Capstone Project - The Battle of Neighborhoods (week 2)

(Best Neighborhoods to settle in, according to some criteria)

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A - Introduction: Business Problem

It appears generally difficult for people to choose the neighborhood where they want to settle in. Mostly when they are not natives of the city in which they intend to stay.

Indeed, Mr. Chris has just got his Canadian's PR card. He is coming from Cameroon and wants to settle in Toronto with his wife and their 3 years old child. Mr. Chris needs us to make some recommendations in order to help him choose the best neighborhood.

Mr. Chris is a junior Data Scientist looking to graduate from one of the universities in Toronto. He would like mostly to find a neighborhood not far of garden school for his child.

Nowadays, there are some great tools that we can use to effectively overcome such a problem. In our case, we are going to use a machine learning tool known as "Segmentation and Clustering", combined with the "Foursquare location data".

B - Data Section: Data understanding

Data Sources

We are going to use **Toronto dataset** scraped from the web. Here is the link: ('https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M'). This table is consisted of 3 columns: postcodes, boroughs and neighborhoods.

We will also get **Toronto's Postcode location data** by downloading from the web. Here is the link: (http://download.geonames.org/export/zip/). This geospatial table is consisted of 4 columns: postcodes, boroughs, latitudes and longitudes.

By Christian

Data Collection
By using the **BeautifulSoup package** for web scraping, we will pull out informations of Postal code, boroughs and neighborhoods, from the table scraped on the web.

By using the **Foursquare API**, we will obtain location data and explore venues around.

The borough and neighborhood table joined with location data, present the latitude and the longitude of each neighborhood.

The exploration of venues presents venues near of the neighborhood of Toronto. We will use it to filter gardens, bus station, and medical centers as well. Now we are ready to prepare the data for the modelling section. Before that let's look at the methodology that we are going to use.

C - Methodology Section

1 - Data wrangling

a – Exploration

We start with the installation of useful packages

- **BeautifulSoup4**: for web scraping
- **xlrd**: for Excel files reading

We import libraries that we are going to use :

- numpy,
- json,
- requests,
- matplotlib,
- folium
- pandas,
- Nominatim from geopy,
- json_normalize,
- kmeans from sklearn,
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Then we scrape the table boroughs and neighborhoods from the web

- Scrape the table from the web by using BeautifulSoup4
- Remove lines with column Borough equals "Not assigned"
- Transform Not assigned neighborhood such a way to become the same as Borough

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	Postcode	Borough	Neighbourhood
2	M3A	North York	Parkwoods
3	M4A	North York	Victoria Village
4	M5A	Downtown Toronto	Harbourfront
5	M6A	North York	Lawrence Heights
6	M6A	North York	Lawrence Manor

b - Geospatial data

Find the latitude and longitude of each Postcode (Boroughs), from the table 'Toronto postcode location data'.
Merge and display the neighborhood's data:

	Postcode	Borough	Neighbourhood	Latitude	Longitude
0	M3A	North York	Parkwoods	43.7545	-79.3300
1	M4A	North York	Victoria Village	43.7276	-79.3148
2	M5A	Downtown Toronto	Harbourfront	43.6555	-79.3626
3	M6A	North York	Lawrence Heights	43.7223	-79.4504
4	M6A	North York	Lawrence Manor	43.7223	-79.4504

c - Explore Neighborhoods in Toronto

Define our Foursquare ID, Foursquare Secret and Foursquare version
Get the top 100 venues that are in Toronto within a radius of 1000 meters. This is for a specific search_query = 'Parkwoods'

Get the result and convert it into a json file

Create a function that extracts the category of the venue

Then, let's create a function to repeat the same process to all the neighborhoods in Manhattan.

Now write the code to run the above function on each neighborhood and create a new dataframe called Toronto_venues.

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	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Parkwoods	43.7545	-79.3300	Brookbanks Park	43.751976	-79.332140	Park
1	Parkwoods	43.7545	-79.3300	GreenWin pool	43.756232	-79.333842	Pool
2	Parkwoods	43.7545	-79.3300	Variety Store	43.751974	-79.333114	Food & Drink Shop
3	Victoria Village	43.7276	-79.3148	Victoria Village Arena	43.723481	-79.315635	Hockey Arena
4	Victoria Village	43.7276	-79.3148	Tim Hortons	43.725517	-79.313103	Coffee Shop

Filter categories related to Bus station/stop, Metro station, Medical center, Garden Center and Pharmacy

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	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
1	Parkwoods	43.7545	-79.3300	TTC stop - 44 Valley Woods	43.755402	-79.333741	Bus Stop
51	Lawrence Heights	43.7223	-79.4504	Shoppers Drug Mart	43.724775	-79.455380	Pharmacy
99	Lawrence Heights	43.7223	-79.4504	Yorkdale Subway Station	43.725293	-79.447822	Metro Station
124	Lawrence Manor	43.7223	-79.4504	Shoppers Drug Mart	43.724775	-79.455380	Pharmacy
172	Lawrence Manor	43.7223	-79.4504	Yorkdale Subway Station	43.725293	-79.447822	Metro Station

Let's group rows by neighborhood and by taking the mean of the frequency of occurrence of each category
Create a dataframe that contents neighborhoods with their 7th common venues among the categories we 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
0	Agincourt North	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
1	Albion Gardens	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
2	Alderwood	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
3	Beaumond Heights	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
4	Bedford Park	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
5	Bloordale Gardens	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
6	Cabbagetown	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
7	Church and Wellesley	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
8	Clairlea	Bus Line	Metro Station	Bus Station	Pharmacy	Medical Center	Garden Center	Garden

2 – Clustering

Firstly, we set the number of clusters to 5.
Then we run the clustering model with the above data.
We add the cluster label to each row.

	Postcode	Borough	Neighborhood	Latitude	Longitude	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
3	M6A	North York	Lawrence Heights	43.7223	-79.4504	4	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
4	M6A	North York	Lawrence Manor	43.7223	-79.4504	4	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
5	M7A	Downtown Toronto	Queen's Park	43.6641	-79.3889	0	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
6	M9A	Queen's Park	Queen's Park	43.6662	-79.5282	0	Pharmacy	Metro Station	Medical Center	Garden Center	Garden	Bus Station	Bus Line
10	M4B	East York	Woodbine Gardens	43.7063	-79.3094	2	Pharmacy	Bus Line	Metro Station	Medical Center	Garden Center	Garden	Bus Station

Finally, we create a map and analyze each cluster (cluster N°0 to N°4).

By Christian

D - Results section

This is what we can observe and leverage from the result of the clustering: We highlight venues categories which are most relevant according to the cluster. Note that we didn't consider the pharmacy in this approach, due to his predominance in all the neighborhoods.

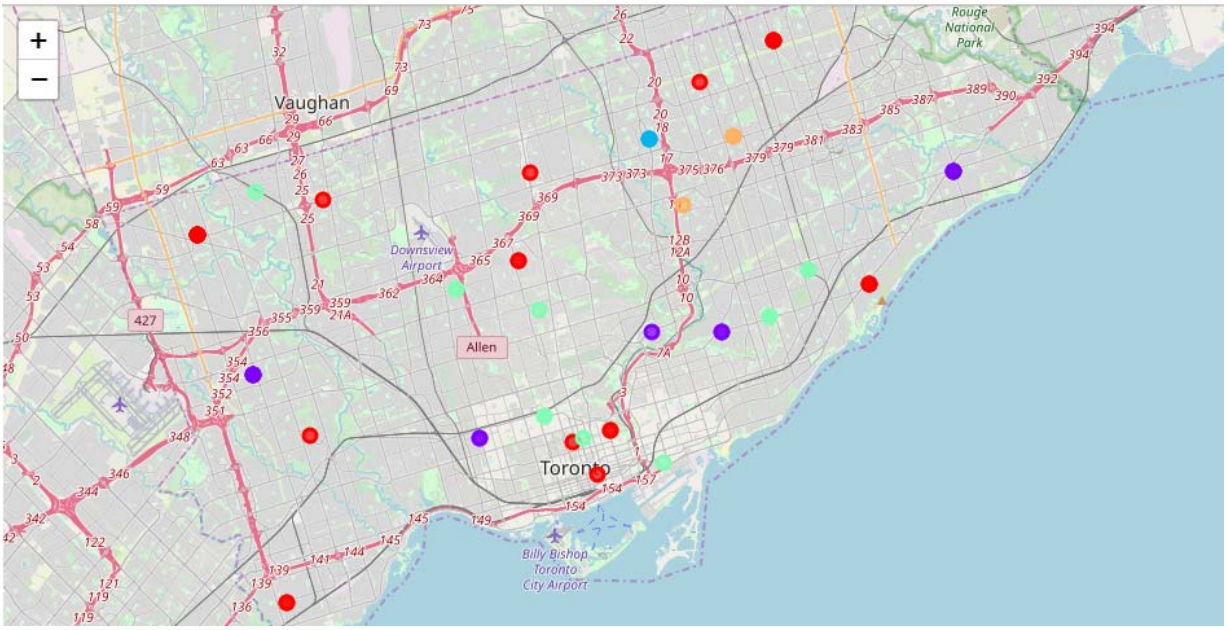
Cluster N°0 (red): Pharmacy, **Metro Station**, Medical Center, Garden Center

Cluster N°1 (violet): Pharmacy / **Garden Center**, Metro Station, Medical Center

Cluster N°2 (blue): Bus line / Pharmacy, Medical Center / Metro Station

Cluster N°3 (green): Pharmacy, **Metro Station**, Medical Center, Garden Center

Cluster N°4 (orange): Pharmacy, **Metro Station**, Medical Center, Garden Center



E - Discussion section

Before clustering, we filtered the venues such a way to have a list of important neighborhoods which are closed to pharmacy, Garden center, bus station/line, and metro station. At that stage, it was already awesome. M. Chris can settle with his family in any 100 neighborhoods selected. But there is an additional effort that we can make to help him more again. We used the tool named "Clustering". This tool consists of selecting the most relevant neighborhood among those which had been already selected.

By Christian

The exam of the clustering above can allow us to give some relevant recommendation to M. Chris, according to his priorities.

Assuming that he would like mostly to be nearest of a garden center in order to easily lead his child to school, we recommend all the neighborhoods in:

- **Cluster N°1:** East and Central Toronto, around Yorkville and Studio District

In another hand, if he would like to be nearest of a Bus line in order to make easiest his movement:

- **Cluster N°2:** Mostly in Scarborough

For cases more generals, he can choose:

- **Cluster N°3 or 4:** Others neighborhoods

F - Conclusion section

According to all above, we can recommend to M. Chris to settle down in cluster N° 1, around **Yorkville** and **Studio District**. Due to the proximity in first with a garden center, then with metro station.