Coursera IBM Data Science Capstone Project : Opening a new Indian Restaurant in Toronto

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1.Introduction
1.1 Background

In the city of Toronto, locating the most suitable location for opening the Indian restaurant is one of the challenging problem. In this Capstone Project , I am creating a hypothetical scenario for a concept of any people who wants to explore opening an authentic Indian restaurant in Toronto area. The idea behind this project is that there may not be enough Indian restaurants in Toronto and it might present a great opportunity for this entrepreneur who is based in Canada. This entrepreneur is thinking of opening this restaurant in locations where Asian food is popular (aka many Asian restaurants in the neighborhood). With the purpose in mind, finding the location to open such a restaurant is one of the most important decisions for this entrepreneur and I am designing this project to help him find the most suitable location.

1.2 Business Problem
The objective of this capstone project is to find the most suitable location for the entrepreneur to open a new Indian restaurant in Toronto, Canada. By using data science methods and machine learning methods such as clustering, this project aims to provide solutions to answer the business question: In Toronto, if an entrepreneur wants to open a Indian restaurant, where should they consider opening it?

1.3 Target Audience
The entrepreneur who wants to find the location to open authentic Indian restaurant

2.Data

To solve this problem, I will need below data :
● List of neighborhoods in Toronto, Canada.

● Latitude and Longitude of these neighborhoods.

● Venue data related to Asian restaurants. This will help us find the neighborhoods that are most suitable to open a Indian restaurant.

3. Methodology :

First, I need to get the list of neighborhoods in Toronto, Canada. This is possible by extracting the list of neighborhoods from wikipedia page ("https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M") I did the web scraping by utilizing pandas html table scraping method as it is easier and more convenient to pull tabular data directly from a web page into dataframe.

However, it is only a list of neighborhood names and postal codes. I will need to get their coordinates to utilize Foursquare to pull the list of venues near these neighborhoods. To get the coordinates, I tried using Geocoder package but it was not working so I used the csv file provided by IBM team to match the coordinates of Toronto neighborhoods. After gathering all these coordinates, I visualized the map of Toronto using Folium package to verify whether these are correct coordinates.

Next, I use Foursquare API to pull the list of top 100 venues within 500 meters radius. I have created a Foursquare developer account in order to obtain account ID and API key to pull the data. From Foursquare, I am able to pull the names, categories, latitude and longitude of the venues. With this data, I can also check how many unique categories that I can get from these venues. Then, I analyze each neighborhood by grouping the rows by neighborhood and taking the mean on the frequency of occurrence of each venue category. This is to prepare clustering to be done later.

Here, I made a justification to specifically look for "Indian restaurants". Previously, when I ran the model, I was looking for "Asian restaurants" but there are very few results (maybe due to Foursquare categorization) so I looked for the Indian restaurant.Lastly, I performed the clustering method by using k-means clustering. K-means clustering algorithm identifies k number of centeriods, and then allocates every data point to the nearest cluster, while keeping the centroids as small as possible. It is one of the simplest and popular unsupervised machine learning algorithms and it is highly suited for this project as well. I have clustered the neighborhoods in Toronto into 3 clusters based on their frequency of occurrence for "Indian food". Based on the results (the concentration of clusters), I will be able to recommend the ideal location to open the restauranant.

4. Results :

Clusters
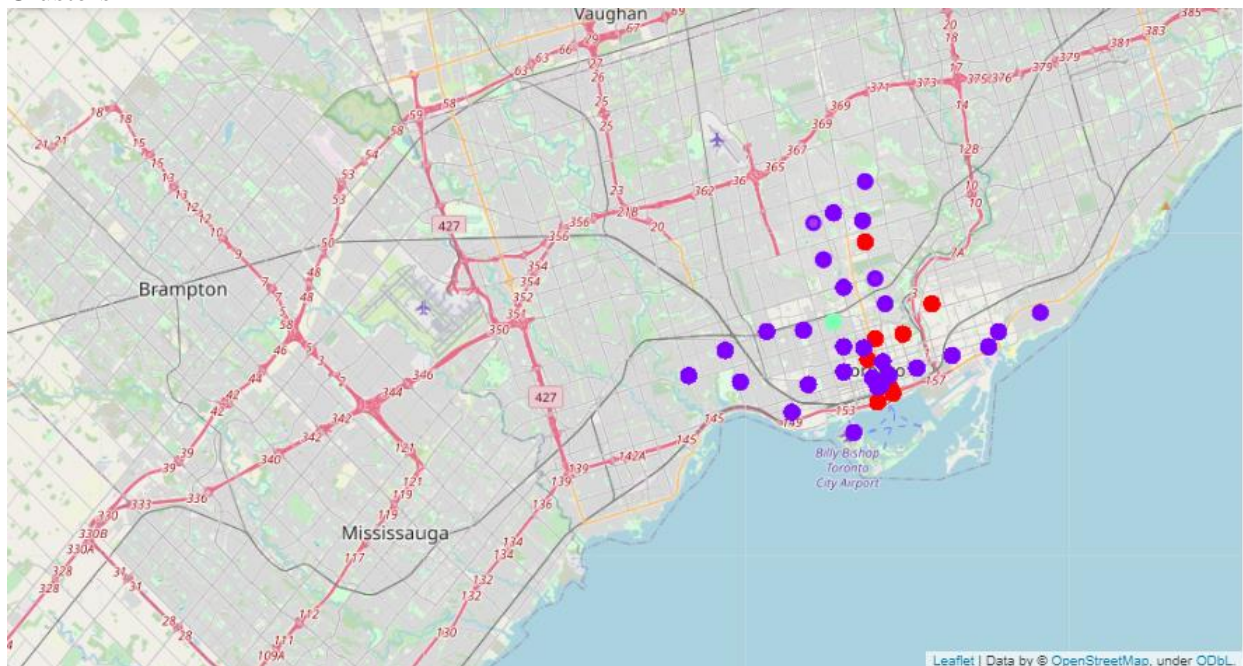
The results from k-means clustering show that we can categorize Toronto neighborhoods into 3 clusters based on how many Indian restaurants are in each neighborhood:
- Cluster 0: Neighborhoods with little or no Indian restaurants
- Cluster 1: Neighborhoods with no Indian restaurants
- Cluster 2: Neighborhoods with high number of Indian restaurants

The results are visualized in the above map with Cluster 0 in red color, Cluster 1 in green color and Cluster 2 in purple color.

5.Recommendations :

Most of Indian restaurants are in Cluster 0 which is around The Annex, North Midtown, Yorkville and lowest (close to zero) in Cluster 1 areas which are Runnymede, Swansea . Therefore, this project recommends the entrepreneur to open an authentic Indian restaurant in these locations with little to no competition. Nonetheless, if the food is authentic, affordable and good taste, I am confident that it will have great following everywhere.

6.Limitations and Suggestions for Future Research :

In this project, I only take into consideration of one factor: the occurrence / existence of Indian restaurants in each neighborhood. There are many factors that can be taken into consideration such as population density, income of residents, rent that could influence the decision to open a new restaurant. However, to put all these data into this project is not possible to do within a short time frame for this capstone project. Future research can take into consideration of these factors. In addition, I am relying on the existence of Indian restaurants only for this project but future research can take into consideration of other variables such as existence of Asian restaurants, Asian population level in each neighborhood etc.

7.Conclusion :

In this project, we have gone through the process of identifying the business problem, specifying the data required, extracting and preparing the data, performing the machine learning by utilizing k-means clustering and providing recommendation to the stakeholder.

8.References :
List of neighborhoods in Toronto:
https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M
Foursquare Developer Documentation: https://developer.foursquare.com/docs