

IBM-COURSERA DATA SCIENCE CAPSTONE PROJECT

OPENING A VEGAN RESTAURANT IN TORONTO

1.INTRODUCTION

1.1 Background

Toronto is the capital city of the Canadian province of Ontario. It is the most populous city in Canada and the fourth largest city in North America. It is made up of the former cities of Toronto, North York, Scarborough, York and Etobicoke, and the former borough of East York. The city is home to a large immigrant population, and is an international center of business, finance, arts, and culture.

It is recognized as one of the most multicultural and cosmopolitan cities in the world

The restaurant and food service industry are one of the fastest growing industries in Canada today. The annual sales generated by the restaurant industry in Ontario are \$33 Billion and there are 9,1 Million visits to restaurants every day (Source: <https://www.restaurantscanada.org/resources/#infographics>)

As a cosmopolitan and diversity city the restaurant offer is very wide there are a lot of different cuisines. Italian, Japanese, Indian, American, Mediterranean...and also some which offers vegan cuisine.

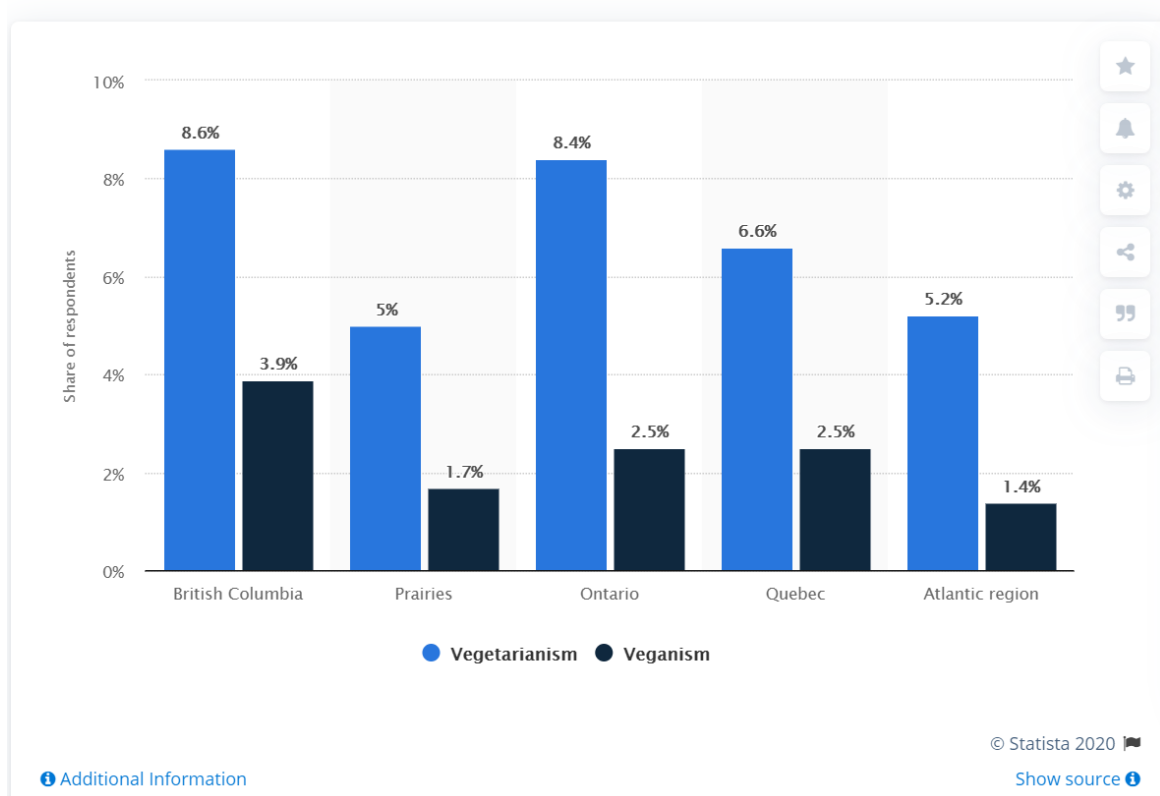
Veganism has emerged as one of the top food and lifestyle trends in the past few years. In 2020, the global market for veggie products (vegan, flexitarian and vegetarian) will reach 5 billion dollars and an exponential growth is expected in successive years.

The main reasons for becoming a veggie are sustainability, health, and respect for animals.

Canada's is home to approximately 850,000 vegans and there are nearly 2.3 million vegetarians (source: Statista) That number is increasing, and it's estimated that the number of Canadians going meatless or eating less meat could exceed 10 million by 2025.

The following chart shows the percentage of vegetarians and vegans in Canada as of March 2018, by region (source Statista. <https://www.statista.com/topics/3262/vegan-vegetarian-diets-in-canada>).

Ontario is the second region with the highest percentage of vegetarian and vegans



It seems like veganism is really catching on, with more vegan restaurants, more vegan options and more grocery stores carrying vegan food.

Moreover, people, especially in cosmopolitan cities like Toronto, are more open to trying and exploring vegetarian or vegan restaurants even if they do not follow a strictly vegan or vegetarian diet.

1. Business problem

The objective of this project is to determine which might be the 'best' neighborhood in Toronto to open a vegan restaurant.

Location is one of the most important decisions to make when you want to open a new restaurant, and even more when it comes to a niche business like a vegan restaurant.

There are several factors that would affect the success of a new restaurant which are directly related to the location such as visibility and accessibility (look for spots that have good street visibility and are easily accessible), demographics (you have to consider a location frequented by your potential client target), or competition.

Moreover, veganism is often associated with a healthy and conscious lifestyle, therefore an ideal spot might be near a successful yoga studio or healthy shop.

1.3 Stakeholders

This study would be extremely useful for any entrepreneur that wants to open a vegan restaurant in the city of Toronto.

The analysis will provide vital information about the more suitable locations for a vegan restaurant which can be used by this target audience.

2.DATA DESCRIPTION

The main data that we use for this project is:

- List of all borough in Toronto and their corresponding neighborhoods
- Coordinates of all neighborhoods
- Venues information for each neighborhood

In accordance with the objective of the project, the factors that will help to make a final decision (where is better to open a vegan restaurant) are:

- Number of existing Vegan restaurants in the neighborhood
- Number of existing Yoga Studio in the neighborhood
- Most common venues of each neighborhood

Data sources and acquisition

We make use of a few data sources to get the data required for this project.

1. Wikipedia

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

The Wikipedia provides almost all the information about the neighborhoods in Toronto. It includes the postal code, borough, and the name of each neighborhoods.

Since the data is not in a format that is suitable for analysis, scraping of the data is done from this site using Beautiful Soup Library. We put the data into a data frame.

| | Postal Code | Borough | Neighbourhood |
|---|-------------|------------------|---------------------------|
| 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 |

2. Geospatial data.

https://cocl.us/Geospatial_data

The second source of data was given by the Coursera course and provides us with the geographical coordinates of all neighborhoods and venues. The file is in CSV format and we can read it using Pandas Library.

| | PostalCode | Latitude | Longitude |
|---|------------|-----------|------------|
| 0 | M1B | 43.806686 | -79.194353 |
| 1 | M1C | 43.784535 | -79.160497 |
| 2 | M1E | 43.763573 | -79.188711 |
| 3 | M1G | 43.770992 | -79.216917 |
| 4 | M1H | 43.773136 | -79.239476 |

3. Foursquare API.

We will get the various location-related data, like the kinds of places in a particular neighborhood, using Foursquare API. This data will include the type of shops, restaurants, cafes, etc. in each neighborhood. We will make calls to Foursquare API using our credentials to acquire these location-related data.

3. METHODOLOGY

3.1 Data Cleaning

After all the data was collected and put into data frames, we need to clean and merge the data to be able to start our analysis.

When we get the data from Wikipedia some cleaning process is required:

1. Some boroughs are shown as “Not assigned”. We remove those lines. Only the cells that have an assigned borough will be processed.

2. All neighborhoods with the same postal code will be grouped. For example, M5A is listed twice and has two neighborhoods: Harbourfront and Regent Park. We will combine these two rows into one with the neighborhoods separated with a comma.

3. We will reorder the Columns so the ‘PostalCode’ appears first for easier readability

3. For borough with neighborhood = ‘Not assigned’, the neighborhood will be the same as the borough.

After all these implementations, our data frame remains like shown below:

| | PostalCode | Borough | Neighborhood |
|---|------------|-----------------|-----------------------------------|
| 0 | M4N | Central Toronto | Lawrence Park |
| 1 | M4P | Central Toronto | Davisville North |
| 2 | M4R | Central Toronto | North Toronto West, Lawrence Park |
| 3 | M4S | Central Toronto | Davisville |
| 4 | M4T | Central Toronto | Moore Park, Summerhill East |

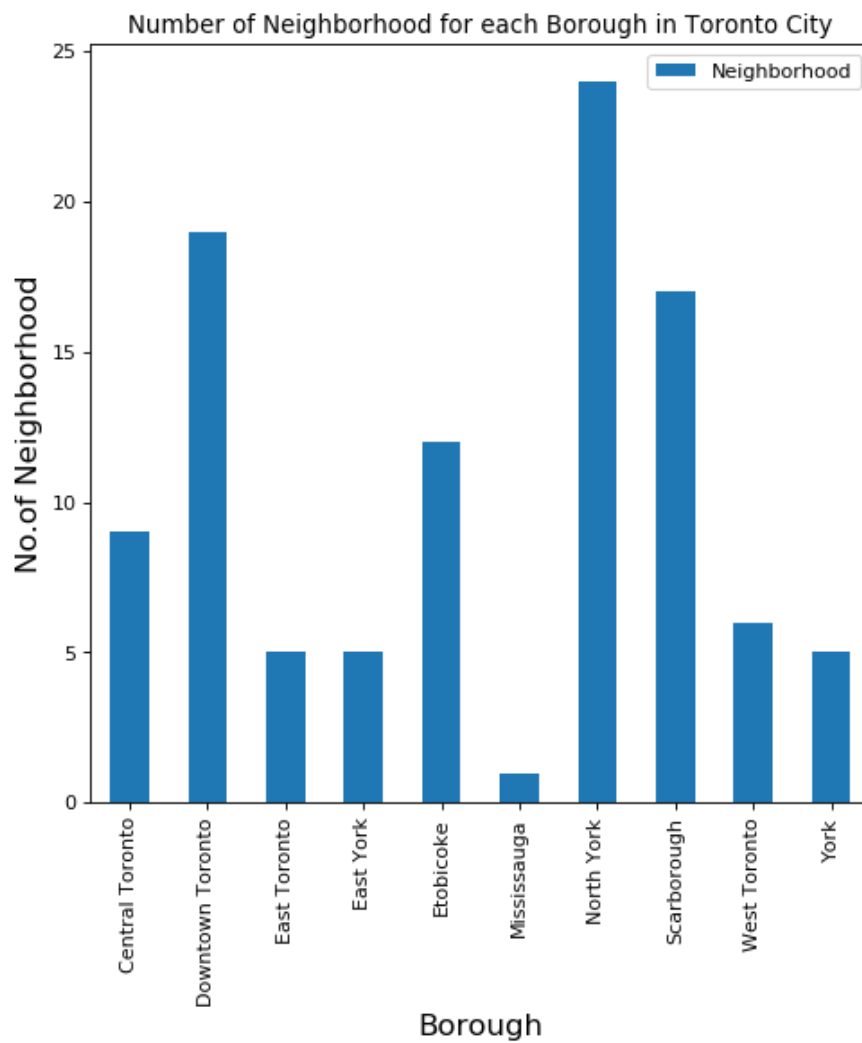
Now we will merge this data frame with the one we got from the Geocoder package with the geographical coordinates of all neighborhoods. We will merge the two tables together based on Postal Code getting the data frame shown below.

| | PostalCode | Borough | Neighborhood | Latitude | Longitude |
|---|------------|-----------------|-----------------------------------|-----------|------------|
| 0 | M4N | Central Toronto | Lawrence Park | 43.728020 | -79.388790 |
| 1 | M4P | Central Toronto | Davisville North | 43.712751 | -79.390197 |
| 2 | M4R | Central Toronto | North Toronto West, Lawrence Park | 43.715383 | -79.405678 |
| 3 | M4S | Central Toronto | Davisville | 43.704324 | -79.388790 |
| 4 | M4T | Central Toronto | Moore Park, Summerhill East | 43.689574 | -79.383160 |

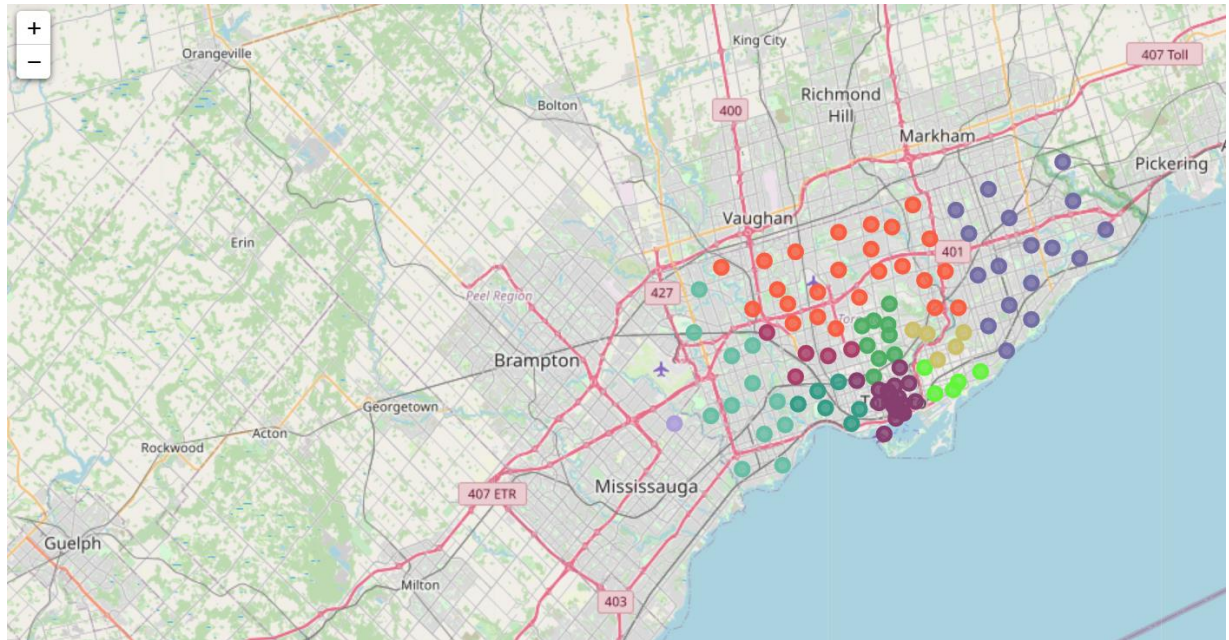
3.1 Data exploration

Now we have our data prepared to start analyzing and exploring it.

We will start comparing the number of neighborhoods in each borough. We will create a bar chart to easily visualize this.



Using Folium we will create a map of Toronto with neighborhoods superimposed on top and color-coded each Neighborhood depending in what borough they are located in



In this map we can clearly visualize the boroughs and neighborhood inside.

Next, we will use the Foursquare API to get a list of all the Venues in Toronto and explore each neighborhood attending to this venue information.

First, we will get the venues for all neighborhoods in our dataset and then we will find out how many unique categories can be curated from all the returned venues.

We get a list of all the venues categories and find that there is a total of 273 unique categories of venues.

The Venue Categories are ['Park' 'Swim School' 'Bus Line' 'Breakfast Spot' 'Food & Drink Shop' 'Department Store' 'Hotel' 'Sandwich Place' 'Gym / Fitness Center' 'Dog Run' 'Dance Studio' 'Yoga Studio' 'Diner' 'Salon / Barbershop' 'Clothing Store' 'Restaurant' 'Spa' 'Mexican Restaurant' 'Coffee Shop' 'Chinese Restaurant' 'Fast Food Restaurant' 'Sporting Goods Shop' 'Café' 'Ice Cream Shop' 'Furniture / Home Store' 'Bagel Shop' 'Dessert Shop' 'Indian Restaurant' 'Pizza Place' 'Seafood Restaurant' 'Italian Restaurant' 'Sushi Restaurant' 'Gym' 'Thai Restaurant' 'Brewery' 'Toy / Game Store' 'Greek Restaurant' 'Gas Station' 'Farmers Market' 'Gourmet Shop' 'Pharmacy' 'Indoor Play Area' 'Trail' 'Playground' 'Liquor Shop' 'Supermarket' 'American Restaurant' 'Pub' 'Fried Chicken Joint' 'Bank' 'Vietnamese Restaurant' 'Light Rail Station' 'Garden' 'Music Venue' 'Jewelry Store' 'BBQ Joint' 'Middle Eastern Restaurant' 'Burger Joint' 'Donut Shop' 'History Museum' 'Japanese Restaurant' 'Bakery' 'General Entertainment' 'Butcher' 'Gastropub' 'Pet Store' 'Deli / Bodega' 'Caribbean Restaurant' 'Taiwanese Restaurant' 'Gift Shop' 'Market' 'Beer Store' 'Plaza' 'Grocery Store' 'Snack Place' 'Theme Restaurant' 'Bubble Tea Shop' 'Beer Bar' 'Ramen Restaurant' 'Juice Bar' 'Bookstore' 'Creperie' 'Martial Arts School' 'Men's Store' 'Gay Bar' 'Escape Room' 'Hobby Shop' 'Ethiopian Restaurant' 'Steakhouse' 'Smoke Shop' 'Distribution Center' 'Sake Bar' 'Health & Beauty Service' 'Theater' 'Mediterranean Restaurant' 'Afghan Restaurant' 'Strip Club' 'Sculpture Garden' 'Historic Site' 'Chocolate Shop' 'Performing Arts Venue' 'French Restaurant' 'Event Space' 'Shoe Store' 'Art Gallery' 'Electronics Store' 'Antique Shop' 'Comic Shop' 'Burrito Place' 'Shopping Mall' 'New American Restaurant' 'Tanning Salon' 'Movie Theater' 'Modern European Restaurant' 'Miscellaneous Shop' 'College Rec Center' 'Cosmetics Shop' 'Lake' 'Tea Room' 'Lounge' 'Video Game Store' 'Wine Bar' 'Other Great Outdoors' 'Lingerie Store' 'Poutine Place' 'Office' 'Hookah Bar' 'Food Truck' 'Camera Store' 'Cocktail Bar' 'Latin American Restaurant' 'Vegetarian / Vegan Restaurant' 'Fountain' 'Tailor Shop' 'Fish Market' 'German Restaurant' 'Cheese Shop' 'Comfort Food Restaurant' 'Asian Restaurant' 'Irish Pub' 'Moroccan Restaurant' 'Belgian Restaurant' 'Kitchen Supply Store' 'Bistro' 'Concert Hall' 'Museum' 'Basketball Stadium' 'Jazz Club' 'Beach' 'Eastern European Restaurant' 'Poke Place' 'Art Museum' 'Portuguese Restaurant' 'Falafel Restaurant' 'Discount Store' 'Salad Place' 'Korean Restaurant' 'Speakeasy' 'Neighborhood' 'Food Court' 'Monument / Landmark' 'Colombian Restaurant' 'General Travel' 'Brazilian Restaurant' 'Gluten-free Restaurant' 'Bar' 'Women's Store' 'Noodle House' 'Building' 'Cupcake Shop' 'Nightclub' 'Skating Rink' 'IT Services' 'Roof Deck' 'Aquarium' 'Train Station' 'Sports Bar' 'Scenic Lookout' 'Baseball Stadium' 'Convenience Store' 'Indie Movie Theater' 'Hotel Bar' 'Molecular Gastronomy Restaurant' 'College Gym' 'College Arts Building' 'Arts & Crafts Store' 'Organic Grocery' 'Dumpling Restaurant' 'Gaming Cafe' 'Record Shop' 'Filipino Restaurant' 'Doner Restaurant' 'Massage Studio' 'Dim Sum Restaurant' 'Hospital' 'Bed & Breakfast' 'Smoothie Shop' 'Airport' 'Airport Lounge' 'Harbor / Marina' 'Airport Food Court' 'Airport Gate' 'Plane' 'Boutique' 'Rental Car Location' 'Airport Terminal' 'Airport Service' 'Boat or Ferry' 'Church' 'Optical Shop' 'Hostel' 'Soup Place' 'Opera House' 'Candy Store' 'Baby Store' 'Athletics & Sports' 'College Auditorium' 'College Cafeteria' 'Health Food Store' 'Fruit & Vegetable Store' 'Frozen Yogurt Shop' 'Fish & Chips Shop' 'Stationery Store' 'Coworking Space' 'Skate Park' 'Garden Center' 'Auto Workshop' 'Recording Studio' 'Intersection' 'Curling Ice' 'Bike Shop' 'Warehouse Store' 'Pool' 'River' 'Baseball Field' 'Construction & Landscaping' 'Wings Joint' 'Supplement Shop' 'Hardware Store' 'Social Club' 'Kids Store' 'Thrift / Vintage Store' 'Print Shop' 'Shopping Plaza' 'Drugstore' 'Golf Course' 'Mobile Phone Shop' 'Luggage Store' 'Bus Station' 'Metro Station' 'Bridal Shop' 'Home Service' 'Business Service' 'Hockey Arena' 'Locksmith' 'Accessories Store' 'Medical Center' 'Korean BBQ Restaurant' 'Hakka Restaurant' 'Soccer Field' 'Motel' 'College Stadium' 'Auto Garage' 'Cuban Restaurant' 'Malay Restaurant' 'Southern / Soul Food Restaurant' 'Climbing Gym' 'Stadium' 'Flea Market' 'Cajun / Creole Restaurant' 'Field' 'Tennis Court' 'Turkish Restaurant']

Is there any Vegan/Vegetarian restaurant among this list? The answer is yes and getting this data is crucial for our analysis. We will find out that there is a total of 16 Vegan/Vegetarian restaurants all over Toronto.

EXPLORING THE NEIGHBORHOODS

Now we will start exploring each Neighborhood.

We will merge the Foursquare Venue data with the Neighborhood data. This will give us the nearest Venue for each of the Neighborhood.

| | Neighborhood | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|---|------------------|----------------------|-----------------------|--------------------------------|---------------|----------------|----------------|
| 0 | Lawrence Park | 43.728020 | -79.388790 | Lawrence Park Ravine | 43.726963 | -79.394382 | Park |
| 1 | Lawrence Park | 43.728020 | -79.388790 | Zodiac Swim School | 43.728532 | -79.382860 | Swim School |
| 2 | Lawrence Park | 43.728020 | -79.388790 | TTC Bus #162 - Lawrence-Donway | 43.728026 | -79.382805 | Bus Line |
| 3 | Davisville North | 43.712751 | -79.390197 | Homeway Restaurant & Brunch | 43.712641 | -79.391557 | Breakfast Spot |
| 4 | Davisville North | 43.712751 | -79.390197 | Sherwood Park | 43.716551 | -79.387776 | Park |

Then we will find out how many venues are in each Neighborhood

| | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|---|----------------------|-----------------------|-----------|---------------|----------------|---------------|
| Neighborhood | | | | | | |
| Agincourt | 5 | 5 | 5 | 5 | 5 | 5 |
| Alderwood, Long Branch | 7 | 7 | 7 | 7 | 7 | 7 |
| Bathurst Manor, Wilson Heights, Downsview North | 21 | 21 | 21 | 21 | 21 | 21 |
| Bayview Village | 4 | 4 | 4 | 4 | 4 | 4 |
| Bedford Park, Lawrence Manor East | 22 | 22 | 22 | 22 | 22 | 22 |
| ... | ... | ... | ... | ... | ... | ... |
| Willowdale, Willowdale West | 5 | 5 | 5 | 5 | 5 | 5 |
| Woburn | 4 | 4 | 4 | 4 | 4 | 4 |
| Woodbine Heights | 8 | 8 | 8 | 8 | 8 | 8 |
| York Mills West | 2 | 2 | 2 | 2 | 2 | 2 |
| York Mills, Silver Hills | 1 | 1 | 1 | 1 | 1 | 1 |

We will also find out the most common 10 top venues for each Neighborhood.

| | Neighborhoods | 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 | Lounge | Skating Rink | Latin American Restaurant | Clothing Store | Breakfast Spot | Falafel Restaurant | Event Space | Ethiopian Restaurant | Escape Room | Discount Store |
| 1 | Alderwood, Long Branch | Pizza Place | Pharmacy | Gym | Sandwich Place | Coffee Shop | Pub | Dog Run | Dim Sum Restaurant | Diner | Discount Store |
| 2 | Bathurst Manor, Wilson Heights, Downsview North | Bank | Coffee Shop | Fried Chicken Joint | Chinese Restaurant | Bridal Shop | Sandwich Place | Diner | Restaurant | Middle Eastern Restaurant | Supermarket |
| 3 | Bayview Village | Japanese Restaurant | Café | Chinese Restaurant | Bank | Distribution Center | Dog Run | Doner Restaurant | Donut Shop | Drugstore | Yoga Studio |
| 4 | Bedford Park, Lawrence Manor East | Sandwich Place | Italian Restaurant | Coffee Shop | Greek Restaurant | Thai Restaurant | Locksmith | Liquor Store | Comfort Food Restaurant | Juice Bar | Butcher |

Then to continue analyzing the data we will perform a technique in which Categorical Data is transformed into Numerical Data for Machine Learning algorithms. This technique is called One hot encoding. For each of the neighborhoods, individual venues were turned into the frequency at how many of those Venues were in each neighborhood.

| | Neighborhoods | Accessories Store | Afghan Restaurant | Airport | Airport Food Court | Airport Gate | Airport Lounge | Airport Service | Airport Terminal | American Restaurant | ... | Train Station | Turkish Restaurant | Vegetarian / Vegan Restaurant | Video Game Store | Vietn Rest |
|---|------------------|-------------------|-------------------|---------|--------------------|--------------|----------------|-----------------|------------------|---------------------|-----|---------------|--------------------|-------------------------------|------------------|------------|
| 0 | Lawrence Park | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 | 0 |
| 1 | Lawrence Park | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 | 0 |
| 2 | Lawrence Park | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 | 0 |
| 3 | Davisville North | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 | 0 |
| 4 | Davisville North | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 | 0 |

Now, we will group those rows by Neighborhood and by taking the average of the frequency of occurrence of each Venue Category. We will get the below data frame:

| | Neighborhoods | Accessories Store | Afghan Restaurant | Airport | Airport Food Court | Airport Gate | Airport Lounge | Airport Service | Airport Terminal | American Restaurant | ... | Train Station | Turkish Restaurant | Vegetarian / Vegan Restaurant | Video Game Store | Vietnamese Restaurant |
|---|---|-------------------|-------------------|---------|--------------------|--------------|----------------|-----------------|------------------|---------------------|-----|---------------|--------------------|-------------------------------|------------------|-----------------------|
| 0 | Agincourt | 0.000000 | 0.000000 | 0.0000 | 0.0000 | 0.0000 | 0.000 | 0.000 | 0.0000 | 0.000000 | ... | 0.00 | 0.0 | 0.000000 | 0.000000 | 0.000000 |
| 1 | Alderwood, Long Branch | 0.000000 | 0.000000 | 0.0000 | 0.0000 | 0.0000 | 0.000 | 0.000 | 0.0000 | 0.000000 | ... | 0.00 | 0.0 | 0.000000 | 0.000000 | 0.000000 |
| 2 | Bathurst Manor, Wilson Heights, Downsview North | 0.000000 | 0.000000 | 0.0000 | 0.0000 | 0.0000 | 0.000 | 0.000 | 0.0000 | 0.000000 | ... | 0.00 | 0.0 | 0.000000 | 0.000000 | 0.000000 |
| 3 | Bayview Village | 0.000000 | 0.000000 | 0.0000 | 0.0000 | 0.0000 | 0.000 | 0.000 | 0.0000 | 0.000000 | ... | 0.00 | 0.0 | 0.000000 | 0.000000 | 0.000000 |
| 4 | Bedford Park, Lawrence Manor East | 0.000000 | 0.000000 | 0.0000 | 0.0000 | 0.0000 | 0.000 | 0.000 | 0.0000 | 0.045455 | ... | 0.00 | 0.0 | 0.000000 | 0.000000 | 0.000000 |

As we mentioned before for this project it is crucial to analyze the Vegan/vegetarian restaurants that already exist in Toronto.

We will create a new data frame that shows the Neighborhood names and the mean frequency of Vegan/vegetarian restaurants in that Neighborhood. This made the data much simpler to analyze for our project.

| | Neighborhood | Vegetarian / Vegan Restaurant |
|-----|---|-------------------------------|
| 43 | Kensington Market, Chinatown, Grange Park | 0.054054 |
| 68 | Runnymede, Swansea | 0.030303 |
| 48 | Little Portugal, Trinity | 0.022222 |
| 18 | Commerce Court, Victoria Hotel | 0.020000 |
| 5 | Berczy Park | 0.018182 |
| ... | ... | ... |
| 32 | Glencairn | 0.000000 |
| 31 | Garden District, Ryerson | 0.000000 |
| 30 | Forest Hill North & West, Forest Hill Road Park | 0.000000 |
| 28 | Fairview, Henry Farm, Oriole | 0.000000 |
| 95 | York Mills, Silver Hills | 0.000000 |

Other venue category that it is interesting to consider in our analysis are the Yoga Studios. This is an ideal venue to have near our restaurant because the clients of yoga studio highly likely will be potential customers of a Vegan restaurant.

We will select only the Neighborhood, vegan restaurants and yoga studio venues so we get a data frame where, using the average of the frequency of occurrence, we can see in which neighborhood we can not find neither a yoga studio or a vegan restaurant, in which ones we find both and in which ones we find at least one of each.

| | Neighborhoods | Vegetarian / Vegan Restaurant | Yoga Studio |
|----|---|-------------------------------|-------------|
| 0 | Agincourt | 0.000000 | 0.000000 |
| 1 | Alderwood, Long Branch | 0.000000 | 0.000000 |
| 2 | Bathurst Manor, Wilson Heights, Downsview North | 0.000000 | 0.000000 |
| 3 | Bayview Village | 0.000000 | 0.000000 |
| 4 | Bedford Park, Lawrence Manor East | 0.000000 | 0.000000 |
| 5 | Berczy Park | 0.018182 | 0.000000 |
| 6 | Birch Cliff, Cliffside West | 0.000000 | 0.000000 |
| 7 | Brockton, Parkdale Village, Exhibition Place | 0.000000 | 0.000000 |
| 8 | Business reply mail Processing Centre, South C... | 0.000000 | 0.000000 |
| 9 | CN Tower, King and Spadina, Railway Lands, Har... | 0.000000 | 0.000000 |
| 10 | Caledonia-Fairbanks | 0.000000 | 0.000000 |
| 11 | Canada Post Gateway Processing Centre | 0.000000 | 0.000000 |
| 12 | Cedarbrae | 0.000000 | 0.000000 |
| 13 | Central Bay Street | 0.014706 | 0.014706 |
| 14 | Christie | 0.000000 | 0.000000 |
| 15 | Church and Wellesley | 0.000000 | 0.026667 |
| 16 | Clarks Corners, Tam O'Shanter, Sullivan | 0.000000 | 0.000000 |

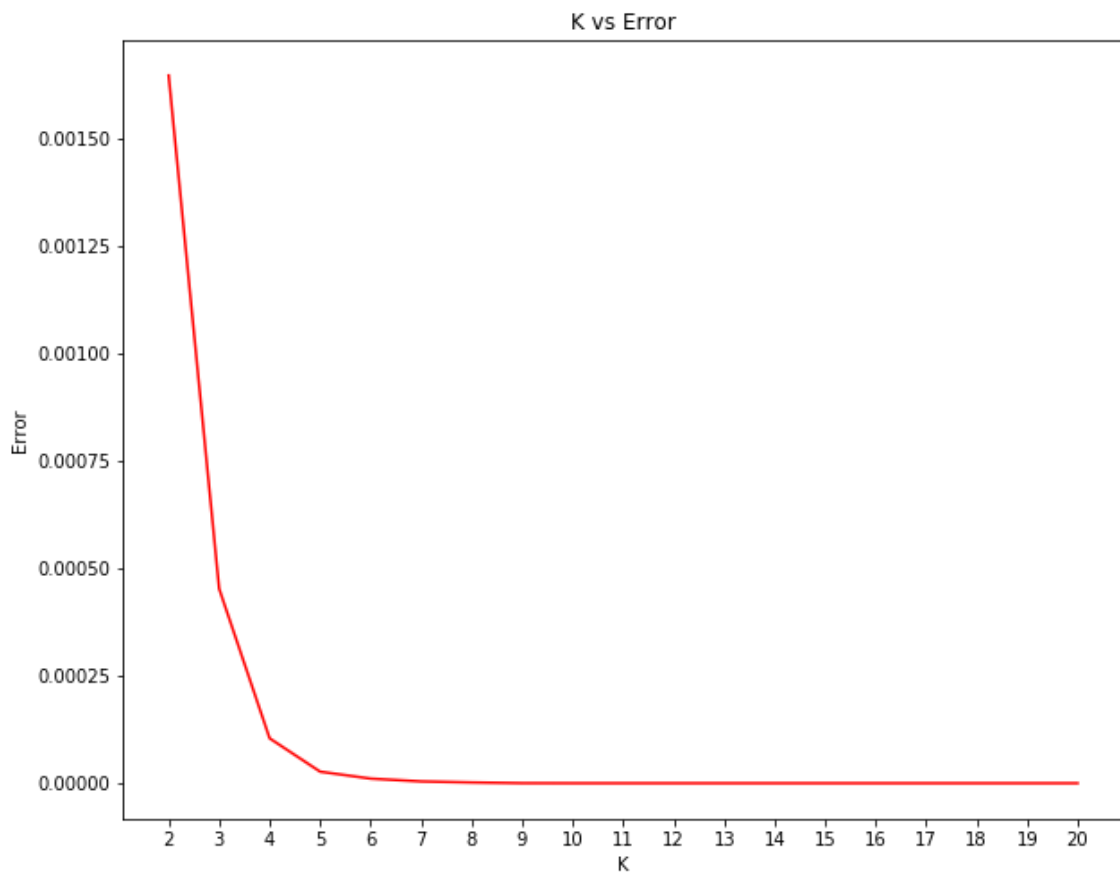
CLUSTERING THE NEIGHBORHOODS

Now we will cluster the neighborhoods based on the neighborhoods that had similar averages of vegan/vegetarian restaurants in that Neighborhood.

To do this we will use a machine learning technique called K-Means clustering. With the K-Means clustering, objects that are similar based on a certain variable are put into the same cluster.

The first step is to get our optimum K value that was neither overfitting nor underfitting the model. This K value determine how many clusters we will get, and we will use the Elbow Point Technique to get it.

In this technique, we run a test with different numbers of K values and measured the accuracy and then chose the best K value. The best K value is chosen at the point in which the line has the sharpest turn. In our case, we have the Elbow Point at K = 4. That means we will have a total of 4 clusters.



According to this technique, our neighborhoods will be divided into 4 different clusters according to the ones that have a similar mean frequency of Vegan/Vegetarian restaurants.

With this classification we will create a new data frame that includes the cluster for each Neighborhood and the occurrence of Vegan/Vegetarian Restaurants.

| | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels |
|---|---|-------------------------------|---------------|
| 0 | Agincourt | 0.0 | 0 |
| 1 | Alderwood, Long Branch | 0.0 | 0 |
| 2 | Bathurst Manor, Wilson Heights, Downsview North | 0.0 | 0 |
| 3 | Bayview Village | 0.0 | 0 |
| 4 | Bedford Park, Lawrence Manor East | 0.0 | 0 |

Now we are going to add info of latitude and longitude and the closest venues to each Neighborhood and sort the results by cluster Labels. This new table would be the basis for analyzing new opportunities for opening a new Vegan restaurant in Toronto.

| | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|-----|--|-------------------------------------|---------------|----------------------|-----------------------|-----------------------------------|---------------|----------------|-------------------------|
| 0 | Agincourt | 0.00 | 0 | 43.794200 | -79.262029 | Panagio's Breakfast & Lunch | 43.792370 | -79.260203 | Breakfast Spot |
| 51 | Mimico NW, The Queensway West, South of Bloor,... | 0.00 | 0 | 43.628841 | -79.520999 | RONA | 43.629393 | -79.518320 | Hardware Store |
| 51 | Mimico NW, The Queensway West, South of Bloor,... | 0.00 | 0 | 43.628841 | -79.520999 | McDonald's | 43.630002 | -79.518198 | Fast Food Restaurant |
| 51 | Mimico NW, The Queensway West, South of Bloor,... | 0.00 | 0 | 43.628841 | -79.520999 | Jim & Maria's No Frills | 43.631152 | -79.518617 | Grocery Store |
| 51 | Mimico NW, The Queensway West, South of Bloor,... | 0.00 | 0 | 43.628841 | -79.520999 | Subway | 43.631659 | -79.519001 | Sandwich Place |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 64 | Richmond, Adelaide, King | 0.01 | 3 | 43.650571 | -79.384568 | Roots | 43.653613 | -79.380244 | Clothing Store |
| 64 | Richmond, Adelaide, King | 0.01 | 3 | 43.650571 | -79.384568 | Ted Baker | 43.652843 | -79.380325 | Clothing Store |
| 64 | Richmond, Adelaide, King | 0.01 | 3 | 43.650571 | -79.384568 | Starbucks | 43.649028 | -79.381593 | Coffee Shop |
| 64 | Richmond, Adelaide, King | 0.01 | 3 | 43.650571 | -79.384568 | Starbucks | 43.646731 | -79.383951 | Coffee Shop |
| 64 | Richmond, Adelaide, King | 0.01 | 3 | 43.650571 | -79.384568 | Starbucks | 43.650751 | -79.388047 | Coffee Shop |

2139 rows × 9 columns

3.1 Data analysis

Let's now start to analysis the data and the characteristics of the cluster that we got.

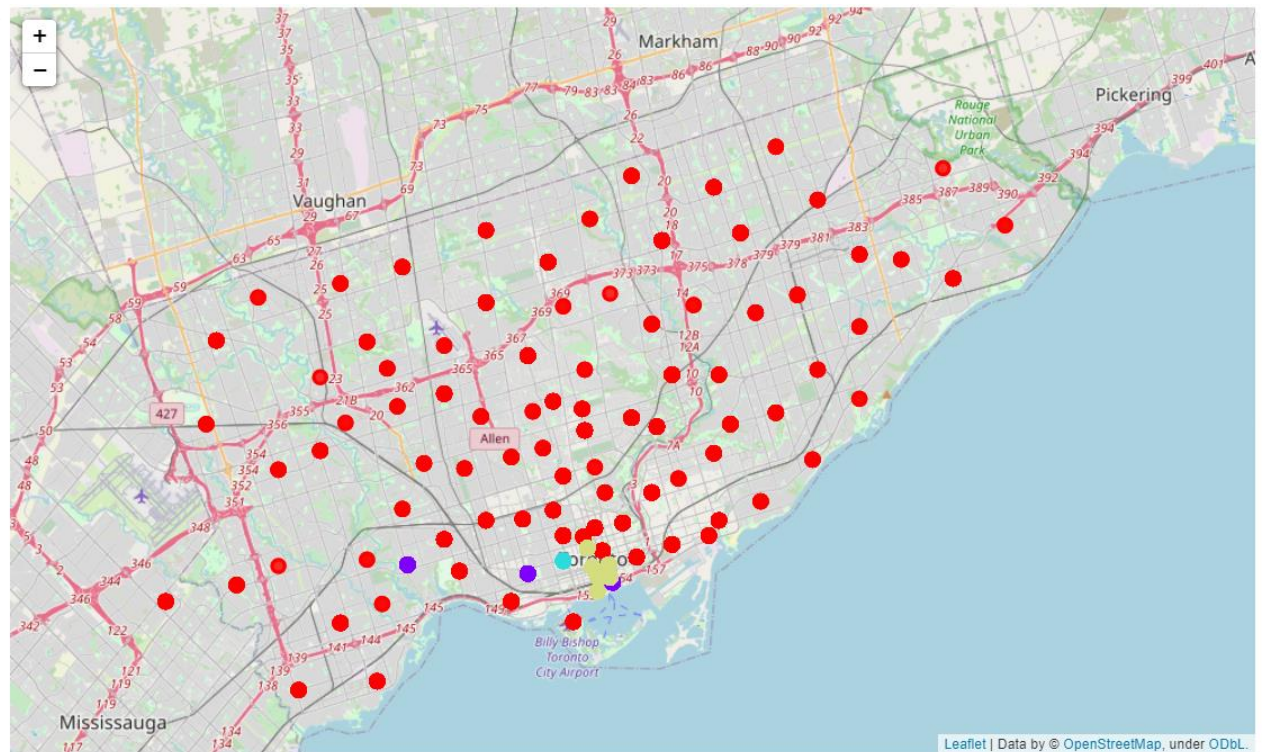
First of all to better visualize the different clusters and neighborhoods in them we will create a map using Folium Library in where each neighborhood will be colored based on their cluster label.

Cluster 0 — Red

Cluster 1 — Purple

Cluster 2 — Turquoise

Cluster 3 — Green Khaki

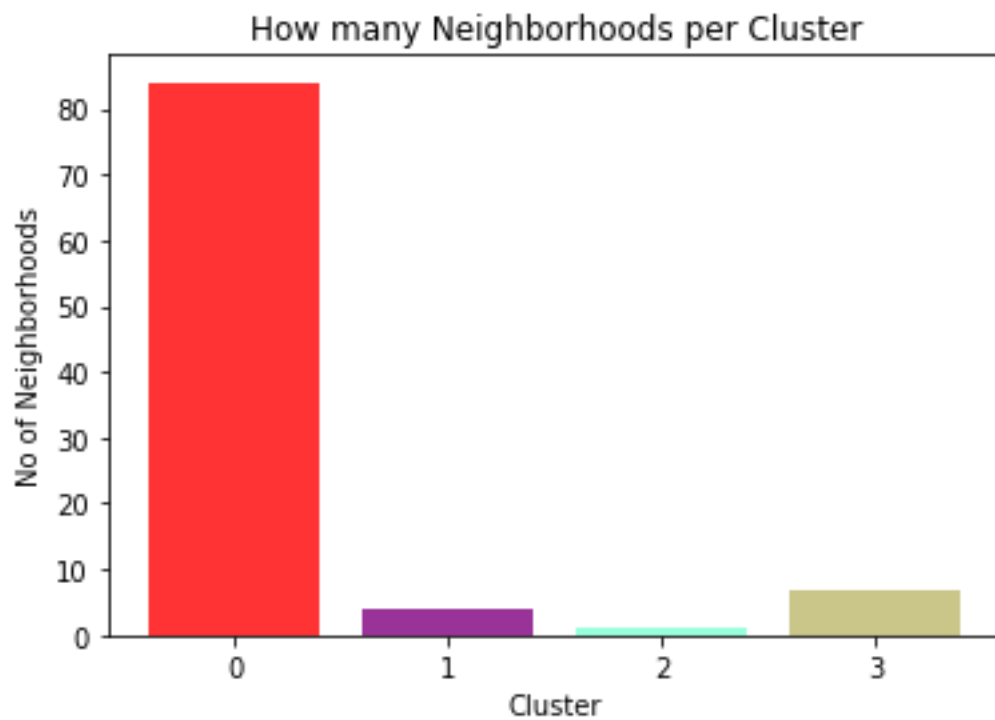


The map above shows the different clusters that had a similar mean frequency of Vegetarian/Vegan restaurants.

In this map we can clearly see that the number of neighborhoods in each cluster is quite different. Cluster 0 (red) is the one with more neighborhoods and geographically it is the more dispersed. Cluster 2 (turquoise) just have one neighborhood and cluster 3 (green khaki) have several neighborhoods but remarkably close one to the others. Cluster 1 (purple) has 4 neighborhoods and little dispersed.

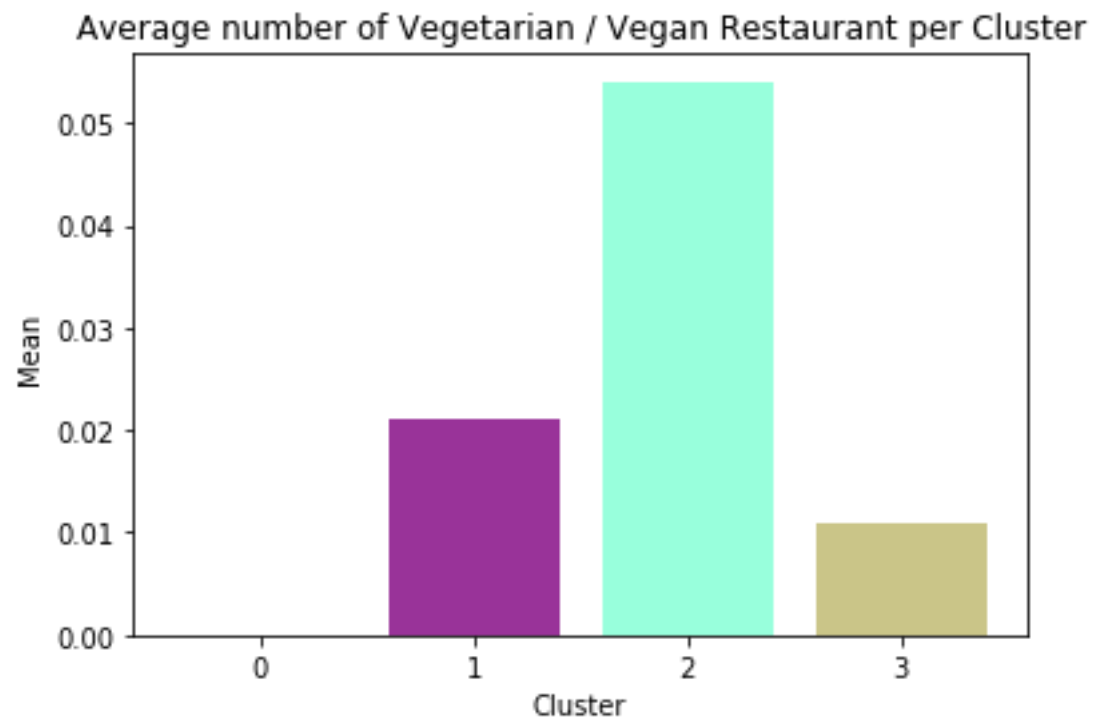
Before analyzing each cluster one by one let see the total amount of neighborhoods in each cluster and the average of Vegan/Vegetarian Restaurants in each one.

Using Matplotlib we create a bar graph where we can compare the number of Neighborhoods per Cluster.



We see that Cluster 0 has the highest number of neighborhoods (84) while cluster 2 has the lowest number (1).

Now let's compare the average Vegetarian/Vegan restaurant per cluster.



Cluster 0, being the one with the highest number of neighborhoods it has the lowest average of Vegan/Vegetarian Restaurants (0,00) while cluster 2 has the highest average (0,54054) but the lowest number of neighborhoods (1).

Now we will make an analysis of each cluster individually. To do this we will create a data frame with the borough of each neighborhood, and we will merge it with each cluster data frame.

CLUSTER 0

| Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|-----------------|-------------------------------|-------------------------------|---------------|----------------------|-----------------------|--------------------------------|---------------|----------------|-------------------|
| Central Toronto | Lawrence Park | 0.0 | 0 | 43.728020 | -79.388790 | TTC Bus #162 - Lawrence-Donway | 43.728026 | -79.382805 | Bus Line |
| Central Toronto | Lawrence Park | 0.0 | 0 | 43.728020 | -79.388790 | Zodiac Swim School | 43.728532 | -79.382860 | Swim School |
| Central Toronto | Lawrence Park | 0.0 | 0 | 43.728020 | -79.388790 | Lawrence Park Ravine | 43.726963 | -79.394382 | Park |
| Central Toronto | Davisville North | 0.0 | 0 | 43.712751 | -79.390197 | Sherwood Park | 43.716551 | -79.387776 | Park |
| Central Toronto | Davisville North | 0.0 | 0 | 43.712751 | -79.390197 | Summerhill Market North | 43.715499 | -79.392881 | Food & Drink Shop |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| York | Runnymede, The Junction North | 0.0 | 0 | 43.673185 | -79.487262 | High Park Brewery | 43.669903 | -79.483430 | Brewery |
| York | Runnymede, The Junction North | 0.0 | 0 | 43.673185 | -79.487262 | 195 Jane Rocket | 43.672335 | -79.492634 | Bus Line |
| York | Runnymede, The Junction North | 0.0 | 0 | 43.673185 | -79.487262 | Wonderfood | 43.672352 | -79.492571 | Convenience Store |
| York | Weston | 0.0 | 0 | 43.706876 | -79.518188 | Wallace C. Swanek Park | 43.708896 | -79.522648 | Park |
| York | Weston | 0.0 | 0 | 43.706876 | -79.518188 | Grattan Park | 43.706222 | -79.521705 | Park |

84 neighborhoods with 225 unique venue categories and nonvegan restaurants

9 yoga studios. Most of them (5) situated in boroughs inside Downtown Toronto and the rest in other boroughs (Central Toronto, East Toronto, and East York)

| Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|------------------|---|-------------------------------|---------------|----------------------|-----------------------|-----------------------|---------------|----------------|---------------|
| Central Toronto | North Toronto West, Lawrence Park | 0.0 | 0 | 43.715383 | -79.405678 | Barreworks | 43.714070 | -79.400109 | Yoga Studio |
| Downtown Toronto | Church and Wellesley | 0.0 | 0 | 43.665860 | -79.383160 | The Yoga Sanctuary | 43.661499 | -79.383636 | Yoga Studio |
| Downtown Toronto | Church and Wellesley | 0.0 | 0 | 43.665860 | -79.383160 | Bikram Yoga Yonge | 43.668205 | -79.385780 | Yoga Studio |
| Downtown Toronto | Regent Park, Harbourfront | 0.0 | 0 | 43.654260 | -79.360636 | The Yoga Lounge | 43.655515 | -79.364955 | Yoga Studio |
| Downtown Toronto | University of Toronto, Harbord | 0.0 | 0 | 43.662696 | -79.400049 | Sivananda Yoga Centre | 43.662754 | -79.402951 | Yoga Studio |
| Downtown Toronto | Queen's Park, Ontario Provincial Government | 0.0 | 0 | 43.662301 | -79.389494 | The Yoga Sanctuary | 43.661499 | -79.383636 | Yoga Studio |
| East Toronto | The Danforth West, Riverdale | 0.0 | 0 | 43.679557 | -79.352188 | Moksha Yoga Danforth | 43.677622 | -79.352116 | Yoga Studio |
| East Toronto | Studio District | 0.0 | 0 | 43.659526 | -79.340923 | Spirit Loft Yoga | 43.663548 | -79.341333 | Yoga Studio |
| East York | Thorncliffe Park | 0.0 | 0 | 43.705369 | -79.349372 | Bikram Yoga East York | 43.705450 | -79.351448 | Yoga Studio |

CLUSTER 1

| | Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|-----|------------------|--------------------|-------------------------------|---------------|----------------------|-----------------------|---------------------|---------------|----------------|---------------------------|
| 235 | West Toronto | Runnymede, Swansea | 0.028571 | 1 | 43.651571 | -79.484450 | The Coffee Bouquets | 43.648785 | -79.485940 | Coffee Shop |
| 218 | West Toronto | Runnymede, Swansea | 0.028571 | 1 | 43.651571 | -79.484450 | Heart | 43.650310 | -79.480125 | Dessert Shop |
| 216 | West Toronto | Runnymede, Swansea | 0.028571 | 1 | 43.651571 | -79.484450 | Cinelli | 43.649916 | -79.482146 | Salon / Barbershop |
| 215 | West Toronto | Runnymede, Swansea | 0.028571 | 1 | 43.651571 | -79.484450 | Max's Market | 43.650525 | -79.479145 | Gourmet Shop |
| 214 | West Toronto | Runnymede, Swansea | 0.028571 | 1 | 43.651571 | -79.484450 | Bloom Restaurant | 43.650307 | -79.479836 | Latin American Restaurant |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 34 | Downtown Toronto | Berczy Park | 0.018182 | 1 | 43.644771 | -79.373306 | Eggspectation | 43.646526 | -79.375134 | Breakfast Spot |

There are 4 neighborhoods with a total of 97 unique venue categories in this cluster.

We can find 5 vegan/vegetarian restaurant situated in 4 different neighborhoods.

| | Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|--|------------------|--------------------------------|-------------------------------|---------------|----------------------|-----------------------|----------------|---------------|----------------|-------------------------------|
| | Downtown Toronto | Berczy Park | 0.018182 | 1 | 43.644771 | -79.373306 | Fresh On Front | 43.647815 | -79.374453 | Vegetarian , Vegar Restaurant |
| | Downtown Toronto | Commerce Court, Victoria Hotel | 0.020000 | 1 | 43.648198 | -79.379817 | Fresh On Front | 43.647815 | -79.374453 | Vegetarian , Vegar Restaurant |
| | Downtown Toronto | Commerce Court, Victoria Hotel | 0.020000 | 1 | 43.648198 | -79.379817 | Rosalinda | 43.650252 | -79.385156 | Vegetarian , Vegar Restaurant |
| | West Toronto | Little Portugal, Trinity | 0.021739 | 1 | 43.647927 | -79.419750 | Veghed | 43.649224 | -79.422326 | Vegetarian , Vegar Restaurant |
| | West Toronto | Runnymede, Swansea | 0.028571 | 1 | 43.651571 | -79.484450 | Awai | 43.650412 | -79.478477 | Vegetarian , Vegar Restaurant |

We also find 2 yoga studios both situated in neighborhoods in where we also find a Vegan/Vegetarian Restaurant.

| | Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|--|--------------|--------------------------|-------------------------------|---------------|----------------------|-----------------------|----------------------------------|---------------|----------------|---------------|
| | West Toronto | Little Portugal, Trinity | 0.021739 | 1 | 43.647927 | -79.41975 | YogaSpace | 43.647607 | -79.420133 | Yoga Studi |
| | West Toronto | Runnymede, Swansea | 0.028571 | 1 | 43.651571 | -79.48445 | (The New) Moksha Yoga Bloor West | 43.648658 | -79.485242 | Yoga Studi |

CLUSTER 2

| Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|------------------|---|-------------------------------|---------------|----------------------|-----------------------|-------------------------|---------------|----------------|-------------------------|
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | FILM CAFE | 43.655109 | -79.402342 | Comfort Food Restaurant |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Saigon Lotus Restaurant | 43.654311 | -79.399225 | Vietnamese Restaurant |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Thirsty and Miserable | 43.654565 | -79.401583 | Beer Bar |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Meeplemart | 43.651628 | -79.397410 | Gaming Cafe |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Dumpling House | 43.653860 | -79.398558 | Dumpling Restaurant |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Pancho y Emiliano | 43.654472 | -79.401969 | Mexican Restaurant |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Trinity Common | 43.656590 | -79.402761 | Bar |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Independent City Market | 43.657337 | -79.401512 | Supermarket |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | A & C World | 43.657409 | -79.399847 | Gaming Cafe |

In this cluster we find only one neighborhood with a total of 49 unique venue categories inside.

There are 4 Vegan Restaurant, so it is the cluster with the highest average. We do not find any Yoga Studio.

| Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|------------------|---|-------------------------------|---------------|----------------------|-----------------------|------------------------------|---------------|----------------|-------------------------------|
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Hibiscus | 43.655454 | -79.402439 | Vegetarian / Vegan Restaurant |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Greens Vegetarian Restaurant | 43.652034 | -79.402382 | Vegetarian / Vegan Restaurant |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Urban Herbivore | 43.656193 | -79.402673 | Vegetarian / Vegan Restaurant |
| Downtown Toronto | Kensington Market, Chinatown, Grange Park | 0.054054 | 2 | 43.653206 | -79.400049 | Buddha's Vegetarian | 43.651904 | -79.403312 | Vegetarian / Vegan Restaurant |

CLUSTER 3

| Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|------------------|--|-------------------------------|---------------|----------------------|-----------------------|--------------------------------------|---------------|----------------|------------------------|
| Downtown Toronto | St. James Town | 0.011765 | 3 | 43.651494 | -79.375418 | Apple Eaton Centre | 43.652818 | -79.380617 | Electronic Store |
| Downtown Toronto | St. James Town | 0.011765 | 3 | 43.651494 | -79.375418 | Seafront Fish Market | 43.648479 | -79.371489 | Fish Market |
| Downtown Toronto | St. James Town | 0.011765 | 3 | 43.651494 | -79.375418 | Schnitzel Queen | 43.654239 | -79.370533 | Germans Restaurant |
| Downtown Toronto | St. James Town | 0.011765 | 3 | 43.651494 | -79.375418 | Buster's Sea Cove | 43.648495 | -79.371462 | Seafood Restaurant |
| Downtown Toronto | St. James Town | 0.011765 | 3 | 43.651494 | -79.375418 | Scheffler's Deli | 43.648643 | -79.371537 | Cheese Shop |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Downtown Toronto | First Canadian Place, Underground city | 0.010000 | 3 | 43.648429 | -79.382280 | DAVIDsTEA | 43.650547 | -79.383385 | Tea Room |
| Downtown Toronto | First Canadian Place, Underground city | 0.010000 | 3 | 43.648429 | -79.382280 | Dineen Coffee | 43.650497 | -79.378765 | Cafe |
| Downtown Toronto | First Canadian Place, Underground city | 0.010000 | 3 | 43.648429 | -79.382280 | John & Sons Oyster House | 43.650602 | -79.381555 | Seafood Restaurant |
| Downtown Toronto | First Canadian Place, Underground city | 0.010000 | 3 | 43.648429 | -79.382280 | Shangri-La Toronto | 43.649129 | -79.386557 | Hotel |
| Downtown Toronto | First Canadian Place, Underground city | 0.010000 | 3 | 43.648429 | -79.382280 | Kupfert & Kim (First Canadian Place) | 43.648547 | -79.381624 | Gluten-free Restaurant |

There are 7 neighborhoods in Cluster 3, and we find 145 unique venue categories. There are 7 Vegetarian/Vegan Restaurants all of them in neighborhoods inside Down Toronto and where we can also find Yoga Studios (2).

| Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|------------------|---|-------------------------------|---------------|----------------------|-----------------------|------------------|---------------|----------------|-------------------------------|
| Downtown Toronto | St. James Town | 0.011765 | 3 | 43.651494 | -79.375418 | Fresh On Front | 43.647815 | -79.374453 | Vegetarian / Vegan Restaurant |
| Downtown Toronto | Central Bay Street | 0.014706 | 3 | 43.657952 | -79.387383 | Vegetarian Haven | 43.656016 | -79.392758 | Vegetarian / Vegan Restaurant |
| Downtown Toronto | Richmond, Adelaide, King | 0.010000 | 3 | 43.650571 | -79.384568 | Rosalinda | 43.650252 | -79.385156 | Vegetarian / Vegan Restaurant |
| Downtown Toronto | Harbourfront East, Union Station, Toronto Islands | 0.010000 | 3 | 43.640816 | -79.381752 | Kupfert & Kim | 43.641179 | -79.378144 | Vegetarian / Vegan Restaurant |
| Downtown Toronto | Toronto Dominion Centre, Design Exchange | 0.010000 | 3 | 43.647177 | -79.381576 | Rosalinda | 43.650252 | -79.385156 | Vegetarian / Vegan Restaurant |
| Downtown Toronto | Stn A PO Boxes | 0.010417 | 3 | 43.646435 | -79.374846 | Fresh On Front | 43.647815 | -79.374453 | Vegetarian / Vegan Restaurant |
| Downtown Toronto | First Canadian Place, Underground city | 0.010000 | 3 | 43.648429 | -79.382280 | Rosalinda | 43.650252 | -79.385156 | Vegetarian / Vegan Restaurant |

| Borough | Neighborhood | Vegetarian / Vegan Restaurant | ClusterLabels | NeighborhoodLatitude | NeighborhoodLongitude | VenueName | VenueLatitude | VenueLongitude | VenueCategory |
|------------------|--------------------|-------------------------------|---------------|----------------------|-----------------------|--------------------|---------------|----------------|---------------|
| Downtown Toronto | Central Bay Street | 0.014706 | 3 | 43.657952 | -79.387383 | The Yoga Sanctuary | 43.661499 | -79.383636 | Yoga Studio |
| Downtown Toronto | Stn A PO Boxes | 0.010417 | 3 | 43.646435 | -79.374846 | Bikram Yoga Centre | 43.649214 | -79.375229 | Yoga Studio |

4.RESULT AND DISCUSSION

Cluster 0 is the one with the highest number of neighborhoods and different category venues but at the same time the only one with any Vegan/Vegetarian Restaurant therefore it has the lowest average of vegan restaurants. On the other hand, there are 9 Yoga Studios in Cluster 0 most of them concentrated in four neighborhoods inside Downtown Toronto.

It is in Cluster 2 where we find the highest average of Vegan/Vegetarian Restaurants (0.054), it has 4 but only 1 Neighborhood, Kensington.

Cluster 1 with 4 Neighborhood and 5 Vegan/Vegetarian Restaurant has the second highest average of Vegan/Vegetarian Restaurants and it has 2 Yoga Studios, both situated in Neighborhoods where you can also find a Vegan Restaurant.

Cluster 3 is the one with the third highest average of Vegan/Vegetarian Restaurant. It has a total of 7 each one situated in a different neighborhood but all inside Downtown Toronto. We can also find two yoga studios both situated in neighborhoods that also has a Vegan Restaurant.

According to this analysis our recommendation is to open a Vegan Restaurant in one of the 4 Neighborhoods inside **Downtown Toronto** and belonging to **Cluster 0**: Church and Wellesley, Regent Park/Harbourfront, University of Toronto/Harbord and Queen's Park Ontario/Provincial Government.

In any of them there are not another Vegan/ Vegetarian Restaurant so we have not direct competition and all of them have a Yoga Studio, even we can find 2 in the Church and Wellesley Neighborhood.

To give a more accurate recommendation among these 4 neighborhoods, we will analyze the results about which are the 10 most common Venues in each of them.

| | Neighborhoods | 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 |
|----|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|--------------------------|-----------------------|-----------------------|------------------------|
| 15 | Church and Wellesley | Coffee Shop | Gay Bar | Japanese Restaurant | Sushi Restaurant | Restaurant | Yoga Studio | Mediterranean Restaurant | Café | Pub | Hotel |
| 1 | df_regent=neighborhoods_venues_sorted[neighborhoods_venues_sorted['Neighborhoods']=='Regent Park, Harbourfront'] | | | | | | | | | | |
| 2 | df_regent | | | | | | | | | | |
| | Neighborhoods | 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 |
| 63 | Regent Park, Harbourfront | Coffee Shop | Bakery | Pub | Park | Breakfast Spot | Café | Theater | Distribution Center | Chocolate Shop | Mexican Restaurant |
| 1 | df_University=neighborhoods_venues_sorted[neighborhoods_venues_sorted['Neighborhoods']=='University of Toronto, Harbord'] | | | | | | | | | | |
| 2 | df_University | | | | | | | | | | |
| | Neighborhoods | 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 |
| 84 | University of Toronto, Harbord | Café | Bookstore | Sandwich Place | Bakery | Bar | Japanese Restaurant | Nightclub | Bank | Italian Restaurant | Beer Bar |
| 1 | df_Queens=neighborhoods_venues_sorted[neighborhoods_venues_sorted['Neighborhoods']=='Queen's Park, Ontario Provincial Government'] | | | | | | | | | | |
| 2 | df_Queens | | | | | | | | | | |
| | Neighborhoods | 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 |
| 62 | Queen's Park, Ontario Provincial Government | Coffee Shop | Yoga Studio | College Auditorium | Bar | Beer Bar | Smoothie Shop | Sandwich Place | Café | Restaurant | Chinese Restaurant |

According to the information in the data frame above we recommend opening the Vegan/Vegetarian Restaurant in **Church and Wellesley** or in **Queen's Park Ontario/Provincial Government**.

In both Neighborhoods there is a Yoga Studio as one of the most common venues and the type of client of Yoga studios are people normally open to trying and exploring vegetarian or vegan restaurants even if they do not follow a strictly vegan or vegetarian diet.

The other 10 most common venues are almost all restaurant or café which tells us that there are people looking for places to eat to whom we can give a different alternative to the restaurants that already exist.

The analysis does not take into consideration other factors that would affect the success of a new restaurant which are directly related to the location such as visibility or accessibility so final decision between this two neighborhoods could depend also on the opportunity to find the best suitable local to rent.

5. CONCLUSION

Veganism has emerged as one of the top food and lifestyle trends in the past few years. Moreover, people, especially in cosmopolitan cities like Toronto, are more open to trying and exploring vegetarian or vegan restaurants.

The purpose of this project was to find the best location in Toronto to open a Vegan/Vegetarian Restaurant.

We got a great measure of data from Wikipedia which we scraped with the BeautifulSoup Web scraping Library. We utilized numerous Python libraries to fetch the information and process all the data into clean data frames. We used Foursquare API to investigate the settings in Neighborhoods of Toronto. We also visualized utilizing different plots present in seaborn and Matplotlib libraries.

Applying the K-Means clustering algorithm, we got different clusters of Neighborhoods in Toronto according to the average of Vegan/Vegetarian Restaurants. After having analyzed the clusters one by one we chose the cluster with fewer Vegan/Restaurants on average, therefore with less competitors. Moreover, having assumed that the type of clients in a yoga studio can most likely be a potential customer of a vegan restaurant, it should be noted that this cluster is the one with the highest number of Yoga Studios. Taking all that in account we got the most 4 suitable neighborhoods within the cluster. We analyzed each one according to the most common venues in them to be able to give the best recommendation to our stakeholders.

The final decision on optimal Vegan/Vegetarian location will be given to the stakeholders. They will be also encouraged to take into consideration additional factors such as accessibility or locals rent opportunities.