A RECOMMENDER SYSTEM FOR SUPERMARKET DEALER

Applied Data Science Capstone

IBM Data Science Professional Certificate

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INTRODUCTION

- Recommender systems are ending up being an essential business tool in e-commerce, as more and more companies are implementing this function into their website.
- Recommender systems usually are kinds of collective filtering that include predictive designs, heuristic search, data collection, user interaction and design upkeep.
- The system generally has to be upgraded regularly with recently added ratings, products and users. In shorts a recommender system is an information filtering technology created to figure out choices that are most likely to the customer's tastes.

SYNOPSIS - PROBLEM DESCRIPTION

There is a supermarket dealer in one of the boroughs of Toronto (Scarborough). This dealer provides places like different types of Restaurants, Bakery, Breakfast Spot, Brewery and Café with fresh and high-quality supermarket products. The dealer wants to build a warehouse for the products to buy from villagers and farmers inside the borough, so that they will support more customers and also bring better "Quality of Service" to the old customers.

SYNOPSIS - DATA REQUIREMENT

a) Geo-locational information about that specific borough and the neighborhoods in that borough. Here it is assumed that it is "Scarborough" in Toronto as per the dealer interests.

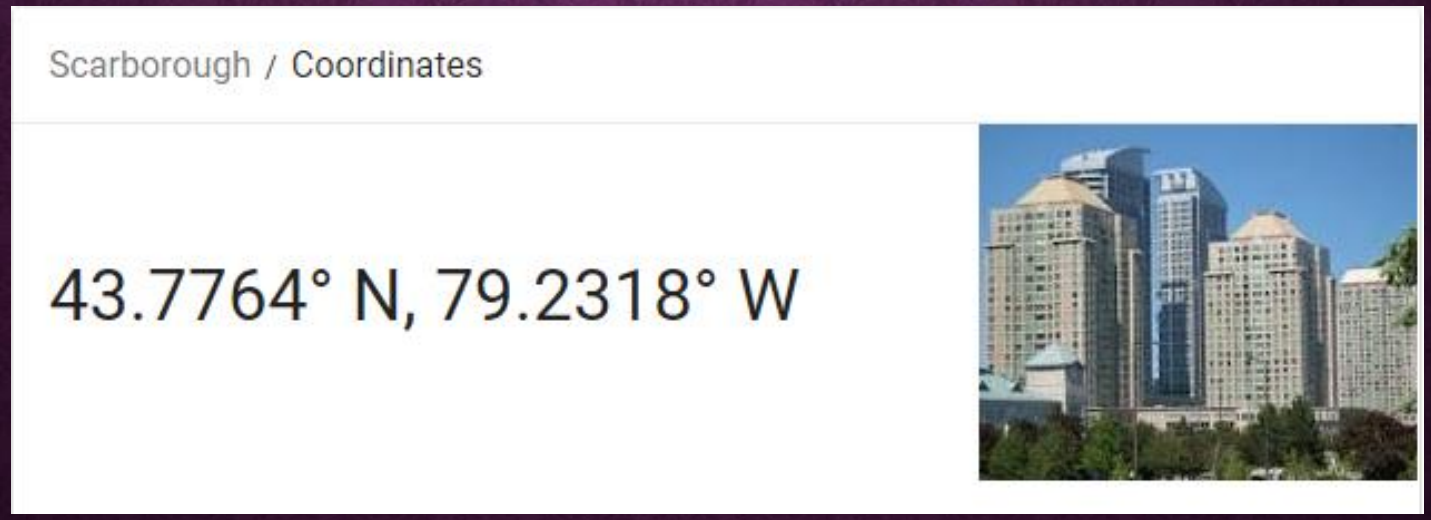

image source: google.com

SYNOPSIS - DATA REQUIREMENT

b) We need data about different venues in different neighborhoods of that specific borough. In order to gain that information, "Foursquare" locational information has been used. A typical request from Foursquare will provide us with the following information:

	Postal Code	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Summary	Venue Category	Distance
0	M1W	Steeles West	43.799525	-79.318389	Mr Congee Chinese Cuisine 龍粥記	This spot is popular	Chinese Restaurant	72
1	M1W	Steeles West	43.799525	-79.318389	Agincourt Bakery	This spot is popular	Bakery	759
2	M1W	Steeles West	43.799525	-79.318389	Little Sheep Mongolian Hot Pot 小肥羊	This spot is popular	Hotpot Restaurant	972
3	M1W	Steeles West	43.799525	-79.318389	Phoenix Restaurant 金凰餐廳	This spot is popular	Chinese Restaurant	147
4	M1W	Steeles West	43.799525	-79.318389	Price Chopper	This spot is popular	Grocery Store	16

DATA SOURCE

- Data set 1: Postal Codes of different regions inside Scarborough to find the list of neighborhoods. The dataset will be consider from https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M.

- Data set 2: The data about different venues in different neighborhoods of that specific borough will be collected from "Foursquare" locational information (https://foursquare.com/). Foursquare is a local search-and-discovery service mobile app which provides search results for its users (Wikipedia). A typical request from Foursquare will provide us with the following information:

[Postal Code] [Neighborhood(s)] [Neighborhood Latitude] [Neighborhood Longitude] [Venue] [Venue Summary] [Venue Category] [Distance (meter)]

METHODOLOGY

- ✓ HTTP requests would be made to this Foursquare API server using zip codes of the Seattle city neighborhoods to pull the location information (Latitude and Longitude).
- ✓ Foursquare API search feature would be enabled to collect the nearby places of the neighborhoods. Due to http request limitations the number of places per neighborhood parameter would reasonably be set to 100 and the radius parameter would be set to 700.
- ✓ Folium- Python visualization library is used to visualize the neighborhoods cluster distribution of Seattle city over an interactive leaflet map.
- ✓ Extensive comparative analysis of two randomly picked neighborhoods carried out to derive the desirable insights from the outcomes using python's scientific libraries Pandas, NumPy and Scikit-learn.
- ✓ Unsupervised machine learning algorithm K-mean clustering is applied to form the clusters of different categories of places residing in and around the neighborhoods. These clusters from each of those two chosen neighborhoods would be analyzed individually collectively and comparatively to derive the conclusions.

EXPLORATORY ANALYSIS

- Identifying Postal Codes (and then Neighborhoods) in "Scarborough"

```
scarborough_data
```

	Postcode	Borough	Neighbourhood	Latitude	Longitude
0	M1W	Scarborough	Steeles West	43.799525	-79.318389
1	M1J	Scarborough	Scarborough Village	43.744734	-79.239476
2	M1G	Scarborough	Woburn	43.770992	-79.216917
3	M1C	Scarborough	Highland Creek, Rouge Hill, Port Union	43.784535	-79.160497
4	M1N	Scarborough	Birch Cliff	43.692657	-79.264848
5	M1R	Scarborough	Maryvale, Wexford	43.750072	-79.295849
6	M1V	Scarborough	Agincourt North, Milliken	43.815252	-79.284577
7	M1H	Scarborough	Cedarbrae	43.773136	-79.239476
8	M1T	Scarborough	Tam O'Shanter	43.781638	-79.304302
9	M1M	Scarborough	Cliffcrest, Cliffside	43.716316	-79.239476
10	M1E	Scarborough	Morningside, West Hill	43.763573	-79.188711
11	M1B	Scarborough	Rouge, Malvern	43.806686	-79.194353
12	M1S	Scarborough	Agincourt	43.794200	-79.262029
13	M1K	Scarborough	Ionview, Kennedy Park	43.727929	-79.262029
14	M1P	Scarborough	Dorset Park, Scarborough Town Centre, Wexford ...	43.757410	-79.273304
15	M1X	Scarborough	Upper Rouge	43.836125	-79.205636
16	M1L	Scarborough	Clairlea, Golden Mile, Oakridge	43.711112	-79.284577

EXPLORATORY ANALYSIS

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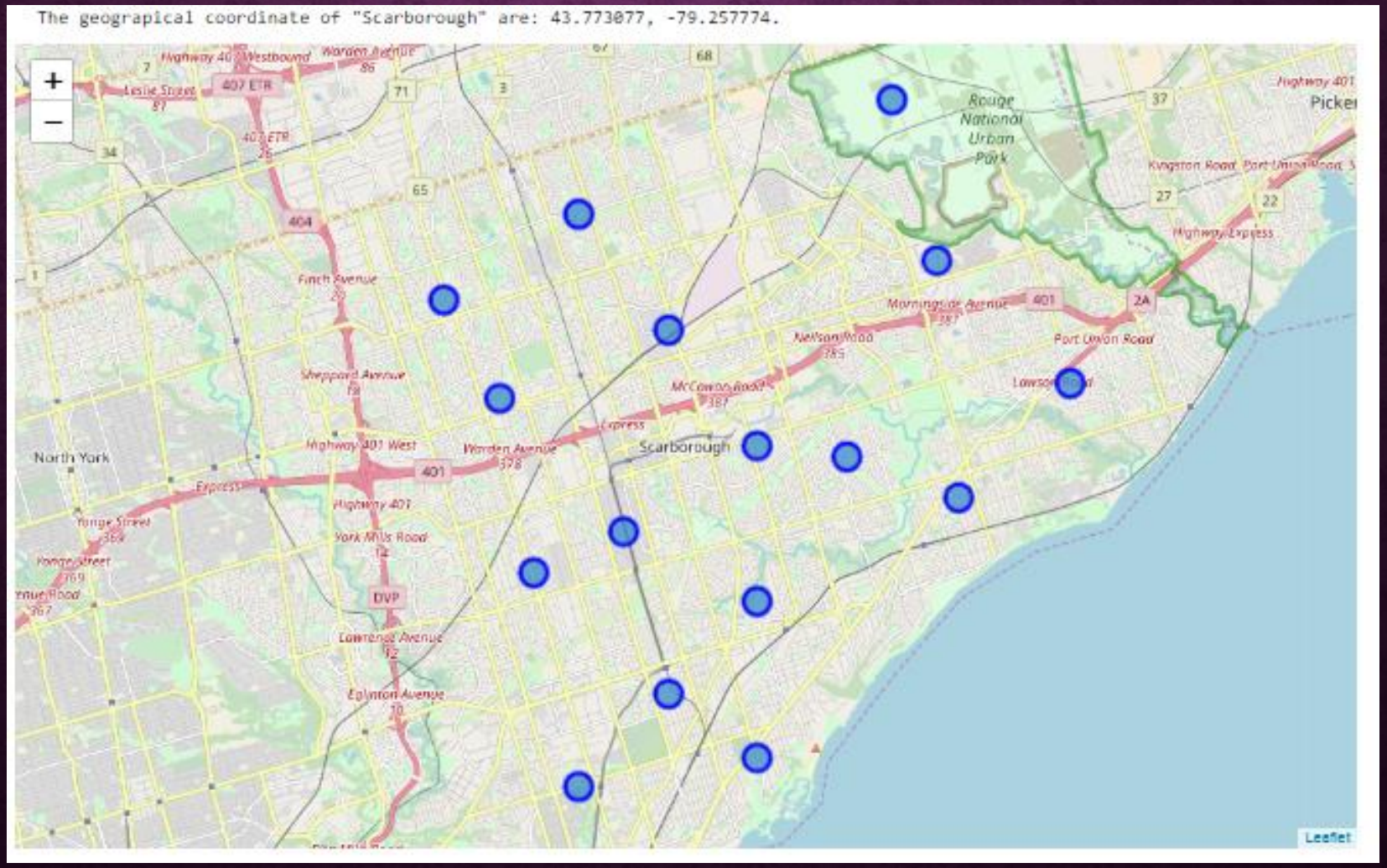

EXPLORATORY ANALYSIS

- Connecting to Foursquare and Retrieving Locational Data for Each Venue in Every Neighborhood

After finding the list of neighborhoods, we then connect to the Foursquare API to gather information about venues inside each and every neighborhood. For each neighborhood, we have chosen the radius to be 1000 meter. It means that we have asked Foursquare to find venues that are at most 1000 meter far from the center of the neighborhood.

EXPLORATORY ANALYSIS

- Processing the Retrieved Data and Creating a Data Frame for All the Venues inside the Scarborough

When the data is completely gathered, we perform processing on that raw data to find our desirable features for each venue. Our main feature is the category of that venue. After this stage, the column "Venue's Category" is One-hot encoded and different venues will have different feature-columns. After On-hot encoding we integrate all restaurant columns to one column "Total Restaurants" and all food joint columns to "Total Joints" column.

EXPLORATORY ANALYSIS

- **Applying one of Machine Learning Techniques (K-Means Clustering)**

```
# import k-means from clustering stage
from sklearn.cluster import KMeans

# run k-means clustering
kmeans = KMeans(n_clusters = 5, random_state = 0).fit(scarborough_onehot)
```

	Bakery	Breakfast Spot	Diner	Fish Market	Food & Drink Shop	Fruit & Vegetable Store	Grocery Store	Noodle House	Pizza Place	Sandwich Place	Total Restaurants	Total Joints	Total Sum
G5	2.000000	1.000000	0.000000	0.0	0.000000	0.00	0.000000	1.000000	1.000000	2.000000	21.000000	0.000000	28.000000
G1	1.333333	0.000000	0.000000	0.0	0.000000	0.00	0.333333	0.666667	1.666667	1.000000	13.333333	2.000000	20.333333
G4	0.000000	1.000000	0.000000	1.0	0.000000	0.00	3.000000	0.000000	3.000000	0.000000	8.000000	1.000000	17.000000
G3	1.500000	0.250000	0.000000	0.0	0.000000	0.25	1.000000	0.000000	0.750000	0.750000	6.750000	1.250000	12.500000
G2	0.285714	0.142857	0.285714	0.0	0.142857	0.00	0.142857	0.000000	0.857143	0.428571	2.000000	0.714286	5.000000

DECISION MAKING AND REPORTING RESULTS

- Now, we focus on the centers of clusters and compare them for their "Total Restaurants" and their "Total Joints".
- The group which its center has the highest "Total Sum" will be our best recommendation to the contractor. {Note: Total Sum = Total Restaurants + Total Joints.}
- This algorithm although is pretty straightforward yet is strongly powerful.

RESULTS

Processing the Retrieved Data and Creating a Data Frame for All the Venues inside the Scarborough

```
scarborough_venues.head()
```

	Postal Code	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Summary	Venue Category	Distance
0	M1W	Steeles West	43.799525	-79.318389	Mr Congee Chinese Cuisine 龍粥記	This spot is popular	Chinese Restaurant	72
1	M1W	Steeles West	43.799525	-79.318389	Agincourt Bakery	This spot is popular	Bakery	759
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The dataset for machine learning (and statistical analysis) purposes.

```
scarborough_onehot
```

Neighborhood	Bakery	Breakfast Spot	Diner	Fish Market	Food & Drink Shop	Fruit & Vegetable Store	Grocery Store	Noodle House	Pizza Place	Sandwich Place	Total Restaurants	Total Joints
Agincourt	2	1	0	0	0	0	0	1	1	2	21	0
Agincourt North, Milliken	1	0	0	0	0	0	0	1	2	0	13	2
Birch Cliff	0	0	1	0	0	0	0	0	0	0	2	0
Cedarbrae	3	0	0	0	0	0	1	0	1	0	7	3
Clairlea, Golden Mile, Oakridge	2	0	1	0	0	0	1	0	1	1	1	0
Cliffcrest, Cliffside	0	0	0	0	0	0	0	0	3	0	1	1
Dorset Park, Scarborough Town Centre, Wexford Heights	2	0	0	0	0	0	1	0	1	1	14	3
Highland Creek, Rouge Hill, Port Union	0	1	0	0	0	0	0	0	0	0	1	1
Ionview, Kennedy Park	0	0	0	0	0	0	2	0	1	1	6	1
Maryvale, Wexford	0	1	0	1	0	0	3	0	3	0	8	1
Morningside, West Hill	0	0	0	0	1	0	0	0	1	1	3	3
Rouge, Malvern	1	0	0	0	0	1	0	0	0	1	7	0
Scarborough Village	0	0	0	0	0	0	0	0	1	1	3	0
Steeles West	2	1	0	0	0	0	1	0	1	1	7	1
Tam O'Shanter	1	0	0	0	0	0	0	1	2	2	13	1
Woburn	0	0	0	0	0	0	0	0	0	0	3	0

DECISION MAKING AND REPORTING RESULTS

	Neighborhood	Group
0	Agincourt	5
1	Agincourt North, Milliken	1
2	Birch Cliff	2
3	Cedarbrae	3
4	Clairlea, Golden Mile, Oakridge	2
5	Cliffcrest, Cliffside	2
6	Dorset Park, Scarborough Town Centre, Wexford ...	1
7	Highland Creek, Rouge Hill, Port Union	2
8	Ionview, Kennedy Park	3
9	Maryvale, Wexford	4
10	Morningside, West Hill	2
11	Rouge, Malvern	3
12	Scarborough Village	2
13	Steeles West	3
14	Tam O'Shanter	1
15	Woburn	2

DECISION MAKING AND REPORTING RESULTS

Best Neighborhood Is ...

```
neigh_summary[neigh_summary['Group'] == 5]
```

	Neighborhood	Group
0	Agincourt	5

```
name_of_neigh = list(neigh_summary[neigh_summary['Group'] == 5]['Neighborhood'])[0]
scarborough_venues[scarborough_venues['Neighborhood'] == name_of_neigh].iloc[0,1:5].to_dict()
```

```
{'Postal Code': 'M1S',
 'Neighborhood': 'Agincourt',
 'Neighborhood Latitude': 43.7942003,
 'Neighborhood Longitude': -79.26202940000002}
```

CONCLUSION

```
neigh_summary[neigh_summary['Group'] == 5]
```

	Neighborhood	Group
0	Agincourt	5

```
name_of_neigh = list(neigh_summary[neigh_summary['Group'] == 5]['Neighborhood'])[0]
scarborough_venues[scarborough_venues['Neighborhood'] == name_of_neigh].iloc[0,1:5].to_dict()
```

```
{'Postal Code': 'M1S',
 'Neighborhood': 'Agincourt',
 'Neighborhood Latitude': 43.7942003,
 'Neighborhood Longitude': -79.26202940000002}
```

Best Group is G5;

Second Best Group is G1;

Third Best Group is G4;

These models can be very useful in helping supermarket dealer to find best neighbourhood in Scarborough.

FUTURE WORK

- Models in this study mainly focused on k-means clustering method. In future I am interested to apply other clustering methods to carry out comparative analysis to find the best model for this neighbourhood analysis problem.


Thank You!