# Clustering Tehran venues based on each district & neighborhoods

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## 1. Introduction

### 1.1 Background

Tehran is a very big city in terms of the number of districts and population. Tehran has over 22 districts with a population of 12 million people(2018) which makes it the second most populated city in the middle east after Istanbul. A big city like Tehran has lot's of neighborhoods and venues.

### 1.2 Problem

Unfortunately, a big city like Tehran doesn't have a good analysis of their venues. For example, a tourist doesn't know the best places in Tehran based on each neighborhood so In this project we are going to cluster each neighborhood in 22 districts of Tehran based on their top 10 venues in each neighborhood.

### 1.3 Interest

The output of this project can be very helpful for tourists or anyone who is interested in finding the best venues of Tehran based on their neighborhoods.

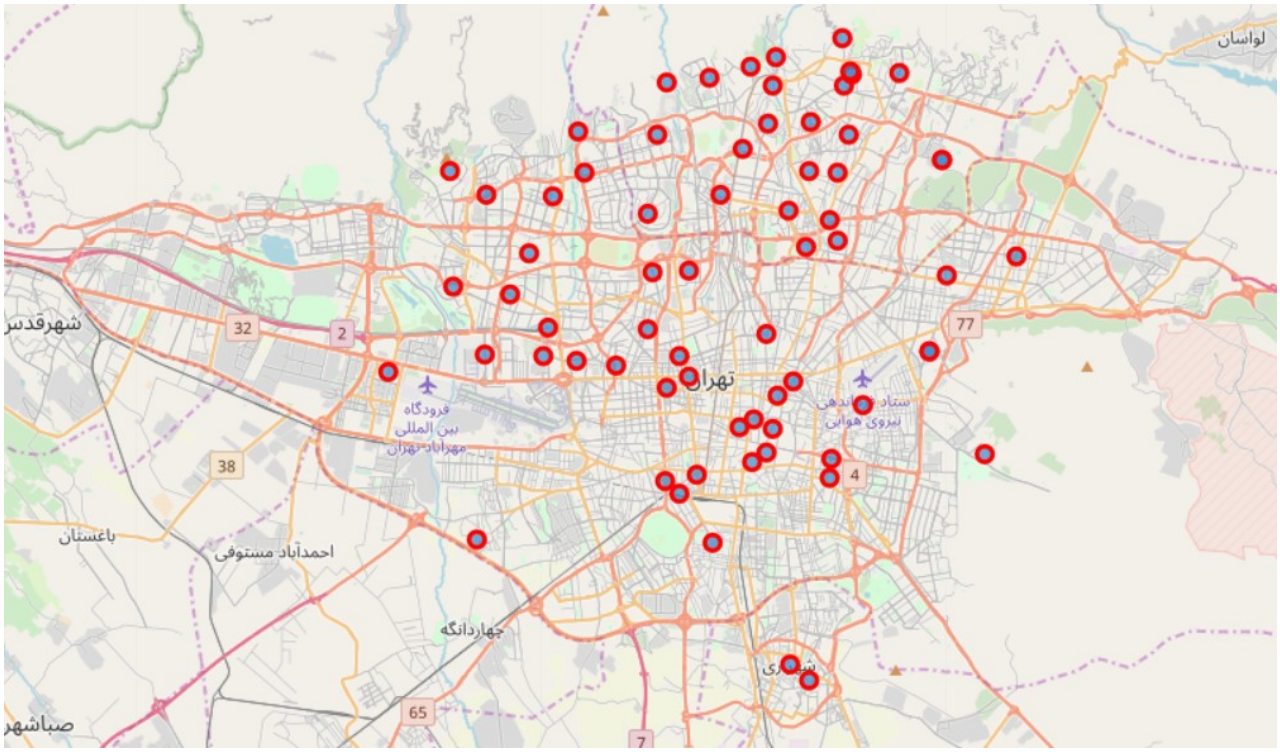
## 2. Data acquisition

Surprisingly, Tehran doesn't have a clean database for data scientists. As a data scientist you have to pretty much collect everything you need yourself. So my first step would be to collect districts and neighborhoods data from Wikipedia and put each one in a row of my Dataframe. After this step I will collect the coordinates for my neighborhoods to plot my data on a map. Coordinates will be collected by Geopy library. For the Final step, I will get my venues data based on each neighborhood using Foursquare API which surprisingly has a valuable database for the city of Tehran.

We gathered our data, thorough multiple steps. First we manually collected our data from the source that we had previously mentioned. In this step we collected name and geographical position of each neighborhood in the city of Tehran. By collecting

this data we now have 2 columns named City side and Neighborhood which we are going to iterate thorough them. After this step we collected coordinates of each of our neighborhoods by using geopy library. For some reasons, few neighborhoods had been falsely coordinated which we corrected them at the end. The reason for this was because geopy uses open street maps to collect geographical data for each neighborhood, and sometimes our neighborhood is not correctly mentioned in the open street map database So we handled it after that geopy's work was done.

Now we have 4 columns in our database including City side, Neighborhood, Latitude and Longitude. So now we can plot our data into a map using folium.




# 3. Methodology

The methodology used to approach this problem includes some statistical exploration of the data and some visualizations. The main machine learning technique involved in the development of this project is clustering, in concrete the K-Means algorithm was used, implemented with Python. At a first moment, the main problem was how to obtain the necessary data to build a constructive approach to the problem to be tackled. Usually, to solve these kinds of optimal business location problems, a lot of consumer's data are needed, but for this example and for the sake of simplicity, the focus was put mainly on neighborhoods. With all this being considered, it was decided that the main goal to efficiently solve this problem, was firstly to define what our target population is, and secondly, find the areas where this population is living, and finally, examine the venues and restaurants in this area to see if our product could work. Here is an example of the data used:

| | City side | Neighborhood | latitude | longitude |
|---|---|---|---|---|
| 0 | North | Aghdasieh | 35.593837 | 51.444406 |
| 1 | North | Lavizan | 35.777055 | 51.502150 |
| 2 | North | Ajodanieh | 35.807800 | 51.483600 |
| 3 | North | Darakeh | 35.804346 | 51.382710 |
| 4 | North | Darband | 35.813517 | 51.429482 |

The First map is plotted after that the table above gathered through some processes.

In the next part we obtained the nearest venue to each neighborhood. This data was obtained through latitude and longitude of each location using Foursquare database.

| | Neighborhood | Neighborhood Latitude | Neighborhood Longitude | Venue | Venue Latitude | Venue Longitude | Venue Category |
|---|---|---|---|---|---|---|---|
| 0 | Aghdasieh | 35.593837 | 51.444406 | Fina Food \| فینا فود | 35.593667 | 51.442405 | Fast Food Restaurant |
| 1 | Aghdasieh | 35.593837 | 51.444406 | زمین چمن مطهري | 35.591102 | 51.446235 | Football Stadium |
| 2 | Aghdasieh | 35.593837 | 51.444406 | فست فود آرادArad Fastfood | 35.593630 | 51.449789 | Fast Food Restaurant |
| 3 | Ajodanieh | 35.807800 | 51.483600 | R&A coffee shop | 35.805885 | 51.484921 | Coffee Shop |
| 4 | Ajodanieh | 35.807800 | 51.483600 | Royal Aghdasiye Fitness Center | 35.805618 | 51.479701 | Gym / Fitness Center |

Looking at this sample, it is possible to see the names of the venues, their coordinates, and the category of each venue. The results are ordered by boroughs. This is a vital step in the segmentation process, since all the important data about the venues is obtained from here. Once the venues per boroughs were obtained, it was then needed to look at the mean occurrence of each venue by neighborhood:

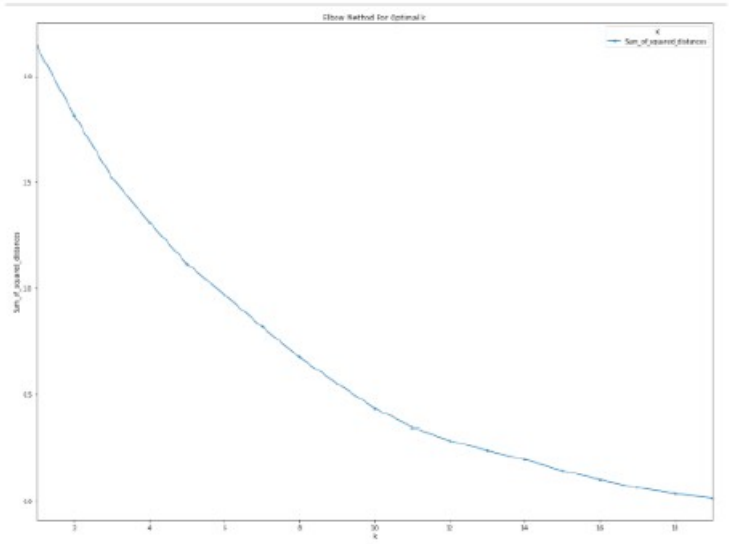
```
----Abbas Abad----
                venue  freq
0  Persian Restaurant  0.25
1              Plaza  0.17
2       Women's Store  0.08
3          Astrologer  0.08
4              Market  0.08


----Afsariyeh----
              venue  freq
0            Plaza  0.17
1       Sports Club  0.17
2         Bookstore  0.17
3             Diner  0.17
4  Kebab Restaurant  0.17


----Aghdasieh----
                  venue  freq
0  Fast Food Restaurant  0.67
1      Football Stadium  0.33
2           Yoga Studio  0.00
3            Nail Salon  0.00
4   Moroccan Restaurant  0.00


----Ajodanieh----
                  venue  freq
0                   Gym  0.18
1           Pizza Place  0.09
2           Coffee Shop  0.09
3                 Café  0.09
4  Fast Food Restaurant  0.09
```

This what the frequencies of occurrence looks like. With this data, it is possible to know which the most common venues are:

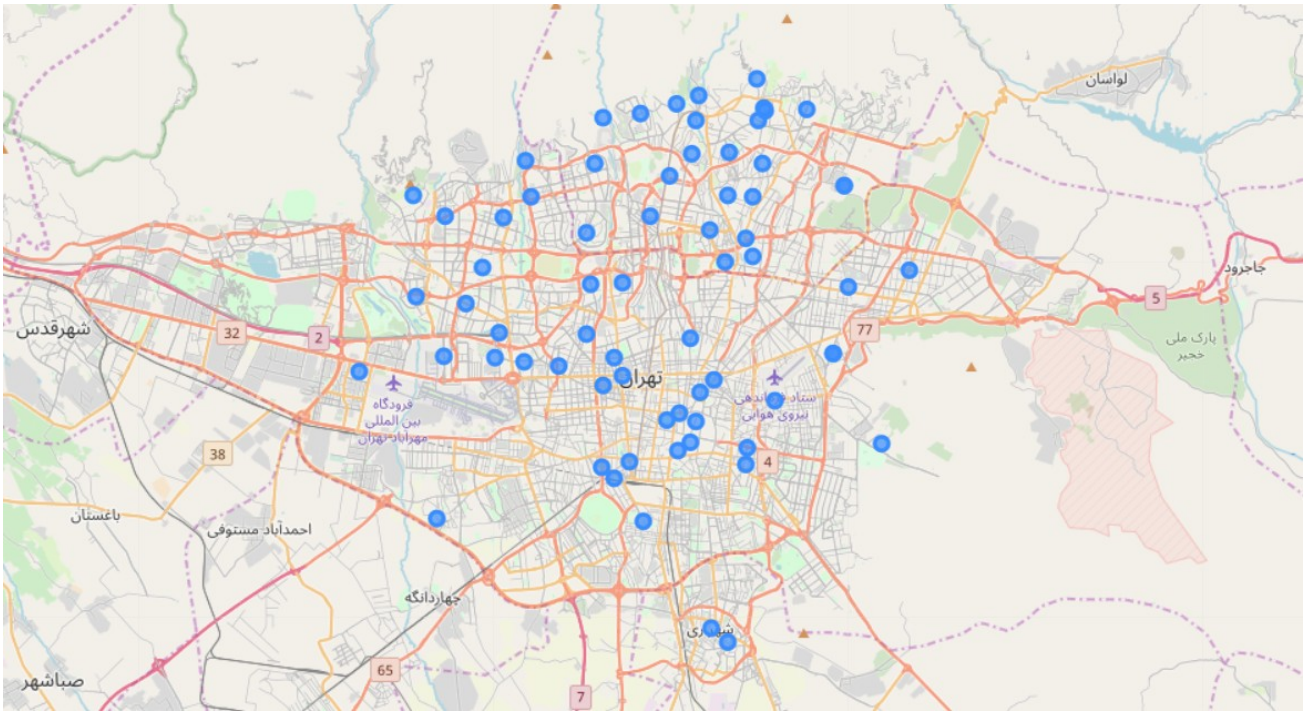
| | Neighborhood | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10 Co Ve |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | Abbas Abad | Persian Restaurant | Plaza | Tailor Shop | Costume Shop | Carpet Store | Metro Station | Market | Astrologer | Women's Store | Fu Ho St |
| **1** | Afsariyeh | Bookstore | Plaza | Sports Club | Diner | Kebab Restaurant | Supermarket | Drugstore | Fast Food Restaurant | Farm | Fa Re |
| **2** | Aghdasieh | Fast Food Restaurant | Football Stadium | Women's Store | Donut Shop | Farm | Falafel Restaurant | Fabric Shop | Electronics Store | Dry Cleaner | Dr |
| **3** | Ajodanieh | Gym | Fast Food Restaurant | Park | Gym / Fitness Center | Pizza Place | Coffee Shop | Japanese Restaurant | Café | Market | Au Ga |
| **4** | Amir Abad | Sports Club | Soccer Field | IT Services | Burger Joint | Athletics & Sports | Health & Beauty Service | Cultural Center | Drugstore | Farm | Cr |

This process is progressive, once a piece of information is obtained, it is possible to go for the next one. With this data in hand, now the segmentation can be made, and the

clusters created. But first it is necessary to determine somehow, what the appropriate number of clusters is. To perform this task, the elbow method was used. This method consists in plotting a hypothetical and usually large number of clusters in our data, and draw a curve representing the squared distances between each cluster. At some point, the distances will descend to a point where there is no need to keep increasing them. This means that creating more divisions in the data (clusters) is pointless as the difference between groups starts being highly difficult to appreciate:



This is our curve. The distances start reducing importantly from cluster6 on. So, it was determined that the optimal number of clusters for this problem was 6. With this being done, it is possibly to build the clusters now and have a look at them:




These are the 6 clusters on the map of Tehran, it is possible to see how many neighborhoods belong to each cluster, which is also important information. Now it is possible to examine the data of each cluster:

| | City side | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | North | Aghdasieh | 35.593837 | 51.444406 | 4.0 | Fast Food Restaurant | Football Stadium | Women's Store | Donut Shop | Farm | Falafel Restaurar |
| 1 | North | Lavizan | 35.777055 | 51.502150 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 2 | North | Ajodanieh | 35.807800 | 51.483600 | 0.0 | Gym | Fast Food Restaurant | Park | Gym / Fitness Center | Pizza Place | Coffee Shop |
| 3 | North | Darakeh | 35.804346 | 51.382710 | 2.0 | Persian Restaurant | Café | Restaurant | Tennis Court | Athletics & Sports | Hookah B |
| 4 | North | Darband | 35.813517 | 51.429482 | 2.0 | History Museum | Garden | Café | Burger Joint | Supermarket | Steakhou |

# 4. Conclusion

Final data show that areas in northern side of Tehran has much more venues density than the other sides of Tehran. The northern side of Tehran has more economical stability than other sides So neighborhoods in northern side are much

more dense compared to other neighborhoods. After the northern side areas which are farther from north side of Tehran has the lowest density. So it would be reasonable for a newcomer to start a business in northern side instead of southern areas of Tehran.