

# Comparison of the similarity between Montreal and Paris

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## 1 Introduction

Montreal, with a population of 1.7 million, is the largest city of the Canadian province of Quebec. With more than 60% of the population being Francophone, Montreal is the second largest primarily French-speaking city in the world, after Paris. As the capital of France, Paris is also the most populous city with an official estimated population of 2.1 million. Paris and Montreal can be considered as two major centers of art, finance, science, and culture in western Europe and north America, respectively. Besides, Montreal is specially related to Paris because it has been profoundly influenced by the french and European culture in history.

Therefore, we are curious about finding the similarity of these two cities in terms of culture, business and life styles. To this end, we will derive the life patterns of Montreal and Paris by investigating their location and venue information of the historical districts, restaurants, cultural centers as well as commercial areas. The results of this report could be beneficial to intercontinental investors, overseas immigrants, and culture industry.

## 2 Data Sources

The sources of data in the project are listed as follows:

- I used **Foursquare API** to get the most common venues of given neighborhoods of Montreal and Paris.
- For the Paris neighborhood or arrondissements data, a **Wikipedia page** [1] exists with all the information we need. I used the beautifulsoup Python package to scrape the Wikipedia page and wrangle the data, clean it, and then read it into a pandas dataframe.
- For the Montreal neighborhood data, a **Wikipedia page** [2] exists with all postal code and neighborhood names. I scraped the Wikipedia page, clean it, and then read it into a pandas dataframe.

- I used **Google Maps Geocoding API** to get the latitude and the longitude coordinates of each neighborhoods in Montreal and Paris.

### 3 Methodology

#### 3.1 Data Preparation

In this stage, I used the Python **Beautifulsoup** package to scrape the neighbourhoods data of Paris and Montreal from Wikipedia page, respectively. The raw information of Paris contains: *Postal Codes, Arrondissements and Neighbourhoods*, where arrondissements are the special categorization of neighbourhoods of Paris. There are 20 arrondissements in Paris and the dataframe of the first five rows is as follows:

	<b>PostalCode</b>	<b>Arrondissements</b>	<b>Neighbourhood</b>
<b>0</b>	75001	1st (Ie) R	Louvre
<b>1</b>	75002	2nd (Ile) R	Bourse
<b>2</b>	75003	3rd (IIIe) R	Temple
<b>3</b>	75004	4th (IVe) R	Hôtel-de-Ville
<b>4</b>	75005	5th (Ve) L	Panthéon
<b>5</b>	75006	6th (VIe) L	Luxembourg

Figure 1: Dataframe of Paris neighbourhoods.

The raw data of Montreal neighbourhoods contains: *Postal Codes and Neighbourhoods*. I eliminate the data that are not assigned a postal code or cannot find the correct coordinates. Finally, there are 120 neighbourhoods and the dataframe contained the fist five rows is shown as following:

	<b>PostalCode</b>	<b>Neighbourhood</b>
<b>0</b>	H1A	Pointe-aux-Trembles
<b>1</b>	H2A	Saint-Michel, East
<b>2</b>	H3A	Downtown Montreal, North
<b>3</b>	H4A	Notre-Dame-de-Grâce, Northeast
<b>4</b>	H5A	Place Bonaventure
<b>5</b>	H7A	Duvernay-Est

Figure 2: Dataframe of Montreal neighbourhoods.

### 3.2 Neighbourhoods Coordinates

Knowing the exact name and postal code of all the neighbourhoods, I used the Python **Geocoder** library to automatically retrieve the latitude and longitude for each neighbourhoods. Joined the latitude and longitude information to the neighbourhoods dataframe as illustrated in the following two figures:

	PostalCode	Arrondissements	Neighbourhood	Latitude	Longitude
0	75001	1st (Ie) R	Louvre	48.861147	2.338028
1	75002	2nd (IIe) R	Bourse	48.867687	2.343122
2	75003	3rd (IIIe) R	Temple	48.862683	2.358681
3	75004	4th (IVe) R	Hôtel-de-Ville	48.856426	2.352528
4	75005	5th (Ve) L	Panthéon	48.846191	2.346079
5	75006	6th (VIe) L	Luxembourg	48.849392	2.332260

Figure 3: Dataframe of Paris neighbourhoods with coordinates.

	index	PostalCode	Neighbourhood	Latitude	Longitude
0	0	H1A	Pointe-aux-Trembles	45.690414	-73.490689
1	1	H2A	Saint-Michel, East	45.559813	-73.599942
2	2	H3A	Downtown Montreal, North	45.499788	-73.571224
3	3	H4A	Notre-Dame-de-Grâce, Northeast	45.467967	-73.628922
4	4	H5A	Place Bonaventure	45.499583	-73.564917
5	5	H7A	Duvernay-Est	45.596601	-73.659459

Figure 4: Dataframe of Montreal neighbourhoods with coordinates.

### 3.3 Geographic Visualization

I used python **Folium** library to visualize geographic details of Paris and Montreal and its neighbourhoods and I created a map of these two cities with neighbourhoods superimposed on top. I used latitude and longitude values to get the visual as below:

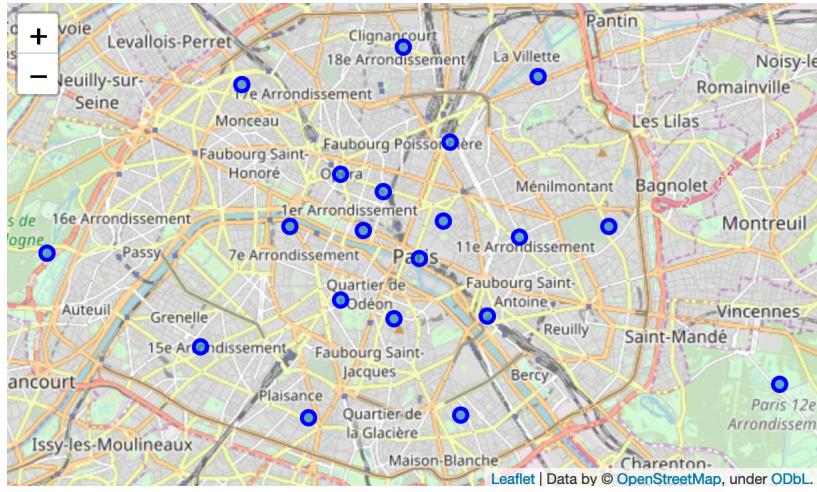


Figure 5: Geographic illustration of Paris neighbourhoods.

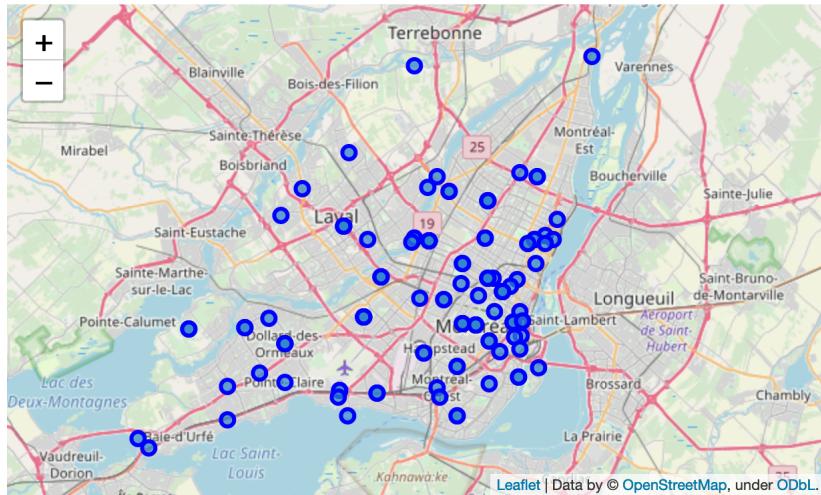


Figure 6: Geographic illustration of Montreal neighbourhoods.

### 3.4 Explore the Neighbourhoods

I utilized the **Foursquare API** to explore the neighbourhoods of Paris and Montreal. Consider the different geographic scales between Paris and Montreal. I designed the limit as 100 venues and the radius 500 meters for each neighbourhood of Paris from their given latitude and longitude information. As for Montreal, I set up the limit of 100 venues in the radius of 5000 meters for a given neighbourhood.

The dataframe for the venue data contains: *Venue*, *Venue Category*, *Venue Latitude* and *Venue Longitude*. The following figures show the merged dataframe of neighbourhoods and venues information of Paris and Montreal.

	Neighbourhood	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Category	Venue Latitude	Venue Longitude
0	Louvre	48.861147	2.338028	Cour Carrée du Louvre	Pedestrian Plaza	48.860360	2.338543
1	Louvre	48.861147	2.338028	Musée du Louvre	Art Museum	48.860847	2.336440
2	Louvre	48.861147	2.338028	La Vénus de Milo (Vénus de Milo)	Exhibit	48.859943	2.337234
3	Louvre	48.861147	2.338028	Place du Palais Royal	Plaza	48.862523	2.336688
4	Louvre	48.861147	2.338028	Le Fumoir	Cocktail Bar	48.860341	2.340647

Figure 7: Venue information for Paris neighbourhoods.

	Neighbourhood	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Category	Venue Latitude	Venue Longitude
0	Pointe-aux-Trembles	45.690414	-73.490689	Dairy Queen	Fast Food Restaurant	45.696294	-73.491945
1	Pointe-aux-Trembles	45.690414	-73.490689	Parc-nature de la Pointe-aux-Prairies	Park	45.678834	-73.501162
2	Pointe-aux-Trembles	45.690414	-73.490689	Club de Golf de l'île de Montréal	Golf Course	45.685743	-73.511631
3	Pointe-aux-Trembles	45.690414	-73.490689	SAQ	Liquor Store	45.712659	-73.512430
4	Pointe-aux-Trembles	45.690414	-73.490689	Bulk Barn	Food & Drink Shop	45.718219	-73.504171

Figure 8: Venue information for Montreal neighbourhoods.

In total, there are 1307 venues in Paris with 215 unique venue categories. Besides, there are 11635 venues in Montreal with 224 unique venue categories. The difference in the amount of venues returned is caused by the wide area of Montreal and its large number of neighbourhoods. Among all the venue categories, the following two dataframes show the top 10 popular venue categories in Paris and Montreal.

	AllNeighbourhoods	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	Batignolles-Monceau	French Restaurant	Japanese Restaurant	Hotel	Italian Restaurant	Bakery	Restaurant	Bar	Bistro	Outdoor Sculpture	Diner
1	Bourse	French Restaurant	Wine Bar	Cocktail Bar	Salad Place	Bistro	Hotel	Thai Restaurant	Bar	Burger Joint	Bakery
2	Butte-Montmartre	French Restaurant	Bar	Italian Restaurant	Pizza Place	Vietnamese Restaurant	Coffee Shop	Convenience Store	Café	Theater	Restaurant
3	Buttes-Chaumont	Bar	French Restaurant	Restaurant	Hotel	Beer Bar	Italian Restaurant	Bistro	Supermarket	Café	Seafood Restaurant
4	Entrepôt	French Restaurant	Bistro	Hotel	Coffee Shop	Indian Restaurant	Café	Pizza Place	Japanese Restaurant	Restaurant	Breakfast Spot

Figure 9: Top 10 venue categories in Paris.

	AllNeighbourhoods	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	Laval-sur-le-Lac	Coffee Shop	Restaurant	Italian Restaurant	Fast Food Restaurant	Breakfast Spot	Grocery Store	Bakery	Sushi Restaurant	Food & Drink Shop	Park
1	Ahuntsic, Central	Café	Bakery	Park	Italian Restaurant	Breakfast Spot	Restaurant	Liquor Store	French Restaurant	Cheese Shop	Boutique
2	Ahuntsic, East	Café	Bakery	Park	Italian Restaurant	Breakfast Spot	Restaurant	Liquor Store	French Restaurant	Cheese Shop	Boutique
3	Ahuntsic, North	Café	Bakery	Park	Italian Restaurant	Breakfast Spot	Restaurant	Liquor Store	French Restaurant	Cheese Shop	Boutique
4	Ahuntsic, Southeast	Café	Bakery	Park	Italian Restaurant	Breakfast Spot	Restaurant	Liquor Store	French Restaurant	Cheese Shop	Boutique

Figure 10: Top 10 venue categories in Montreal.

### 3.5 Neighbourhood Clustering

According to the popular common venues in each city, I used **K-means clustering** method to cluster neighbourhoods based on the characteristic of their common venues. K-means clustering is an unsupervised learning method and we first need to draw the elbow curve to set up the optimum number of clusters K. To this end, we segmented the neighbourhoods of Paris and Montreal into 1, 2, ..., 12 clusters. The elbow curves are shown below.

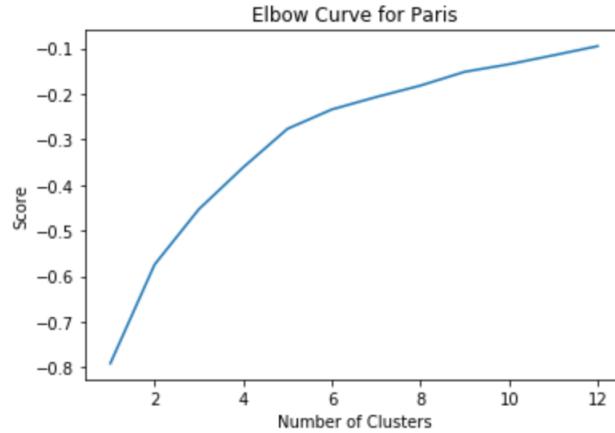


Figure 11: Elbow curve for Paris.

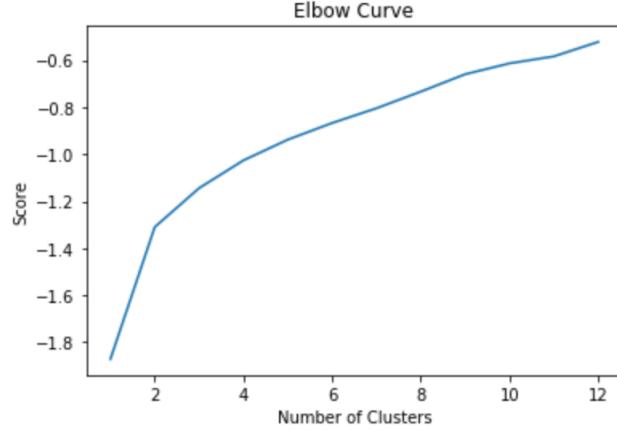


Figure 12: Elbow curve for Montreal.

From the elbow curves, the optimum number of clusters is indicated to be 5 for Paris and 2 for Montreal, since another cluster doesn't give much better modeling of the data. The following are merged dataframes of cluster labels for each neighbourhood of Paris and Montreal.

	PostalCode	Arrondissements	Neighbourhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	75001	1st (Ie) R	Louvre	48.861147	2.338028	2	French Restaurant	Café	Hotel	Coffee Shop	Plaza
1	75002	2nd (IIe) R	Bourse	48.867687	2.343122	2	French Restaurant	Wine Bar	Cocktail Bar	Salad Place	Bistro
2	75003	3rd (IIIe) R	Temple	48.862683	2.358681	2	French Restaurant	Japanese Restaurant	Restaurant	Burger Joint	Italian Restaurant
3	75004	4th (IVe) R	Hôtel-de-Ville	48.856426	2.352528	2	French Restaurant	Ice Cream Shop	Wine Bar	Plaza	Cosmetics Shop
4	75005	5th (Ve) L	Panthéon	48.846191	2.346079	2	French Restaurant	Hotel	Bar	Italian Restaurant	Indie Movie Theater

Figure 13: Cluster labels for neighbourhoods in Paris.

	index	PostalCode	Neighbourhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	0	H1A	Pointe-aux-Trembles	45.690414	-73.490689	0	Pharmacy	Coffee Shop	Restaurant	Italian Restaurant	Grocery Store
1	1	H2A	Saint-Michel, East	45.559813	-73.599942	1	Café	Park	Breakfast Spot	Italian Restaurant	Bakery
2	2	H3A	Downtown Montreal, North	45.499788	-73.571224	1	Café	Hotel	French Restaurant	Cocktail Bar	Restaurant
3	3	H4A	Notre-Dame-de-Grâce, Northeast	45.467967	-73.628922	1	Park	Café	Coffee Shop	Gym	Bakery
4	4	H5A	Place Bonaventure	45.499583	-73.564917	1	Café	Hotel	French Restaurant	Cocktail Bar	Portuguese Restaurant

Figure 14: Cluster labels for neighbourhoods in Montreal.

## 4 Results

We created **Bar Charts** to show the venue distribution of each cluster in Paris and Montreal. Besides, we used **Folium** library to generate clustered maps of Paris and Montreal indicated by different labels and colors.

### 4.1 Clusters of Paris

To conclude the venues categories in each cluster, we create **Bar Charts** for each cluster using the number of its 1st, 2nd and 3rd most common venues. First, we shown the venue bar charts for each cluster in Paris as below.

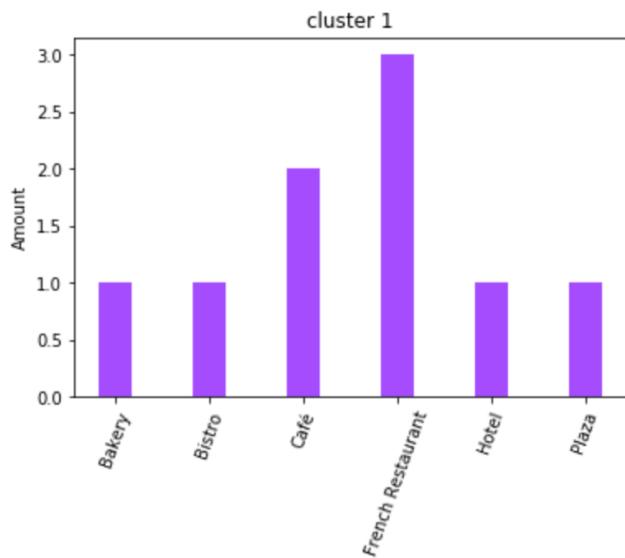


Figure 15: Top 3 most common venues in cluster 1 of Paris.

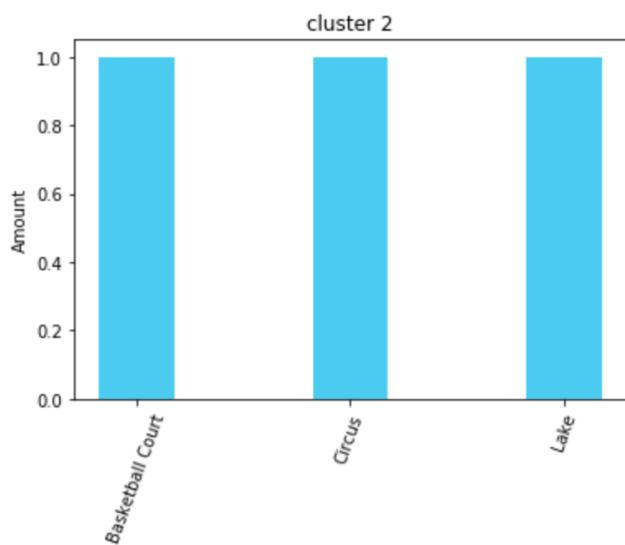


Figure 16: Top 3 most common venues in cluster 2 of Paris.

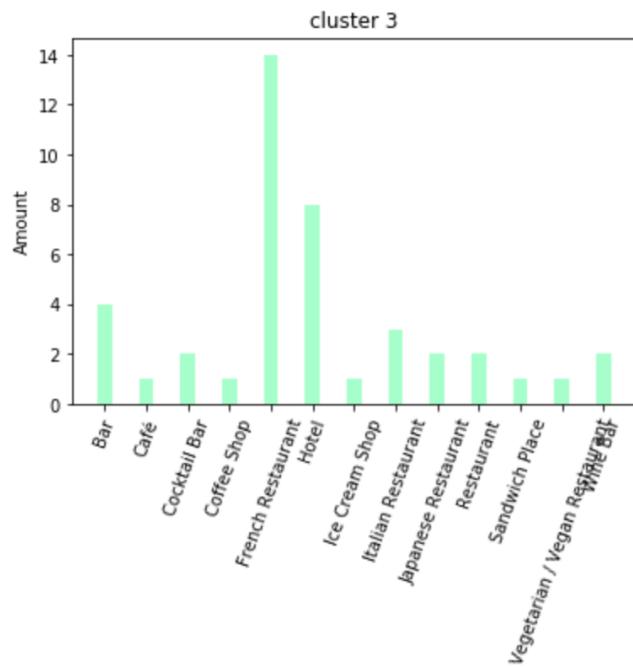


Figure 17: Top 3 most common venues in cluster 3 of Paris.

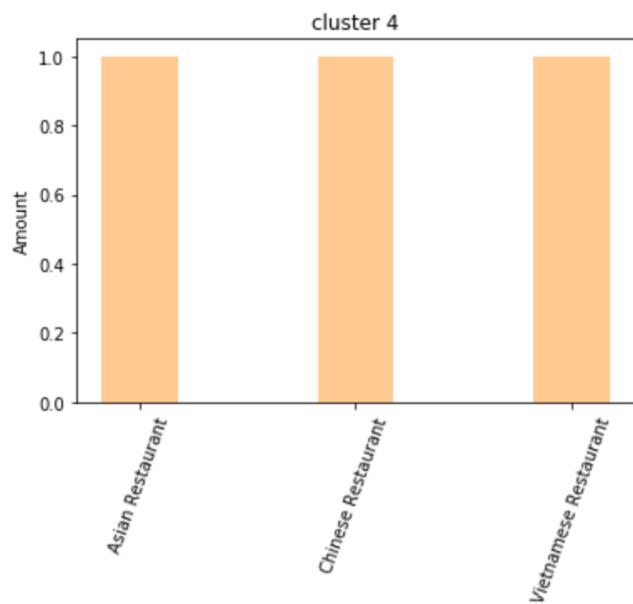


Figure 18: Top 3 most common venues in cluster 4 of Paris.

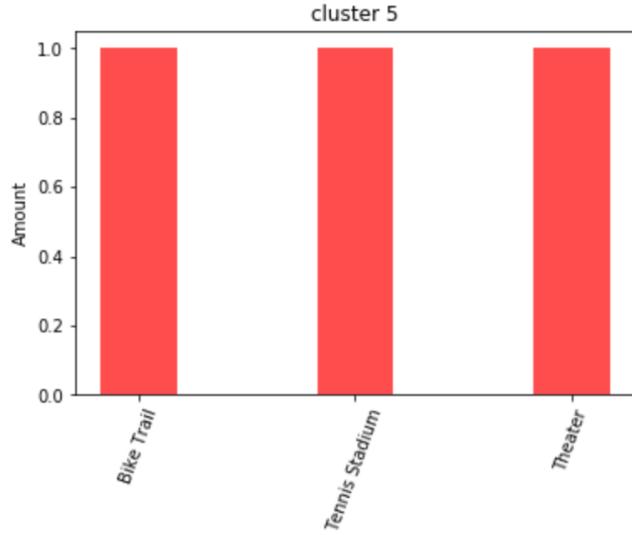


Figure 19: Top 3 most common venues in cluster 5 of Paris.

When we examine above figures, we can label each cluster of Paris as follows:

- Paris Cluster 1: Food, hotel and plaza district.
- Paris Cluster 2: Sport court and lake district.
- Paris Cluster 3: Intensive restaurant and bar district.
- Paris Cluster 4: Asian restaurant district.
- Paris Cluster 5: Stadium and theatre district.

You can also see a clustered map neighbourhoods of Paris in the below.

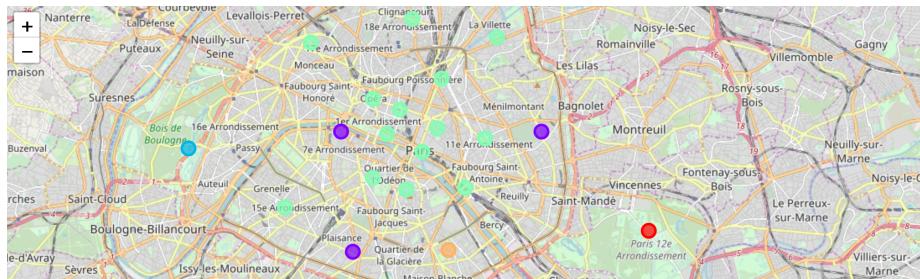


Figure 20: Clustered map of Paris.

## 4.2 Clusters of Montreal

Using the same method, we created bar charts showing the top 3 most common venues in each cluster of Montreal, as in the following.

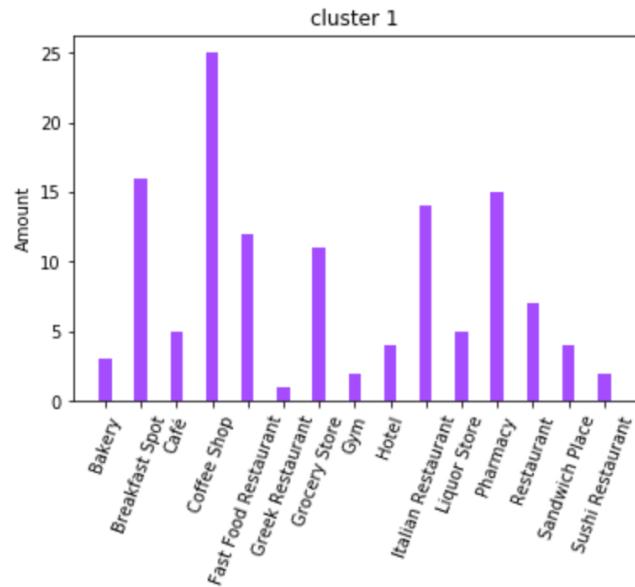


Figure 21: Top 3 most common venues in cluster 1 of Montreal.

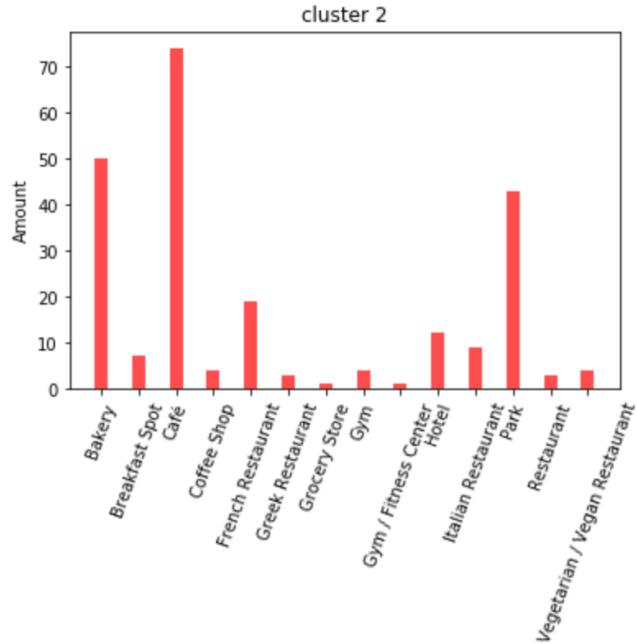


Figure 22: Top 3 most common venues in cluster 2 of Montreal.

In summary, we can label each cluster of Montreal as follows:

- Montreal Cluster 1: Cafe, restaurant and grocery district.
- Montreal Cluster 2: Intensive cafe, bakery and park district.

You can also see a clustered map neighbourhoods of Montreal in the below.

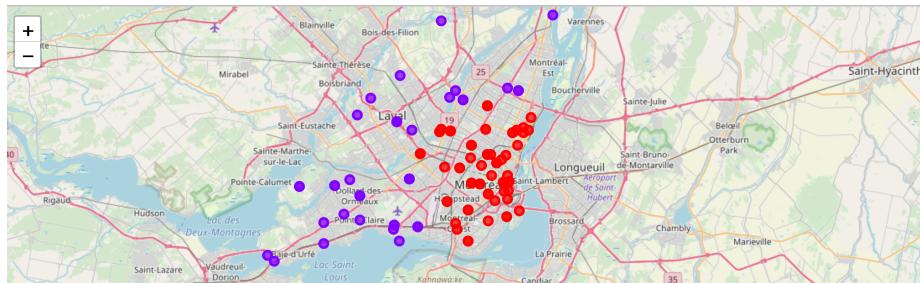


Figure 23: Clustered map of Montreal.

## 5 Discussion

In summary, my main target of this report is to study the similarities or dissimilarities between Paris and Montreal.

My first observation is that the structure of Paris is better functionally modeled than Montreal. In Paris, the centre district has intensive restaurants and bars, while in the outskirts, we can find areas for sport courts, art and oriental cultures. By contrast, Montreal can be simply characterized by downtown and rural district. There are mostly cafe and restaurants in the whole area of Montreal, but in a more intensive scale in the downtown than countryside.

Second, Paris is more touristic and multi-cultural city than Montreal. The various restaurants for European food and asian food imply that the tourists and residents of Paris came from different countries in the world. In Montreal, the venues tends to be more residential than Paris, where we can find common venues such as grocery shops, gyms and pharmacies.

Finally, the restaurants in Montreal are partially from France and other European countries such as Italy and Greece. Also, we can find numbers of fast food or sandwich places, which are more north American style. Different from Paris, bakeries and breakfast spots seem to be popular to the daily life of people in Montreal.

## 6 Conclusion

This report demonstrated a comparison of Paris and Montreal in terms of culture, business and life styles. These two cities are the top 2 largest french speaking regions in the world. However, from the results of our study, there are still many different points in terms of the city structure and the venues. These differences indicate that people in Montreal and Paris still stick to their own culture and life styles. The result of this report could be helpful to global investors, immigrants, and culture industry.

## 7 References

1. [https://en.wikipedia.org/wiki/Arrondissements\\_of\\_Paris](https://en.wikipedia.org/wiki/Arrondissements_of_Paris)
2. [https://en.wikipedia.org/wiki/List\\_of\\_postal\\_codes\\_of\\_Canada:\\_H](https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_H)