

# THE BATTLE OF NEIGHBORHOODS

Applied Data Science  
Capstone Project  
June 2020

# AGENDA

- ❑ Introduction
- ❑ Data Description
- ❑ Methodology
- ❑ Exploratory Data Analysis
- ❑ Results and Discussion
- ❑ Conclusions

# INTRODUCTION

- Toronto is the most popular and capital city of Ontario province in Canada.
- It is the largest city (population of 2,956,024 by July 2018) in Canada
- Fourth populous city in North America
- World leader in areas like business, finance, technology, entertainment and culture.
- As per Economist Intelligence Unit – Global Liveability Index 2019, Toronto ranks as 7th most livable cities in the world



Toronto city, Canada

Toronto's rankings in other fields like best hospitals, safety etc. confirm that it continues to offer a high quality of life for 2.9 million residents who choose to live and work here.

# Introduction

## **Problem Statement:**

Issue in this capstone project is related to decision making regarding right neighborhood to reside in terms of services and amenities when somebody has planned to migrate to a completely new city.

## **Objectives:**

- To understand publicly available details on Toronto city's neighborhoods and utilize them to analyze using machine learning algorithms and data visualization tools to find best suitable neighborhood in Toronto city based on most common venues
- To find best suitable neighborhood in Toronto city where high rated Indian restaurants are available.

## **Targeted Audience:**

- Frequent flyers to Toronto
- Planning to relocate to Toronto and prefer to reside in a neighborhood with all the amenities and good rated Indian restaurants available in and around.

# DATA DESCRIPTION

## ❑ Toronto City data that contains list Boroughs, Neighborhoods

- **Data source :** [https://en.wikipedia.org/wiki/List\\_of\\_postal\\_codes\\_of\\_Canada:\\_M](https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M)
- **Description:** This data set contains the required information. And we will use this data set to explore various neighborhoods of Toronto city. This wiki data would be converted to pandas data frame and further used

## ❑ Geo-spatial coordinate data of Toronto city

- **Data source :** [https://cocl.us/Geospatial\\_data](https://cocl.us/Geospatial_data)
- **Description:** This will give latitude and longitudes data for every neighborhood in Toronto city

## ❑ Indian restaurants in each neighborhood Toronto city

- **Data source:** Fousquare API
- **Description:** All the venues in each neighborhood can be obtained using this API. Further, Indian restaurants can be filtered from this list

# METHODOLOGY

**Step 1:** Information obtained from the wiki page is scraped and created into a data frame with postal code, boroughs and neighborhoods of Toronto city

**Step 2:** Geospatial data is used to obtain latitude and longitude details for each neighborhood and this data is merged to neighborhoods data from step 1

**Step 3:** Foursquare API is used to find all the venues in each neighborhood.

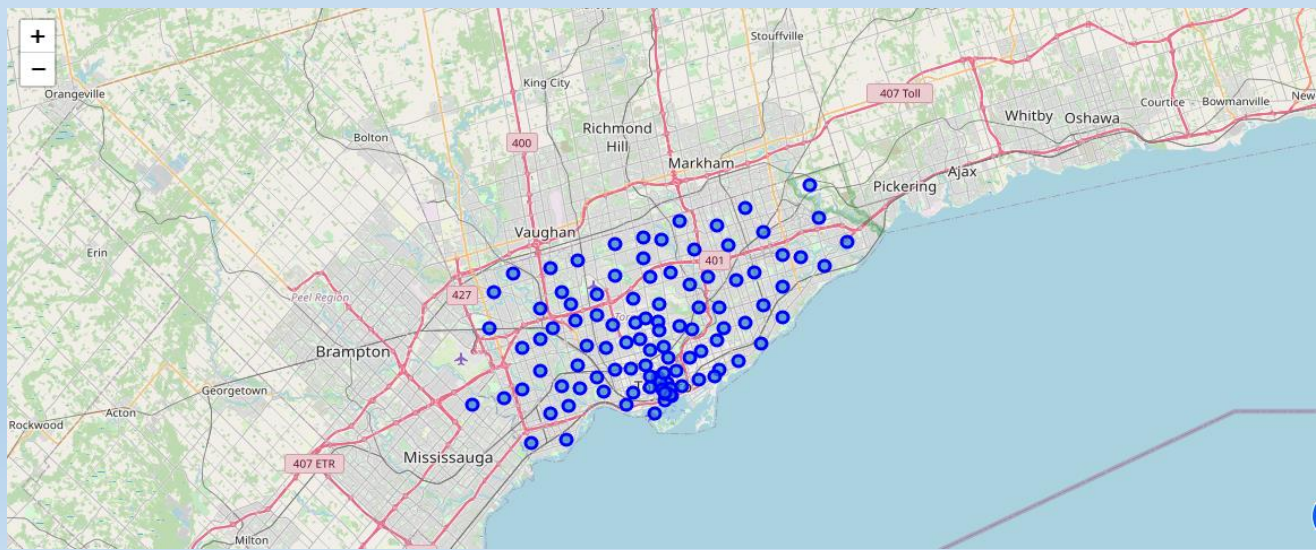
**Step 4:** Clustering the neighborhoods based on common venues to explore the best suited/recommended using machine learning algorithm of k-means

**Step 5:** Filtering Indian restaurants from the venues list obtained from step 3. Exploring likes, ratings and tips of each Indian restaurant venue using Foursquare API and based on their counts assigning rank to each Indian restaurant

**Step 6:** Visualization of these restaurants in neighborhoods with ranking data using folium for decision making

# PREPROCESSING AND DATA CLEANING

- Wiki data is converted into html and further into data frame using pandas
- Data frame is merged with geo spatial data so as to get a borough, neighborhoods and their corresponding latitude and longitude coordinates
- Total size of this data frame is 103 rows and 4 columns.
- Map with Toronto neighborhoods is generated



	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

	Borough	Neighborhood	Latitude	Longitude
0	North York	Parkwoods	43.753259	-79.329656
1	North York	Victoria Village	43.725882	-79.315572
2	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636
3	North York	Lawrence Manor, Lawrence Heights	43.718518	-79.464763
4	Downtown Toronto	Queen's Park, Ontario Provincial Government	43.662301	-79.389494
5	Etobicoke	Islington Avenue, Humber Valley Village	43.667856	-79.532242
6	Scarborough	Malvern, Rouge	43.806686	-79.194353
7	North York	Don Mills	43.745906	-79.352188
8	East York	Parkview Hill, Woodbine Gardens	43.706397	-79.309937
9	Downtown Toronto	Garden District, Ryerson	43.657162	-79.378937
10	North York	Glencairn	43.709577	-79.445073



# EXPLORATORY DATA ANALYSIS

- Foursquare API is used to explore venues
- Venues limited to 100 numbers & 500m radius
- All the nearby venues are classified into various categories like parks, coffee shops, restaurants etc
- 2133 venues are explored in total.
- Grouped based on neighborhoods
- 273 unique categories

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Parkwoods	43.753259	-79.329656	Brookbanks Park	43.751976	-79.332140	Park
1	Parkwoods	43.753259	-79.329656	TTC stop #8380	43.752672	-79.326351	Bus Stop
2	Parkwoods	43.753259	-79.329656	Variety Store	43.751974	-79.333114	Food & Drink Shop
3	Victoria Village	43.725882	-79.315572	Victoria Village Arena	43.723481	-79.315635	Hockey Arena
4	Victoria Village	43.725882	-79.315572	Tim Hortons	43.725517	-79.313103	Coffee Shop

## Analyzed each neighborhood

- Based on neighborhoods, venues are grouped into 93
- 273 unique categories
- 10 most common venues are selected

	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	Agincourt	Latin American Restaurant	Skating Rink	Lounge	Clothing Store	Breakfast Spot	Doner Restaurant	Dim Sum Restaurant	Diner	Discount Store	Distribution Center
1	Alderwood, Long Branch	Pizza Place	Coffee Shop	Sandwich Place	Dance Studio	Pharmacy	Pub	Gym	Airport Service	Falafel Restaurant	Ethiopian Restaurant
2	Bathurst Manor, Wilson Heights, Downsview North	Bank	Coffee Shop	Park	Ice Cream Shop	Sushi Restaurant	Shopping Mall	Middle Eastern Restaurant	Restaurant	Mobile Phone Shop	Deli / Bodega
3	Bayview Village	Chinese Restaurant	Café	Bank	Japanese Restaurant	Women's Store	Diner	Discount Store	Distribution Center	Dog Run	Doner Restaurant
4	Bedford Park, Lawrence Manor East	Sandwich Place	Italian Restaurant	Restaurant	Coffee Shop	Sushi Restaurant	Pharmacy	Juice Bar	Liquor Store	Indian Restaurant	Butcher

## Neighborhood Clustering

- k-means algorithm is used for clustering
- k=5 is considered



# EXPLORATORY DATA ANALYSIS

## Exploring Indian Restaurants

- Foursquare API is used to explore restaurants
- 12 Restaurants are listed venues
- Each Indian restaurant has been analyzed based on likes, tips and ratings. Number of likes, tips and ratings are analyzed
- Average ratings are calculated for each restaurant based on neighborhood and borough

	Neighborhood	Average Rating
7	The Annex, North Midtown, Yorkville	8.80
6	St. James Town, Cabbagetown	8.40
2	Church and Wellesley	8.10
3	Davisville	8.10
0	Bedford Park, Lawrence Manor East	7.40
1	Central Bay Street	7.10
5	Harbourfront East, Union Station, Toronto Islands	7.10
8	The Danforth West, Riverdale	7.00
9	Thorncliffe Park	7.00
4	Dorset Park, Wexford Heights, Scarborough Town...	6.85

	Borough	Neighborhood	ID	Name	Likes	Rating	Tips
0	Downtown Toronto	Central Bay Street	57c07e5f498ed3724a049dc1	Colaba Junction	11	7.1	5
1	East York	Thorncliffe Park	4daf08e66e81e2dffdd4fe40	Iqbal Kebab & Sweet Centre	13	7.6	6
2	East York	Thorncliffe Park	4bed9f2fbac3c9b6ad93fee9	Hakka Garden	10	6.4	12
3	Downtown Toronto	Harbourfront East, Union Station, Toronto Islands	50b79b94e4b0a577af25a83f	Indian Roti House	38	7.1	14
4	East Toronto	The Danforth West, Riverdale	4c1d5337eac020a1cb1048c2	Sher-E-Punjab	10	7.0	8
5	North York	Bedford Park, Lawrence Manor East	4d796616542ab1f75eb87c41	The Copper Chimney	14	7.4	15
6	Scarborough	Dorset Park, Wexford Heights, Scarborough Town...	5226562611d2cd49d83ef03b	Kairali	9	7.2	6
7	Scarborough	Dorset Park, Wexford Heights, Scarborough Town...	4bf96c435317a593a23a017f	Karaikudi Chettinad South Indian Restaurant	27	6.5	23
8	Central Toronto	The Annex, North Midtown, Yorkville	4c62c59ce1621b8dd0332453	Roti Cuisine of India	40	8.8	19
9	Central Toronto	Davisville	5169d445e4b07de190b5c3d6	Marigold Indian Bistro	11	8.1	11
10	Downtown Toronto	St. James Town, Cabbagetown	4c8c21fdf0ce236ab28e15ef	Butter Chicken Factory	18	8.4	10
11	Downtown Toronto	Church and Wellesley	4bedf8b5e24d20a17b567214	Kothur Indian Cuisine	16	8.1	19

	Borough	Average Rating
0	Central Toronto	8.450
1	Downtown Toronto	7.675
4	North York	7.400
2	East Toronto	7.000
3	East York	7.000
5	Scarborough	6.850

# RESULTS: Neighborhood Clustering

	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
51	Cliffside, Cliffcrest, Scarborough Village West	American Restaurant	Motel	Deli / Bodega	Dessert Shop	Dim Sum Restaurant	Diner	Discount Store	Distribution Center	Dog Run	Women's Store

Cluster 1 with one neighborhood

	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
1	Victoria Village	Portuguese Restaurant	Coffee Shop	Pizza Place	Intersection	French Restaurant	Hockey Arena	Distribution Center	Department Store	Dessert Shop	Dim Sum Restaurant
2	Regent Park, Harbourfront	Coffee Shop	Pub	Bakery	Park	Theater	Restaurant	Breakfast Spot	Café	Event Space	Performing Arts Venue
3	Lawrence Manor, Lawrence Heights	Furniture / Home Store	Accessories Store	Clothing Store	Coffee Shop	Boutique	Miscellaneous Shop	Event Space	Women's Store	Vietnamese Restaurant	Construction & Landscaping
4	Queen's Park, Ontario Provincial Government	Coffee Shop	Sushi Restaurant	Music Venue	Beer Bar	Smoothie Shop	Sandwich Place	Burger Joint	Burrito Place	Restaurant	Café
7	Don Mills	Coffee Shop	Restaurant	Gym	Japanese Restaurant	Beer Store	Asian Restaurant	Sporting Goods Shop	Bike Shop	Shopping Mall	Sandwich Place
8	Parkview Hill, Woodbine Gardens	Pizza Place	Gym / Fitness Center	Athletics & Sports	Intersection	Fast Food Restaurant	Gastropub	Pharmacy	Pet Store	Bank	Dumpling Restaurant

Cluster 2 with 83 neighborhoods

	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
6	Malvern, Rouge	Fast Food Restaurant	Doner Restaurant	Dessert Shop	Dim Sum Restaurant	Diner	Discount Store	Distribution Center	Dog Run	Donut Shop	Falafel Restaurant

Cluster 3 with 1 neighborhood

	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	Parkwoods	Park	Bus Stop	Food & Drink Shop	Distribution Center	Dessert Shop	Dim Sum Restaurant	Diner	Discount Store	Dog Run	Event Space
21	Caledonia-Fairbanks	Park	Pool	Women's Store	Gourmet Shop	Curling Ice	Eastern European Restaurant	Dumpling Restaurant	Drugstore	Donut Shop	Doner Restaurant
35	East Toronto, Broadview North (Old East York)	Park	Convenience Store	Doner Restaurant	Dessert Shop	Dim Sum Restaurant	Diner	Discount Store	Distribution Center	Dog Run	Women's Store
61	Lawrence Park	Park	Swim School	Bus Line	Dog Run	Dim Sum Restaurant	Diner	Discount Store	Distribution Center	Doner Restaurant	Department Store
64	Weston	Convenience Store	Park	Doner Restaurant	Dessert Shop	Dim Sum Restaurant	Diner	Discount Store	Distribution Center	Dog Run	Women's Store
66	York Mills West	Convenience Store	Park	Doner Restaurant	Dessert Shop	Dim Sum Restaurant	Diner	Discount Store	Distribution Center	Dog Run	Women's Store
83	Moore Park, Summerhill East	Restaurant	Trail	Park	College Stadium	Colombian Restaurant	Electronics Store	Eastern European Restaurant	Dumpling Restaurant	Drugstore	Donut Shop
85	Milliken, Agincourt North, Steeles East, L'Am...	Park	Asian Restaurant	Playground	Dog Run	Dessert Shop	Dim Sum Restaurant	Diner	Discount Store	Distribution Center	Doner Restaurant

Cluster 4 with 10 neighborhoods

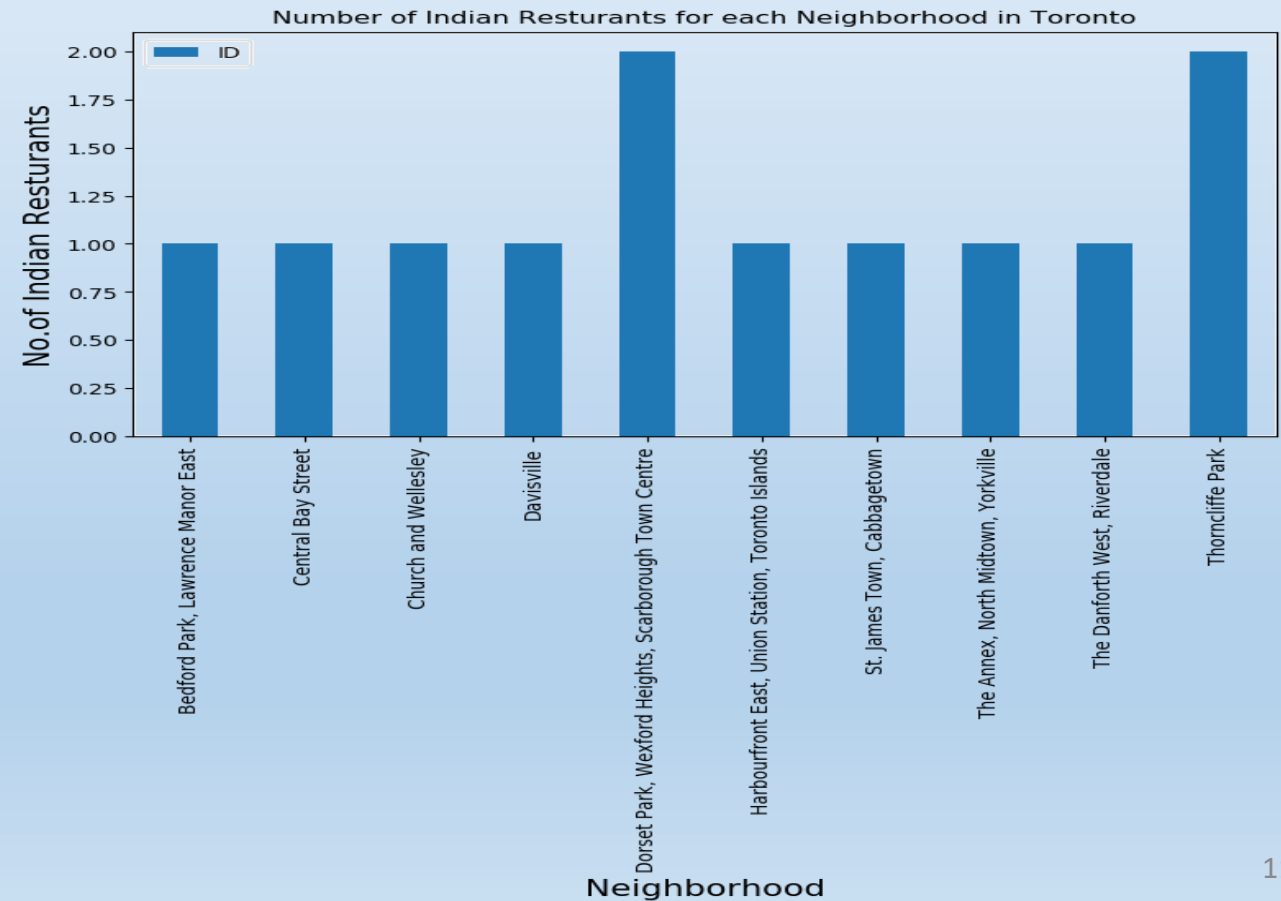
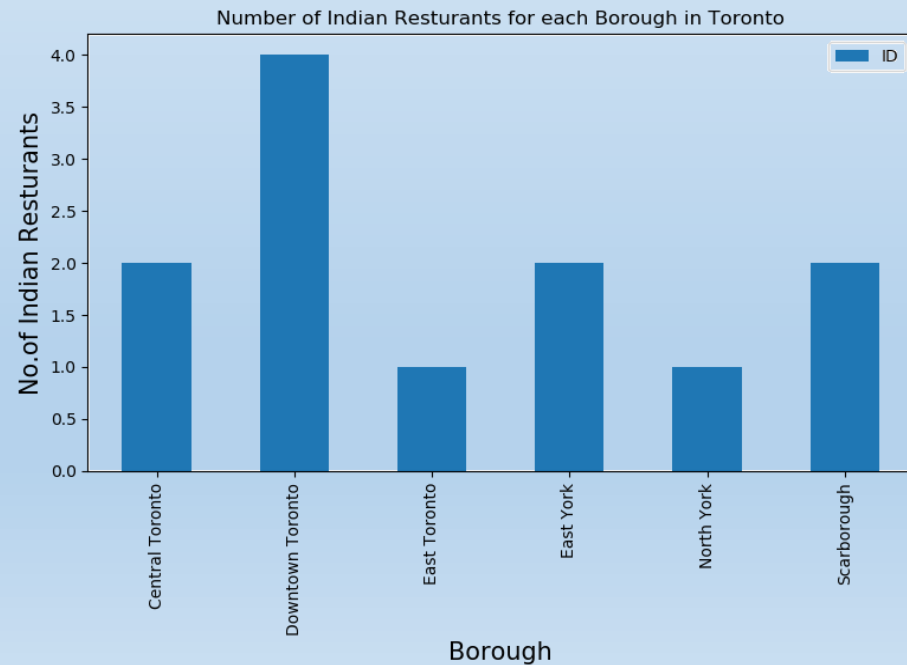
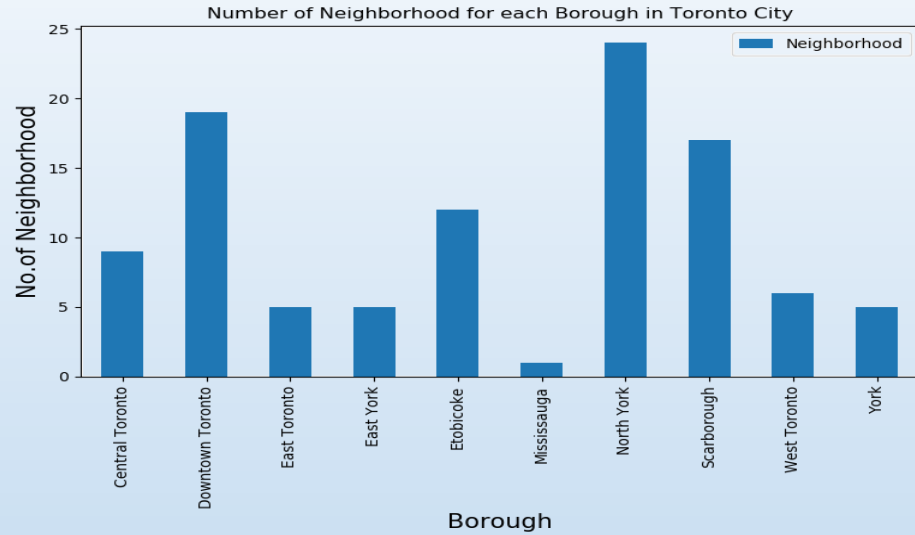
	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
57	Humberlea, Emery	Baseball Field	Women's Store	Dim Sum Restaurant	Diner	Discount Store	Distribution Center	Dog Run	Doner Restaurant	Donut Shop	Farmers Market
101	Old Mill South, King's Mill Park, Sunnylea, Hu...	Business Service	Baseball Field	Doner Restaurant	Dim Sum Restaurant	Diner	Discount Store	Distribution Center	Dog Run	Women's Store	Dessert Shop

Cluster 5 with 2 neighborhood

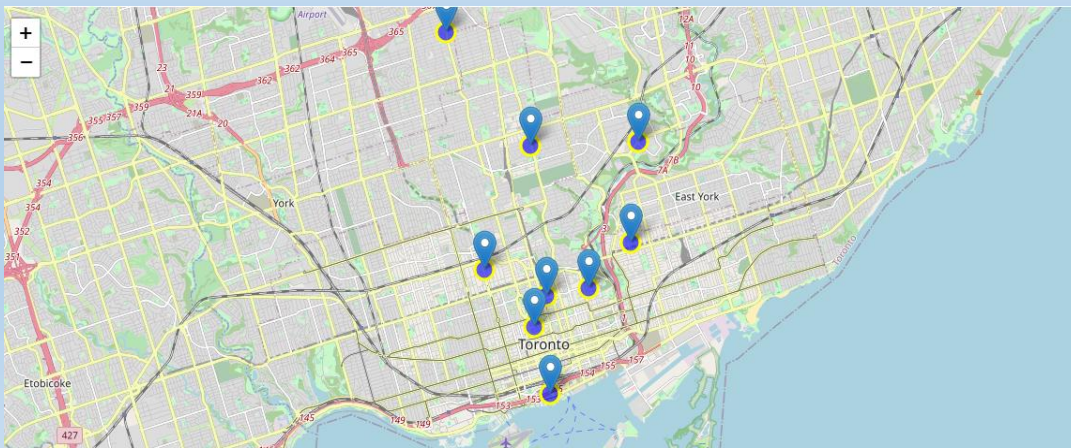
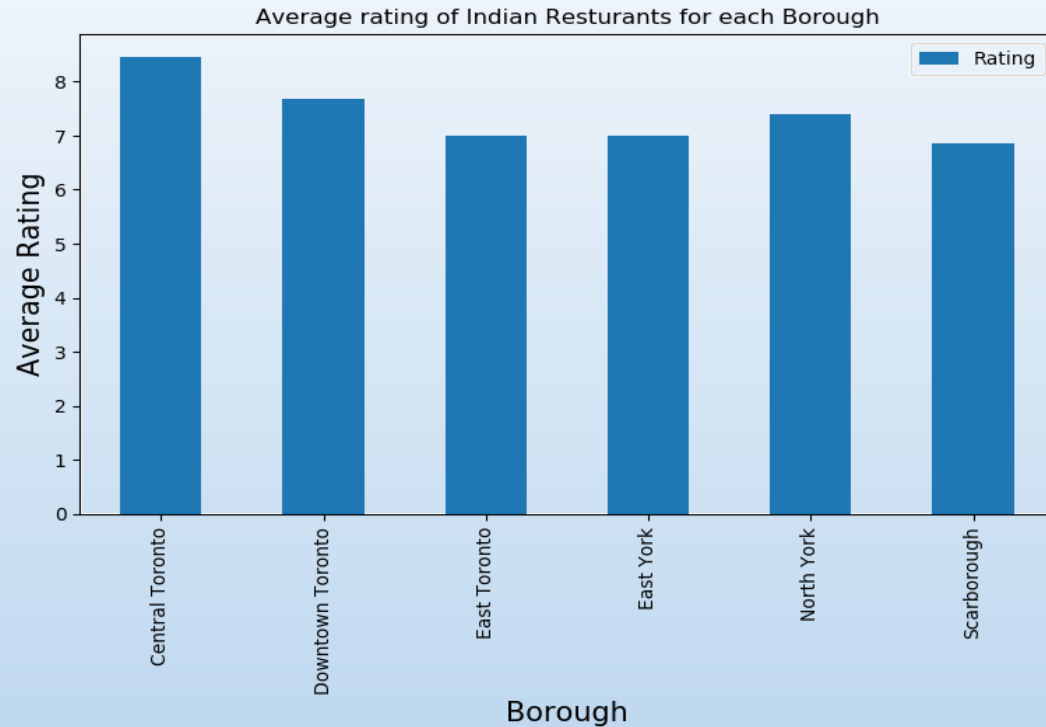
- All the neighborhoods are clustered into 5
- Each cluster is examined with respect to first 10 most common venues.
- Cluster 2 labeled as 1 seems to have major amenities like coffee shops, pubs, restaurants and services
- Cluster 3 labeled as 2 also seems to have all the possible amenities.

# RESULTS: Count of Indian Restaurants

- Maximum number of neighborhoods are in North York borough
- Maximum of 4 restaurants are found in Downtown Toronto
- Maximum of 2 in two neighborhoods is found and rest having one each



# RESULTS: Indian Restaurants rating



	Neighborhood	Average Rating
7	The Annex, North Midtown, Yorkville	8.80
6	St. James Town, Cabbagetown	8.40
2	Church and Wellesley	8.10
3	Davisville	8.10
0	Bedford Park, Lawrence Manor East	7.40
1	Central Bay Street	7.10
5	Harbourfront East, Union Station, Toronto Islands	7.10
8	The Danforth West, Riverdale	7.00
9	Thorncliffe Park	7.00
4	Dorset Park, Wexford Heights, Scarborough Town...	6.85

- Average rating of each restaurant range between 6.85 and 8.8 for neighborhoods
- Downtown Toronto borough has maximum of 4 Indian restaurants.
- Maximum of 2 number of restaurants are observed to be in Thorncliffe Park and Dorset Park, Wexford Heights, Scarborough Town neighborhoods.

# CONCLUSIONS

## ➤ **Insight 1:**

- Highest average rating of Indian Restaurant: 8.8
- Borough: Central Toronto
- Neighborhood: The Annex, North Midtown, Yorkville
- Name of Indian Restaurant: Roti Cuisine of India

## ➤ **Insight 2:**

- Highest number of Indian restaurants:4
- Borough: Down Toronto, Scarborough

## ➤ **Insight 3:**

- Highest number of Indian restaurants:2
- Neighborhood: Thorncliffe Park -Iqbal kabab and sweet center
- Neighborhood: Park, Wexford Heights, Scarborough Town - Kairali

## ➤ **Insight 4:**

- More number of top 10 most common venues with all amenities like coffee shops, women stores, parks, restaurants, auto shops etc

## **Final Decision:**

Comparing all the choices, Cluster 2 is the most appropriate cluster to choose to reside in with 10 more top common venues available around in addition to Indian restaurants