Analysis of Housing Price and Venues in Ontario

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Introduction

Introduction and Background Discussion

Ontario is Canada's second-largest province by area, covering more than one million square kilometers. The province is located in central Canada; it is bordered by Quebec to the east, Manitoba to the west, and the Great Lakes making up a part of its southern border with the United States. Ontario covers all types of landscapes, from the forested Canadian Shield, southern fertile farmland, and over 250,000 lakes. Moreover, Ottawa is Canada's capital, in the east of southern Ontario, near the city of Montréal and the U.S. Ontario is a very diverse province. For example, 54.8% of the population of Toronto was born outside Canada, which is the second-largest percentage of immigrants in a single city on Earth.

Ontario has a very diverse and inclusive environment which is a new home for many international people. It is important for newcomers to familiarize themselves with the community and settle down with convenience. This analysis is providing those newcomers with details about housing prices and venues around to find the best accommodations that will perfectly suit them.

The main factors and criteria that will be considered in this project are 'Housing Prices' and 'Good Amenities'. Analysis of housing price will provide newcomers a big picture and general idea of the range of the price and see the comparisons between different areas in Ontario. Good amenities will ensure the newcomers have the access to what they need including restaurants, cafes, gyms, libraries, grocery stores, and so on.

Data Description

The dataset regarding the housing prices in Ontario is from Kaggle dataset - House Sales in Ontario. This is a .csv file that includes the listing prices for the sale of properties (mostly houses) in Ontario. The dataset includes the following fields:

- Price in dollars
- Address of the property
- Latitude and Longitude of the address obtained by using Google Geocoding service
- Area Name of the property obtained by using Google Geocoding service

In total, there are around 23500 houses in this dataset that will be cleaned and analyzed.

In additional to the housing price dataset, Foursquare API will be used to get the most common venues in Ontario. For example, the data will help in determine the unique types and quantity of venues across different areas in Ontario. This data set is essential in segmenting and clustering the different neighbourhoods inside Ontario.

## Methodology and Data Exploration

The data is taken from Kaggle (https://www.kaggle.com/mnabaee/ontarioproperties). The data includes various information such as housing price and geo-locations. A Sample data is shown below:

|	Unnamed: 0	Address	AreaName	Price ($)	lat	lng
0	0	86 Waterford Dr Toronto, ON	Richview	999888	43.679882	-79.544266
1	1	#80 - 100 BEDDOE DR Hamilton, ON	Chedoke Park B	399900	43.250000	-79.904396
2	2	213 Bowman Street Hamilton, ON	Ainslie Wood East	479000	43.251690	-79.919357
3	3	102 NEIL Avenue Hamilton, ON	Greenford	285900	43.227161	-79.767403
4	6	#1409 - 230 King St Toronto, ON	Downtown	362000	43.651478	-79.368118

The data is then being cleaned to eliminate houses with invalid latitude and longitude and unreasonable house prices. The city attribute is being extracted from the address for later use.

|	ID	Address	AreaName	Price	lat	lng	City
0	0	86 Waterford Dr Toronto, ON	Richview	999888	43.679882	-79.544266	Toronto
1	1	#80 - 100 BEDDOE DR Hamilton, ON	Chedoke Park B	399900	43.250000	-79.904396	Hamilton
2	2	213 Bowman Street Hamilton, ON	Ainslie Wood East	479000	43.251690	-79.919357	Hamilton
3	3	102 NEIL Avenue Hamilton, ON	Greenford	285900	43.227161	-79.767403	Hamilton
4	6	#1409 - 230 King St Toronto, ON	Downtown	362000	43.651478	-79.368118	Toronto

The figure shown below illustrates the top 20 areas plotted according to their number of houses on sale.

Top 20 Areas by Number of Houses on Sale
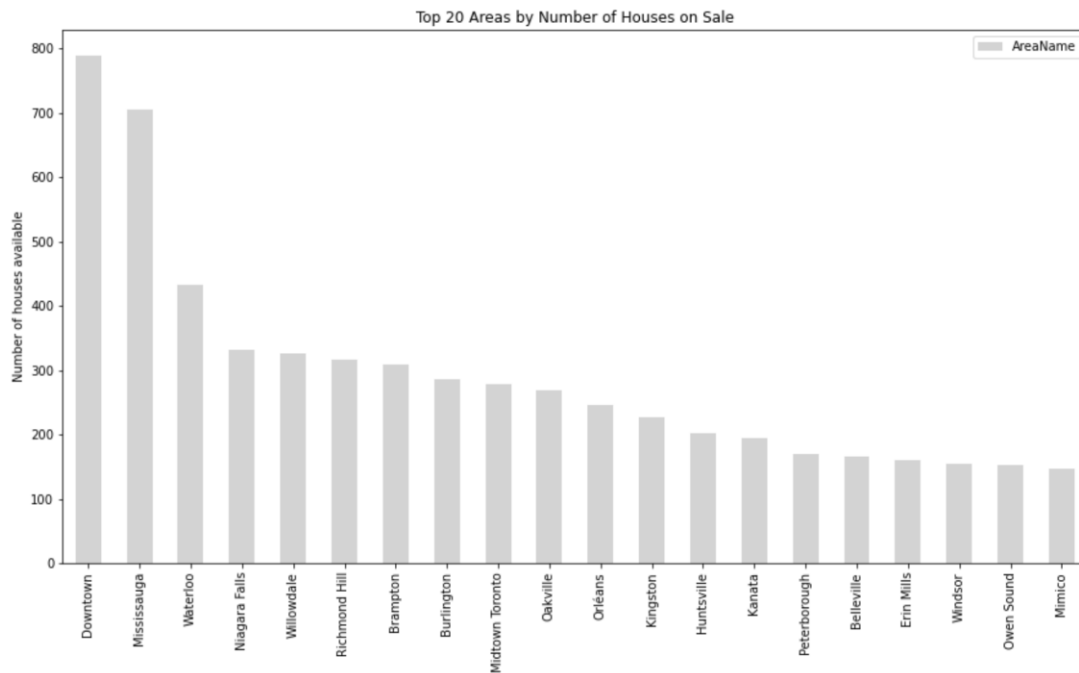
Pie chart is also being generated to provide a better visualization of the top 10.

Top 10 Areas by Number of Houses on Sale
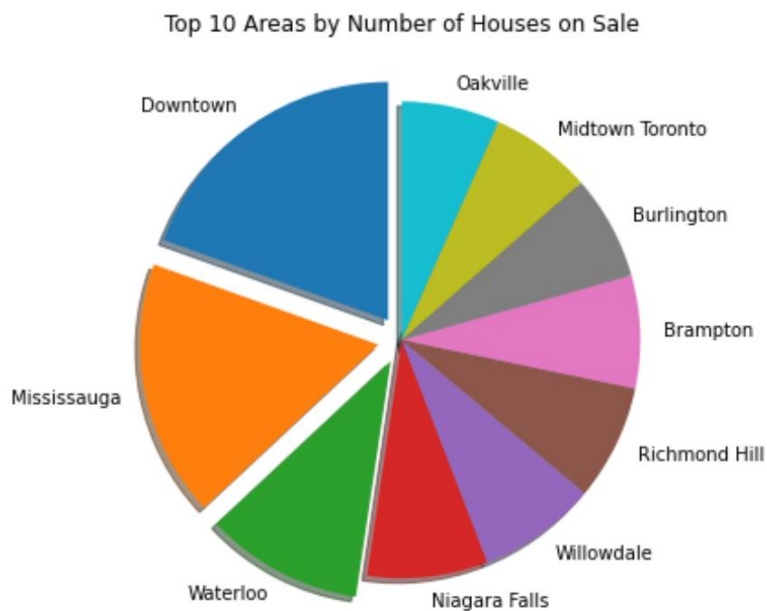
For newcomers, it is also important to have an idea of the housing price in different location areas. A boxplot is created to demonstrate the difference in housing price for each community.

Boxplot grouped by AreaName
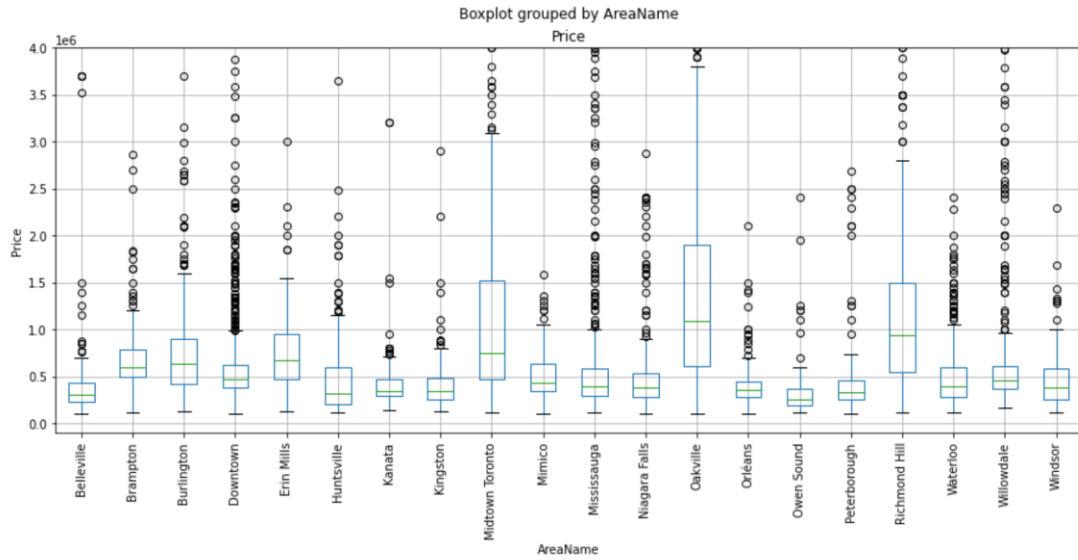
The average housing price for each area is sorted in descending order and by utilizing the bar chart, it is clear that Ancaster has the highest average housing price in Ontario.

Top 20 Mean Prices of Houses by Area
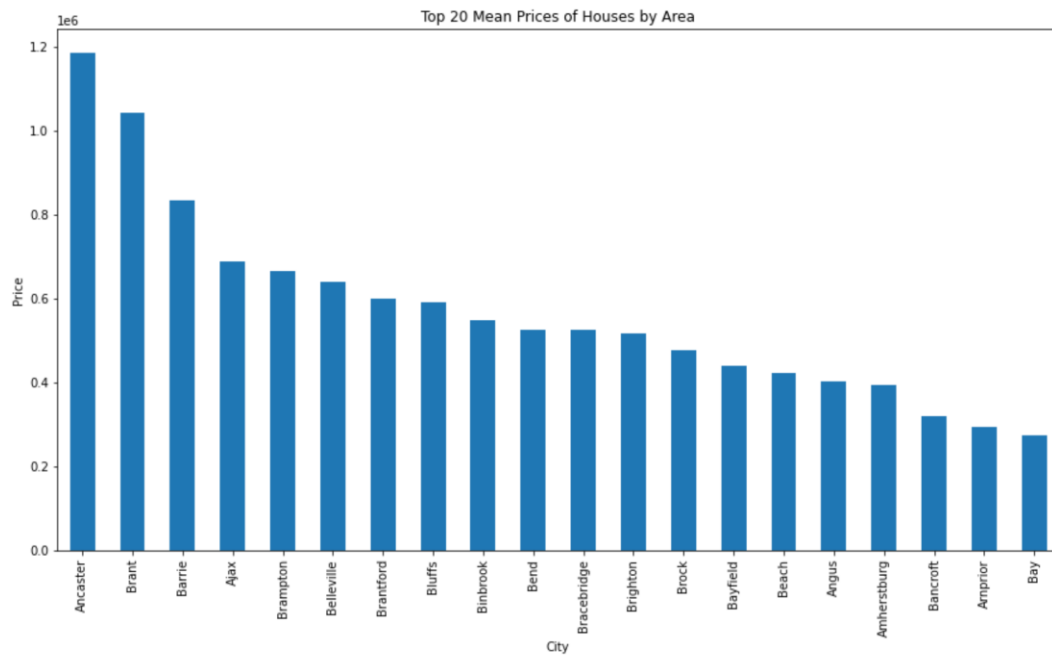
A map is plotted using Folium that has 100 houses marked with details.
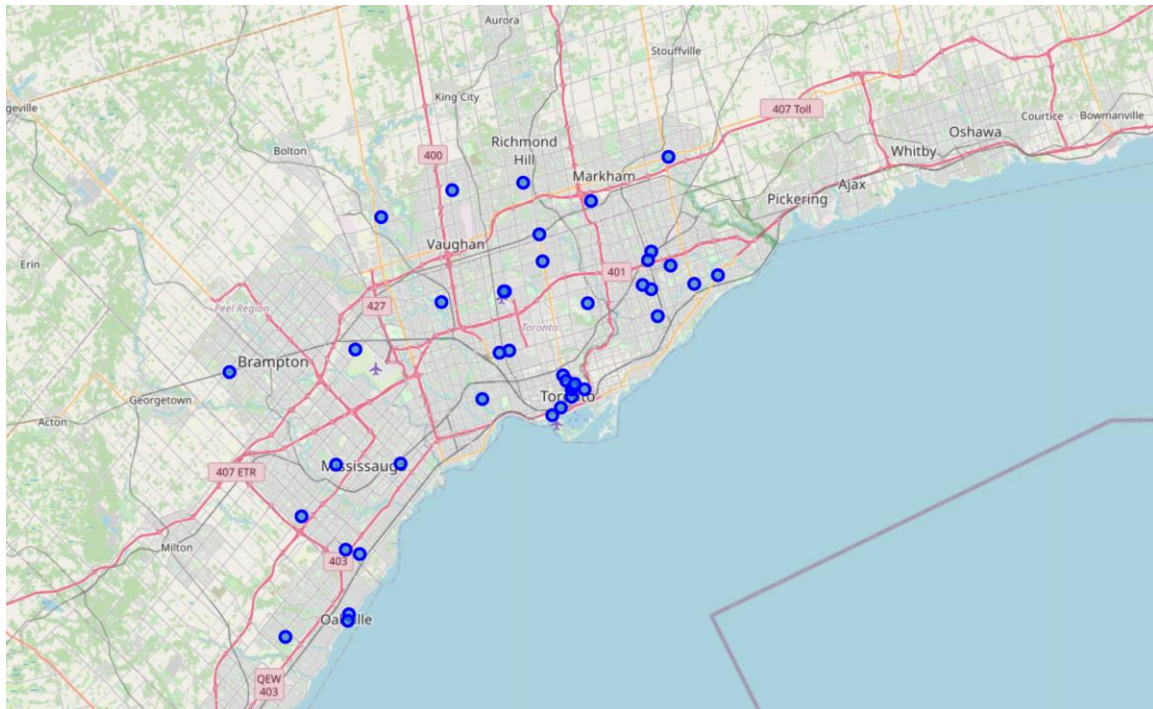
Due to the huge amount of data, the focus of the housing price is limited to Toronto Area due to the fact that it has the largest population.
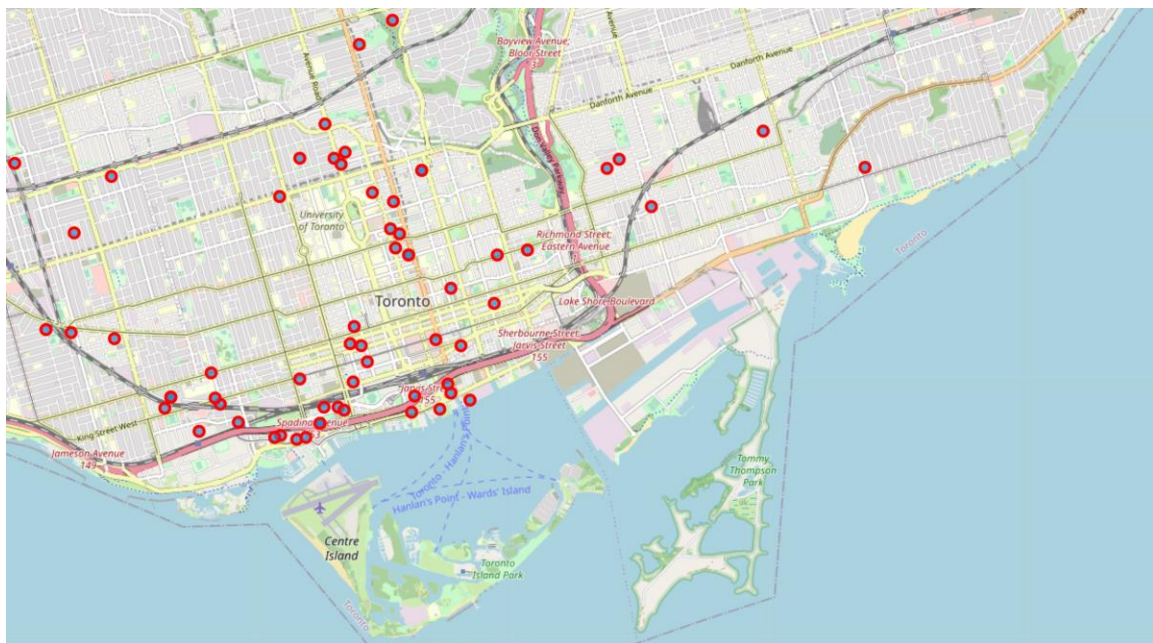
Using the Foursquare API, it is able to get the top venues from the Toronto area. More than 5000 venues were found and returned by Foursquare. Below shows the top 5 rows of the dataset.

	AreaName	Area Latitude	Area Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	West Hill	43.774265	-79.181625	LCBO	43.771462	-79.184384	Liquor Store
1	West Hill	43.774265	-79.181625	Bulk Barn	43.771342	-79.184341	Food & Drink Shop
2	West Hill	43.774265	-79.181625	Sunset Grill	43.772319	-79.184900	Breakfast Spot
3	West Hill	43.774265	-79.181625	Booster Juice	43.770668	-79.184150	Smoothie Shop
4	West Hill	43.774265	-79.181625	Subway	43.771832	-79.185109	Sandwich Place

There are 303 unique category from the venue data returned.

A summary of the top 10 venues for each area is show below:

	AreaName	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	Furniture / Home Store	Men's Store	Dessert Shop	Restaurant	Chinese Restaurant	Japanese Restaurant	Bubble Tea Shop	Shopping Mall	Arts & Crafts Store	Hotel
1	Alderwood	Discount Store	Pizza Place	Light Rail Station	Burrito Place	Convenience Store	Grocery Store	Shopping Mall	Skating Rink	Sandwich Place	Park
2	Bathurst Manor	Park	Men's Store	Escape Room	Bus Line	French Restaurant	Gas Station	Metro Station	Coffee Shop	Baseball Field	Bar
3	Bayview Village	Coffee Shop	Café	Clothing Store	Pharmacy	Chinese Restaurant	Bank	Furniture / Home Store	Gourmet Shop	Thai Restaurant	Gift Shop
4	Bendale	Clothing Store	Sandwich Place	Cosmetics Shop	Intersection	Fish & Chips Shop	Coffee Shop	Bus Station	Bar	Food Court	Movie Theater

To better understand the dataset, the similarities between areas could be explored through unsupervised learning algorithm – K-Means clustering. The entire dataset is segmented into 7 different clusters.

	ID	Address	AreaName	Price	lat	lng	City	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
1019	5915	4609 Kingston Rd Toronto, ON	West Hill	588000	43.774265	-79.181625	Toronto	5	Breakfast Spot	Automotive Shop	Discount Store	Liquor Store	Sandwich Place	Food & Drink Shop	Asian Restaurant	Athletics & Sports	Greek Restaurant	Chinese Restaurant
102	422	712 BROCK AVE Toronto, ON	Wallace Emerson	939000	43.661915	-79.439941	Toronto	5	Café	Bar	Bakery	Mexican Restaurant	Caribbean Restaurant	Cocktail Bar	Coffee Shop	Sandwich Place	Diner	Pizza Place
1987	34991	77 Dentonia Park Ave Toronto, ON	Old East York	415000	43.692848	-79.292099	Toronto	5	Ice Cream Shop	Convenience Store	Gym	Paper / Office Supplies Store	Park	Metro Station	Gas Station	Bank	Chinese Restaurant	Beer Store
73	178	592 The Queensway Toronto, ON	The Queensway	699900	43.628426	-79.493980	Toronto	1	Italian Restaurant	Coffee Shop	Flower Shop	Park	Ice Cream Shop	Bank	Eastern European Restaurant	Fish Market	Fast Food Restaurant	Field
1352	6257	#310 - 777 STEELES AVE W Toronto, ON	Newtonbrook	395000	43.792667	-79.443939	Toronto	5	Coffee Shop	Park	Bank	Chinese Restaurant	Korean Restaurant	Middle Eastern Restaurant	Discount Store	Grocery Store	Café	Food Court

To closely examine each cluster generated by the algorithm:

Cluster 1

	Address	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
2047	49 JOHN TABOR TR Toronto, ON	0	Fast Food Restaurant	Pizza Place	Pharmacy	Park	Grocery Store	Bubble Tea Shop	Supermarket	Convenience Store	Sandwich Place	Gym / Fitness Center
2496	#101 - 99 BLACKWELL AVE Toronto, ON	0	Fast Food Restaurant	Pizza Place	Pharmacy	Park	Grocery Store	Bubble Tea Shop	Supermarket	Convenience Store	Sandwich Place	Gym / Fitness Center
3092	9 Norman Wesley Way Toronto, ON	0	Grocery Store	Pizza Place	Recreation Center	Pharmacy	Café	Furniture / Home Store	Metro Station	Coffee Shop	Park	Escape Room
1360	#405 - 99 BLACKWELL AVE Toronto, ON	0	Fast Food Restaurant	Pizza Place	Pharmacy	Park	Grocery Store	Bubble Tea Shop	Supermarket	Convenience Store	Sandwich Place	Gym / Fitness Center
2910	#54 - 42 Pinery Tr Toronto, ON	0	Fast Food Restaurant	Pizza Place	Pharmacy	Park	Grocery Store	Bubble Tea Shop	Supermarket	Convenience Store	Sandwich Place	Gym / Fitness Center
3146	#Ph09 - 1060 SHEPPARD AVE W Toronto, ON	0	Grocery Store	Pizza Place	Recreation Center	Pharmacy	Café	Furniture / Home Store	Metro Station	Coffee Shop	Park	Escape Room
3282	100 Pennyhill Dr Toronto, ON	0	Fast Food Restaurant	Pizza Place	Pharmacy	Park	Grocery Store	Bubble Tea Shop	Supermarket	Convenience Store	Sandwich Place	Gym / Fitness Center
4315	#1921 - 5 SHEPPARD AVE Toronto, ON	0	Pizza Place	Grocery Store	Coffee Shop	Ice Cream Shop	Spa	Vietnamese Restaurant	Fast Food Restaurant	Cosmetics Shop	Pharmacy	Sandwich Place
3280	#214 - 430 Mclevin Ave Toronto, ON	0	Fast Food Restaurant	Pizza Place	Pharmacy	Park	Grocery Store	Bubble Tea Shop	Supermarket	Convenience Store	Sandwich Place	Gym / Fitness Center
4755	124 BARSE ST Toronto, ON	0	Pizza Place	Bagel Shop	Coffee Shop	Bakery	Ice Cream Shop	Chinese Restaurant	Mexican Restaurant	Middle Eastern Restaurant	Convenience Store	Grocery Store
3139	#1367 - 60 ANN O'REILLY RD Toronto, ON	0	Pizza Place	Gas Station	Coffee Shop	Grocery Store	Sandwich Place	Gym / Fitness Center	Clothing Store	Food	Flower Shop	Flea Market
3600	#3220 - 5 Sheppard Ave Toronto, ON	0	Pizza Place	Grocery Store	Coffee Shop	Ice Cream Shop	Spa	Vietnamese Restaurant	Fast Food Restaurant	Cosmetics Shop	Pharmacy	Sandwich Place

Cluster 2

	Address	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
73	592 The Queensway Toronto, ON	1	Italian Restaurant	Coffee Shop	Flower Shop	Park	Ice Cream Shop	Bank	Eastern European Restaurant	Fish Market	Fast Food Restaurant	Field
1022	#201 - 56 Sidney Belsey Cres Toronto, ON	1	Pizza Place	Bus Line	Fast Food Restaurant	Park	Ice Cream Shop	Asian Restaurant	Coffee Shop	Convenience Store	Yoga Studio	Field
3341	47 Braymore Blvd Toronto, ON	1	Intersection	Bus Station	Park	Fast Food Restaurant	Gas Station	Pizza Place	Food Truck	Food Stand	Food Court	Food & Drink Shop
1582	39 Victoria Blvd Toronto, ON	1	Pizza Place	Bus Line	Fast Food Restaurant	Park	Ice Cream Shop	Asian Restaurant	Coffee Shop	Convenience Store	Yoga Studio	Field
3735	#4 - 24 Martin Ross Ave Toronto, ON	1	Park	Café	Furniture / Home Store	Grocery Store	Escape Room	Sporting Goods Shop	Supermarket	Middle Eastern Restaurant	Metro Station	Shopping Mall
1214	#3008 - 16 Brookers Lane Toronto, ON	1	Italian Restaurant	Grocery Store	Building	Pet Store	Furniture / Home Store	Smoothie Shop	Sushi Restaurant	Field	Park	Liquor Store
	#2307 - 75 Emmett Ave				Fast Food		Ice Cream	Asian		Convenience		

Cluster 3, 4 and 5

Cluster 3

```
In [143]: toronto_merged.loc[toronto_merged['Cluster Labels'] == 2, toronto_merged.columns[[1] + list(range(5, toronto_merged.shape[1]))]]
```

Out[143]:

	Address	lng	City	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
2397	79 CHAPMAN AVE Toronto, ON	-79.297798	Toronto	2	Pet Store	Health & Beauty Service	Theater	Chinese Restaurant	Yoga Studio	Falafel Restaurant	Fast Food Restaurant	Field	Filipino Restaurant	Fish & Chips Shop

Cluster 4

```
In [144]: toronto_merged.loc[toronto_merged['Cluster Labels'] == 3, toronto_merged.columns[[1] + list(range(5, toronto_merged.shape[1]))]]
```

Out[144]:

	Address	lng	City	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
1533	10 Flora Dr Toronto, ON	-79.281387	Toronto	3	Bowling Alley	Outdoor Sculpture	Yoga Studio	Food	Field	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop

Cluster 5

```
In [146]: toronto_merged.loc[toronto_merged['Cluster Labels'] == 4, toronto_merged.columns[[1] + list(range(5, toronto_merged.shape[1]))]]
```

Out[146]:

	Address	lng	City	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
2675	14 STONG CRT Toronto, ON	-79.516373	Toronto	4	Liquor Store	Grocery Store	Athletics & Sports	French Restaurant	Flea Market	Fast Food Restaurant	Field	Filipino Restaurant	Fish & Chips Shop	Fish Market

Cluster 6

|	Address	lng	City	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
1019	4609 Kingston Rd Toronto, ON	-79.181625	Toronto	5	Breakfast Spot	Automotive Shop	Discount Store	Liquor Store	Sandwich Place	Food & Drink Shop	Asian Restaurant	Athletics & Sports	Greek Restaurant	Chinese Restaurant
102	712 BROCK AVE Toronto, ON	-79.439941	Toronto	5	Café	Bar	Bakery	Mexican Restaurant	Caribbean Restaurant	Cocktail Bar	Coffee Shop	Sandwich Place	Diner	Pizza Place
1987	77 Dentonia Park Ave Toronto, ON	-79.292099	Toronto	5	Ice Cream Shop	Convenience Store	Gym	Paper / Office Supplies Store	Park	Metro Station	Gas Station	Bank	Chinese Restaurant	Beer Store
1352	#310 - 777 STEELES AVE W Toronto, ON	-79.443939	Toronto	5	Coffee Shop	Park	Bank	Chinese Restaurant	Korean Restaurant	Middle Eastern Restaurant	Discount Store	Grocery Store	Café	Food Court
4670	#301 - 185 BONIS AVE Toronto, ON	-79.292114	Toronto	5	Fast Food Restaurant	Intersection	Market	Beer Store	Coffee Shop	Liquor Store	Bank	Sandwich Place	Pet Store	Pharmacy
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
112	#2111 - 290 ADELAIDE ST W Toronto, ON	-79.390945	Toronto	5	Coffee Shop	Café	Restaurant	Japanese Restaurant	Hotel	Italian Restaurant	Park	Grocery Store	Pizza Place	Sushi Restaurant
2049	23 CANDY COURT WAY Toronto, ON	-79.445152	Toronto	5	Coffee Shop	Park	Bank	Chinese Restaurant	Korean Restaurant	Middle Eastern Restaurant	Discount Store	Grocery Store	Café	Food Court
1915	#112 - 363 SORAUREN AVE W Toronto, ON	-79.444771	Toronto	5	Coffee Shop	Restaurant	Brewery	Vietnamese Restaurant	Café	Breakfast Spot	Bookstore	Park	Gift Shop	Fish Market
4436	#530 - 2 EVA RD Toronto, ON	-79.563148	Toronto	5	Convenience Store	Sushi Restaurant	Intersection	Turkish Restaurant	Fish & Chips Shop	Skating Rink	Chinese Restaurant	Farmers Market	Tapas Restaurant	Sandwich Place
2443	#1007 - 36 LISGAR ST Toronto, ON	-79.423431	Toronto	5	Coffee Shop	Bar	Restaurant	Café	Furniture / Home Store	Sandwich Place	Art Gallery	Vegetarian / Vegan Restaurant	Italian Restaurant	Bank

155 rows × 14 columns
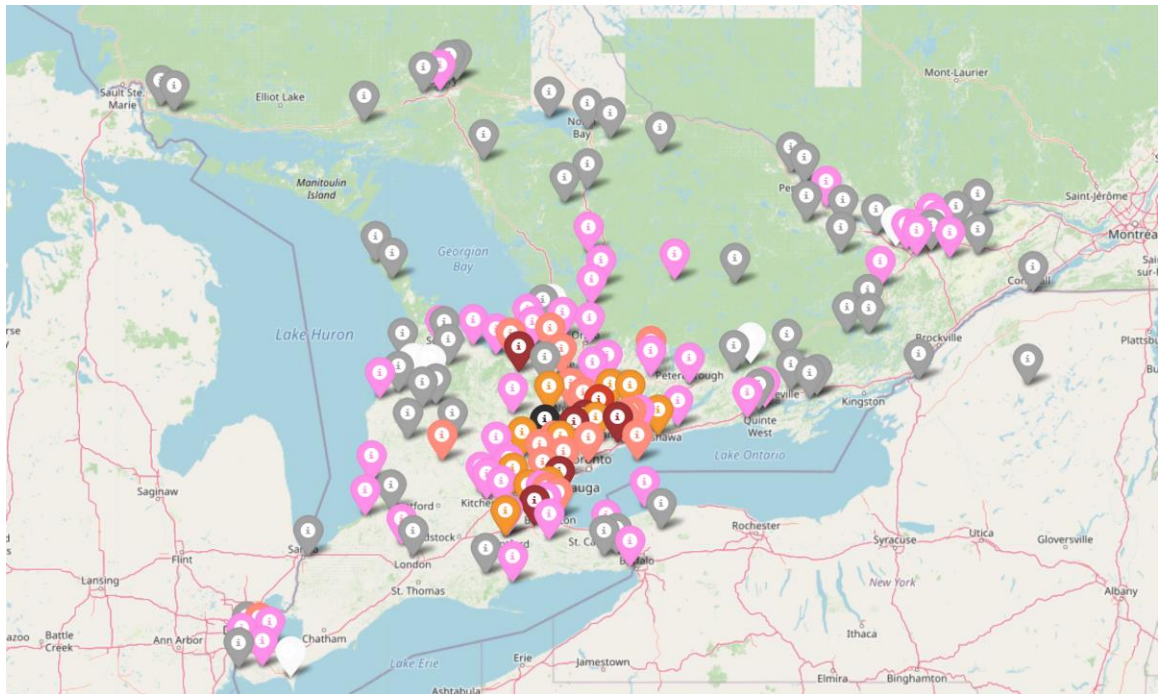
Cluster 7

|	Address	lng	City	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
1514	8 Firestone Rd Toronto, ON	-79.576218	Toronto	6	Garden	Park	Eastern European Restaurant	Yoga Studio	Flower Shop	Field	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market
1449	##1008 - 420 Mill Rd Toronto, ON	-79.588692	Toronto	6	Garden	Park	Eastern European Restaurant	Yoga Studio	Flower Shop	Field	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market

Results

With all the data analysis and clustering performed before, a cluster map for Toronto is created as shown below:
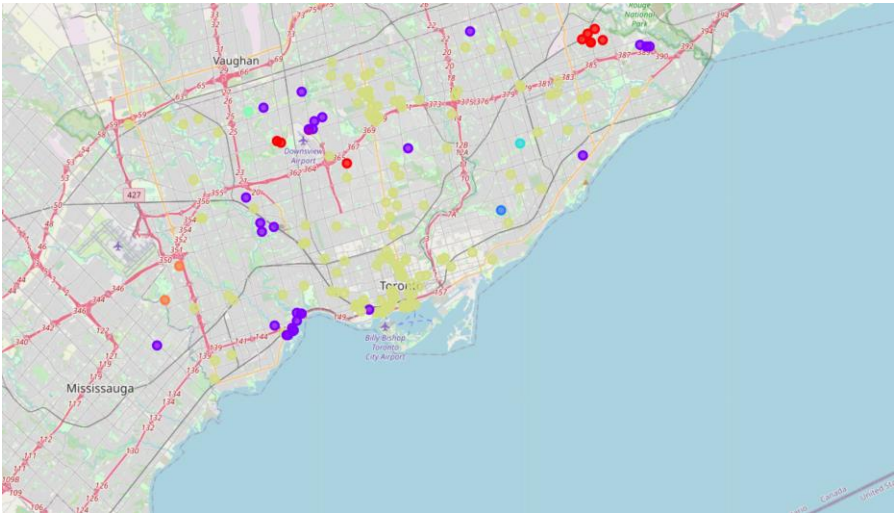
With the housing price average, a map illustrating that is found below:

Combining the housing price and the venue clustering, we have generated a map shown below for better visualization.
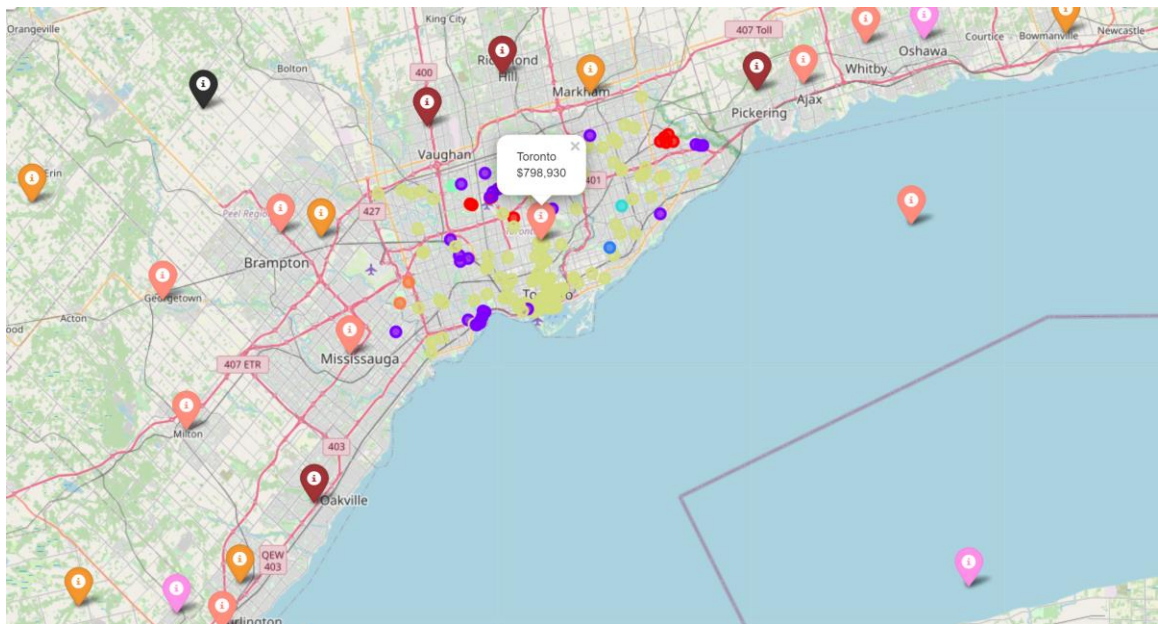
Discussion

Ontario is a very diverse province in Canada with a huge population. Ontario is also very popular for newcomers to choose as their landing province due to it's high venue density across the city and the resources we have in Ontario. The most important thing for the newcomers is to settle down and find a suitable place to stay. With the combination of house price and resources, it will be really hard for the newcomers to consider both at the same time. This analysis provides them sufficient information to make some decisions.

The Foursquare API is used to determine the top venues around the area, then using the K-Means clustering algorithm to groups then into 7 different unique set. The Geo location from the Kaggle dataset was used to assist the performance of this step.

Many useful information is also included in Section B. Data Exploration.

Conclusion

In conclusion, this analysis (including clustering and visualization) is valuable for newcomers who is decided to come to Ontario. This provides them details of housing price comparison and resources around the community area. With visualization of the maps, they could get the exact location of the available houses which is beneficial.