Deciding What Boroughs of Toronto are Best Suited for International Students

Why is This Important?

- The decision to choose an area to live when going abroad to study or find work can be time consuming.
 - Using machine learning algorithms, this process can be made faster by proposing which boroughs best match the reader's interests.
- While the location is important, the price of accommodation is also a factor, meaning combining the surrounding venues with the average prices of 1-bedroom apartments results in more valuable insights.

Data Collection

- 1. The data containing Toronto's boroughs were pulled out of a <u>wikipedia page</u> displaying all of Toronto's postal codes along with boroughs and neighborhoods.
- 2. The surrounding venues data came from the <u>Foursquare API</u>, in this case, used for searching nearby venus around a given location.
- 3. The average 1-bedroom prices were pulled from a <u>table</u> made by the <u>Canada Mortgage and Housing Corporation</u>.

Data Cleaning

The borough data was
fitted with their
respective latitude and
longitude along with the
average 1-bedroom
prices for each borough.

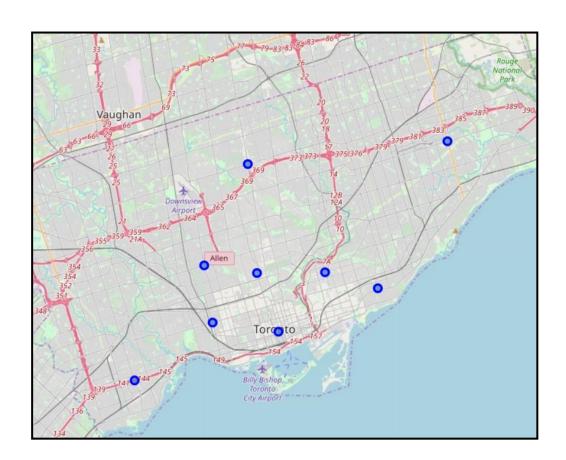
	Borough	Latitude	Longitude	1-Bedroom Apt. Avg. Price (\$)
0	Central Toronto	43.690773	-79.403162	1522
1	Downtown Toronto	43.652503	-79.383558	1721
2	East Toronto	43.680800	-79.294400	1289
3	East York	43.691200	-79.341700	1199
4	Etobicoke	43.620500	-79.513200	1261
5	North York	43.761500	-79.411100	1281
6	Scarborough	43.776400	-79.231800	1216
7	West Toronto	43.658315	-79.442783	1339
8	York	43.695700	-79.450400	1301

Feature Selection

- Because the analysis was based on boroughs rather than neighborhoods, a higher venue collection radius was chosen.
- Thus the venue limit was set to 100 and the radius to 1 km around a borough's center point.

Borough	# of Venues
Central Toronto	100
Downtown Toronto	100
East Toronto	100
West Toronto	100
East York	100
Etobicoke	92
North York	100
Scarborough	79
York	75

Map of Toronto's Boroughs Unclustered



Data Analysis

- 1. Created a One-Hot Encoding Data Frame of the surrounding venues around each borough.
- 2. Transformed the Data Frame to show at what frequency each venue name returned for each borough.
- 3. Finally, the Data Frame was transformed again to show the 10 most common venue types per borough.

10 Most Common Venue Types per Borough

	Borough	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
7	West Toronto	Café	Coffee Shop	Bar	Gastropub	Restaurant	Bakery	Cocktail Bar	Park	Brewery	Italian Restaurant
1	Downtown Toronto	Coffee Shop	Café	Hotel	Theater	Steakhouse	Gastropub	Pizza Place	Japanese Restaurant	Restaurant	Plaza
8	York	Coffee Shop	Grocery Store	Furniture / Home Store	Sandwich Place	Bakery	Pizza Place	Italian Restaurant	Fast Food Restaurant	Playground	Bank
6	Scarborough	Coffee Shop	Pharmacy	Sandwich Place	Gas Station	Park	Indian Restaurant	Fast Food Restaurant	Gym	Wings Joint	Chinese Restaurant
2	East Toronto	Coffee Shop	Pub	Bakery	Breakfast Spot	Park	Beach	BBQ Joint	Pharmacy	Thai Restaurant	Japanese Restaurant
4	Etobicoke	Coffee Shop	Restaurant	Italian Restaurant	Sandwich Place	Bakery	Convenience Store	Sushi Restaurant	Grocery Store	Fast Food Restaurant	Burrito Place
3	East York	Greek Restaurant	Café	Coffee Shop	Pizza Place	Gastropub	Ice Cream Shop	Bakery	Ethiopian Restaurant	Yoga Studio	Burger Joint
0	Central Toronto	Italian Restaurant	Park	Café	Coffee Shop	Restaurant	American Restaurant	Middle Eastern Restaurant	Sushi Restaurant	Vegetarian / Vegan Restaurant	Indian Restaurant
5	North York	Korean Restaurant	Coffee Shop	Bubble Tea Shop	Pizza Place	Japanese Restaurant	Grocery Store	Ramen Restaurant	Bank	Sandwich Place	Fried Chicken Joint

Clustering

The Machine Learning algorithm used was k-means clustering using k=3, which produced the following Data Frame:

6th Most

7th Most

8th Most

9th Most

10th Most

100	Borough	Latitude	Longitude	1-Bedroom Apt. Avg. Price (\$)	Cluster	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue	Common Venue
0	Central Toronto	43.690773	-79.403162	1522	0	Italian Restaurant	Park	Café	Coffee Shop	Restaurant	American Restaurant	Middle Eastern Restaurant	Sushi Restaurant	Vegetarian / Vegan Restaurant	Indian Restaurant
8	York	43.695700	-79.450400	1301	1	Coffee Shop	Grocery Store	Furniture / Home Store	Sandwich Place	Bakery	Pizza Place	Italian Restaurant	Fast Food Restaurant	Playground	Bank
6	Scarborough	43.776400	-79.231800	1216	1	Coffee Shop	Pharmacy	Sandwich Place	Gas Station	Park	Indian Restaurant	Fast Food Restaurant	Gym	Wings Joint	Chinese Restaurant
4	Etobicoke	43.620500	-79.513200	1261	1	Coffee Shop	Restaurant	Italian Restaurant	Sandwich Place	Bakery	Convenience Store	Sushi Restaurant	Grocery Store	Fast Food Restaurant	Burrito Place
5	North York	43.761500	-79.411100	1281	1	Korean Restaurant	Coffee Shop	Bubble Tea Shop	Pizza Place	Japanese Restaurant	Grocery Store	Ramen Restaurant	Bank	Sandwich Place	Fried Chicken Joint
7	West Toronto	43.658315	-79.442783	1339	2	Café	Coffee Shop	Bar	Gastropub	Restaurant	Bakery	Cocktail Bar	Park	Brewery	Italian Restaurant
1	Downtown Toronto	43.652503	-79.383558	1721	2	Coffee Shop	Café	Hotel	Theater	Steakhouse	Gastropub	Pizza Place	Japanese Restaurant	Restaurant	Plaza
2	East Toronto	43.680800	-79.294400	1289	2	Coffee Shop	Pub	Bakery	Breakfast Spot	Park	Beach	BBQ Joint	Pharmacy	Thai Restaurant	Japanese Restaurant
3	East York	43.691200	-79.341700	1199	2	Greek Restaurant	Café	Coffee Shop	Pizza Place	Gastropub	Ice Cream Shop	Bakery	Ethiopian Restaurant	Yoga Studio	Burger Joint

3rd Most

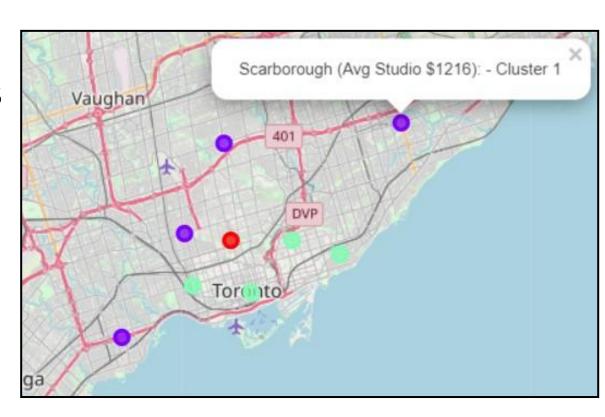
4th Most

5th Most

1st Most

2nd Most

Map of Toronto's Boroughs Clustered



Final Data Frame Clustered

	Borough	1-Bedroom Apt. Avg. Price (\$)	Cluster	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
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Cluster o: Mostly restaurants, parks and cafés

Central Toronto

Cluster 1: Mostly coffee shops, Grocery Stores and restaurants

- York
- Scarborough

Cluster 2: Mostly coffee shops, pubs/bars and cafés

- Downtown Toronto
- East Toronto