, 1, 4, 0, 2, 1, 3, 1, 1], dtype=int32)
```

K-Means Cluster Output Table

	Postcode	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue
0	M4N	Central Toronto	Lawrence Park	43.728020	-79.388790	0	Bus Line	Park	Swim School	Yoga Studio	Fast Food Restaurant	Flower Shop	Food & Drink Shop	Fried Chicken Joint
1	M4P	Central Toronto	Davisville North	43.712751	-79.390197	1	Hotel	Sandwich Place	Park	Breakfast Spot	Gym	Department Store	Food & Drink Shop	Garden
2	M4R	Central Toronto	North Toronto West, Lawrence Park	43.715383	-79.405678	1	Coffee Shop	Clothing Store	Yoga Studio	Spa	Fast Food Restaurant	Metro Station	Mexican Restaurant	Park
3	M4S	Central Toronto	Davisville	43.704324	-79.388790	1	Dessert Shop	Pizza Place	Sandwich Place	Gym	Italian Restaurant	Café	Sushi Restaurant	Coffee Shop
4	M4T	Central Toronto	Moore Park, Summerhill East	43.689574	-79.383160	2	Tennis Court	Yoga Studio	Gas Station	Farmers Market	Fast Food Restaurant	Flower Shop	Food & Drink Shop	Fried Chicken Joint

Map of Cluster Distribution

```
map_clusters
```



Foursquare Query for Supermarket and Carpark data

To meet the additional requirement of the problem, use Foursquare Query
for the Proff of Concept.
The Query was run on the following two category search.

1. Supermarket to establish how many and type of supermarkets are in Central Toronto and their location in the Neighborhood.
2. Availability of the parking is important for attracting the prospective customers.

See below the code for query use and its output.

```
search_query = 'Super Market'
radius = 1000
print(search_query + ' .... OK!')
```

```
Super Market .... OK!
```

Supermarket Query Output

Supermarket List and Map

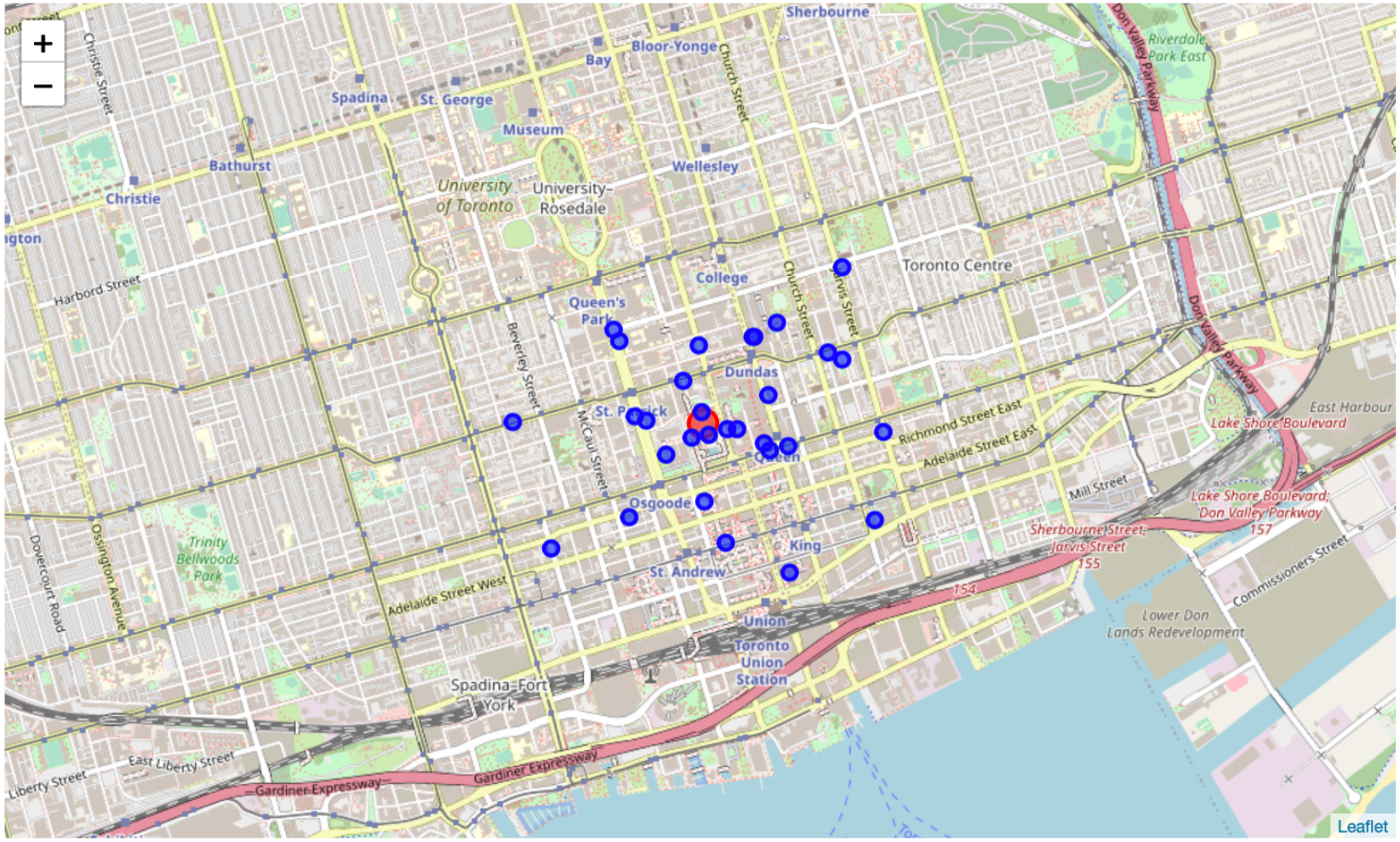
```
dataframe_filtered.name
```

```
0                                   The Supermarket
1                       Starbucks (Market at Longo's)
2                                   City of Toronto
3                                    Farmers Market
4                                 Superior Amusements
5                            Marcello's Market and Deli
6     Superior Plus Interlock and Construction Inc.
7             Mike's Independent City Market Toronto
8                    The Market by Longo's Elizabeth
9                                    The 888 Market
10                                      Super wraps
11                             Super Premium Ice Cream
12                               The Market by Longo’s
13                                  Super Ordinary Lab
14                               The Market By Longo's
15                                 Super Dollar & More
16                                          Super Stop
17              Superior Court of Justice Courthouse
18                                       Super Dollar
19                    The Farmers’ Market at Ryerson
20                Richtree Natural Market Restaurants
21                         Market Square Shoe Repair
22                                       Hasty Market
23                                    Foodwares Market
24                                       Market Spell
25                 Sick Kids Hospital Farmer's Market
26                                       Jarvis Market
27            Nathan Phillips Square Farmer's Market
28                               SickKids Farmers Market
29                                    Tiny Flower Market
Name: name, dtype: object
```

Map of Car Park in Central Torronto

```
# display map
Carpark_map
```

0]:



Analysis and Results

I use following information from the Data Analysis and Machine Learning for the analysis and the results.

- Analysis of the Venues and Categories.
- Analysis of K-Means Clustering
- Foursquare query search

Analysis of the Venues and Categories

- Each neighbourhood along with the top 5 most common venues makes it possible to to select the Neighbourhoods with many shops.

```
----Forest Hill North & West, Forest Hill Road Park----
                  venue  freq
0        Jewelry Store  0.25
1                Trail  0.25
2                 Park  0.25
3     Sushi Restaurant  0.25
4  American Restaurant  0.00


----Lawrence Park----
                  venue  freq
0          Swim School  0.33
1                 Park  0.33
2             Bus Line  0.33
3  American Restaurant  0.00
4  Rental Car Location  0.00
```

Analysis of the Venues and Categories

Top 10 categories for each Neighborhood can identify the area with more footfall

	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	Davisville	Dessert Shop	Pizza Place	Sandwich Place	Gym	Italian Restaurant	Café	Sushi Restaurant	Coffee Shop	Pharmacy	Park
1	Davisville North	Hotel	Sandwich Place	Park	Breakfast Spot	Gym	Department Store	Food & Drink Shop	Garden	Flower Shop	Fried Chicken Joint
2	Forest Hill North & West, Forest Hill Road Park	Trail	Park	Jewelry Store	Sushi Restaurant	Yoga Studio	Fried Chicken Joint	Farmers Market	Fast Food Restaurant	Flower Shop	Food & Drink Shop
3	Lawrence Park	Bus Line	Park	Swim School	Yoga Studio	Fast Food Restaurant	Flower Shop	Food & Drink Shop	Fried Chicken Joint	Garden	Gas Station
4	Moore Park, Summerhill East	Tennis Court	Yoga Studio	Gas Station	Farmers Market	Fast Food Restaurant	Flower Shop	Food & Drink Shop	Fried Chicken Joint	Garden	Gourmet Shop

Analysis of K-Means Clustering identify Cluster 2 have the highest number of venues

Cluster 2

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

]:

	Borough	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
1	Central Toronto	1	Hotel	Sandwich Place	Park	Breakfast Spot	Gym	Department Store	Food & Drink Shop	Garden	Flower Shop	Fried Chicken Joint
2	Central Toronto	1	Coffee Shop	Clothing Store	Yoga Studio	Spa	Fast Food Restaurant	Metro Station	Mexican Restaurant	Park	Diner	Gym / Fitness Center
3	Central Toronto	1	Dessert Shop	Pizza Place	Sandwich Place	Gym	Italian Restaurant	Café	Sushi Restaurant	Coffee Shop	Pharmacy	Park
5	Central Toronto	1	Pub	Coffee Shop	American Restaurant	Sports Bar	Pizza Place	Liquor Store	Restaurant	Light Rail Station	Skating Rink	Fried Chicken Joint
8	Central Toronto	1	Café	Sandwich Place	Coffee Shop	Indian Restaurant	Park	Pharmacy	Pizza Place	Pub	Liquor Store	Middle Eastern Restaurant

Foursquare query search

- There are 29 Super Markets are there in Central Toronto, and list suggest there are mainly Western(Local), and Chines Super Markets.
- There is both public and private car parks.

Discussion

Cluster Analysis and interpretation

Amont the total 5 clusters, Cluster 2 has the maximum number of Venues and Categories gives good choice and selection.

Line 33 Top 5 most common Venues are in Summer Hill West, The Annex and Davisille.

Line 35 Top 10 Venues with good Footfall are Davisville, Davisville North, Summer Hill Westand and The Annex.

Cluster Analysis based on the Postcode also confirn the above listed Neighbourhoods are best for setup Supermarket.

Discussion

- Based on the analysis and results, following Neighborhoods are suitable for setting the Asian Ingredients supermarket.
- The selection is based on the following criteria,

➢ Good mix of the venues categories bring all type of the customers.

➢Neighborhood with mainly shops, café, pub, restaurants bring higher footfall.

Classification	Neighbourhoods
Best	Davisville, Summer Hill West, The Annex
Ok	Lawrence Park
Avoid	Moore Park

Conclusion

- Toronto is the capital city of Canada, and population of about 6 million.
- About 12 % of the population is Asian, excluding Chines.
- Central Toronto borough with nine Neighborhood has good selection of the venues and its categories bring customers for the shopping.
- It appears, with the growing Asian population there are not many Asian ingredient supermarket in Central Toronto.
- Scope for both wholesale and retail business from same location.
- There is good public transportation facility to Central Toronto from surrounding Boroughs and Neighborhoods.

The above points suggest Central Toronto is the ideal location for the South Asian Ingredient supermarket