# Coursera Capstone Project

# Battle of Neighborhoods in Ha Noi

## 1. Introduction

Hanoi is the capital of Vietnam. It covers an area of 3,328.9 square kilometres (1,285 sq mi). With an estimated population of 7.7 million as of 2018, it is the second largest city in Vietnam. The metropolitan area, encompassing nine additional neighbouring provinces, has an estimated population of 16 million. Located in the central area of the Red River Delta, Hanoi is the commercial, cultural, and educational centre of Northern Vietnam. Having an estimated nominal GDP of US$32.8 billion, it is the second most productive economic centre of Vietnam, following Ho Chi Minh City.

The Old Quarter (Vietnamese: *Phố cổ Hà Nội*) is the name commonly given to the historical civic urban core of Hanoi, located outside the Imperial

Citadel of Thăng Long. This quarter used to be the residential, manufacturing and commercial center, where each street was specialized in one specific type of manufacturing or commerce.

Another common name referring to approximately the same area is the 36 streets (Vietnamese: *Hà Nội 36 phố phường*), after the 36 streets or guilds that used to make up the urban area of the city.

### Business problem

My friend wanted to open a restaurant or a cafe in Old Quarter, but he didn't know where to open with little competition. This data analysis article will clarify and may help him with some useful information for his decision.

### Target Audience of this project

This project is particularly useful to property developers and investor looking to open or invest in new business like restaurant, cafe, food, hotel in Ha Noi Old quarter

## 2. Data acquisition and cleaning

### Ha Noi Neighborhoods Data

List of  districts, wards of Ha Noi from the following URL: https://www.gso.gov.vn/dmhc2015/Default.aspx

### Google map API

This project would use Google Map API Geocoder to get the Latitude and Longitude of each area

### Foursquare API

This project would use Four-square API as its prime data gathering source. This API provides the ability to perform location search, location sharing and details about a business.

### Step by Step

Downloaded data is excel file includes all districts and wards of Vietnam, filtering the data only for wards of Hanoi Old Quarter.

Next, I used Google API to get the longitude and latitude of each ward, to serve as input to the nearby Foursquare API search.

Then combine the longitude and latitude obtained with the districts and wards data.

```
# define a function to get coordinates
def get_latlng(neighborhood):
    # initialize your variable to None
    lat_lng_coords = None
    # loop until you get the coordinates
    while(lat_lng_coords is None):
        g = geocoder.arcgis('{}, Malaysia'.format(neighborhood))
        lat_lng_coords = g.latlng
    return lat_lng_coords
```

```
coords = [ get_latlng(neighborhood) for neighborhood in dfoldtown["area"].tolist() ]
```

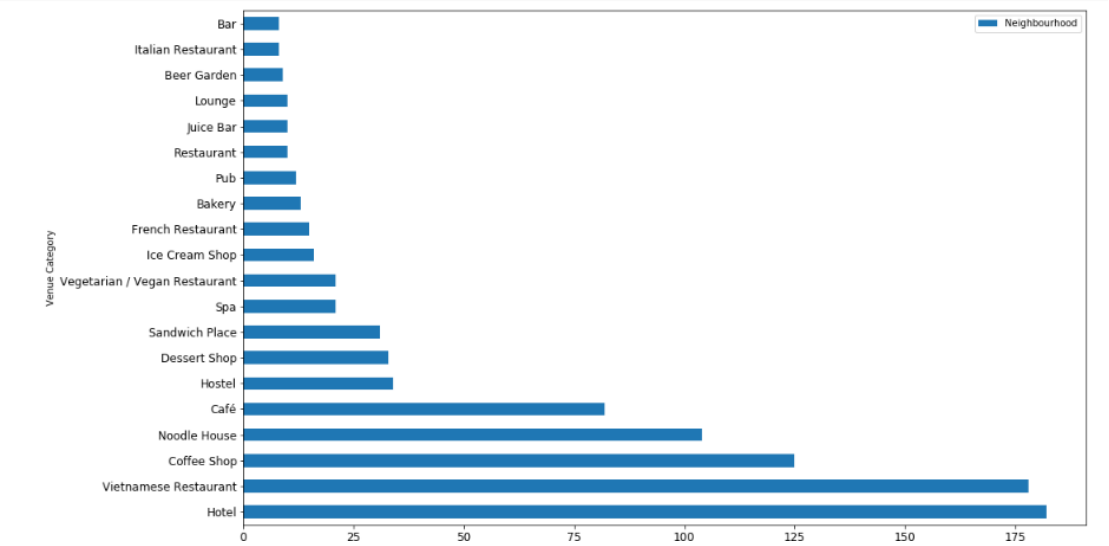
```
# create temporary dataframe to populate the coordinates into Latitude and Longitude
df_oldtown_coords = pd.DataFrame(coords, columns=['Latitude', 'Longitude'])
```

```
df_oldtown_coords.head()
```

I then used the Foursquare API to search and continued to merge it into district and ward data. I use Foursquare API to pull the list of top 100 venues within 500 meters radius. I have created a Foursquare developer account to obtain account ID and API key to pull the data. From Foursquare, I can pull the names, categories, latitude, and longitude of the venues.

The Foursquare API returns all the venues, so to get only food and beverage service venues (bar, coffee, restaurant, food, wine, ice cream …). I used the Pandas function to filter the result.

I used Pandas to make the horizontal bar chart of the top 20 Venues in Ha Noi Old Quarter:



## 1. Methodology

After data acquisition and cleaning, this project applies K-mean clustering unsupervised machine learning algorithm to cluster the venues based on a list of locations for different types of food and beverage service points such as bars, cafes, Chinese restaurants, Vietnamese restaurants, Seafood restaurants, etc. This would give a better understanding of the similarities and dissimilarities between the chosen neighborhoods  to retrieve more insights.

Analyze Each Neighborhood, group rows by neighborhood and by taking the mean of the frequency of occurrence of each category. Next, create the new data frame and display the top 10 venues for each neighborhood.

Then use the Kmean algorithm from the sklearn library to divide it into 5 groups with similar properties. Next, assign labels from Kmean result to each neighborhood using the Pandas merge function.

```
# set number of clusters
kclusters = 5

hn_grouped_clustering = HN_grouped.drop('Neighbourhood', 1)

# run k-means clustering
kmeans = KMeans(n_clusters=kclusters, random_state=0).fit(hn_grouped_clustering)

# check cluster labels generated for each row in the dataframe
kmeans.labels_
# to change use .astype()
```

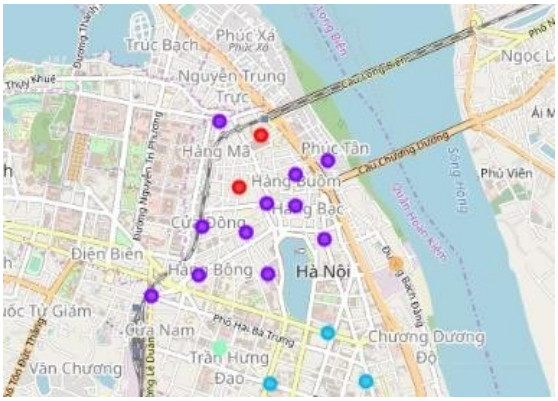
The next step, I used folium to draw a map and folium to draw circle marker to visualize the resulting clusters.

```
# create map
map_clusters = folium.Map(location=[lat_HN, long_HN], zoom_start=11)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i + x + (i*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(HN_merged['Latitude'], HN_merged['Longitude'], HN_merged['area'], HN_merged['Cluster_Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters)

map_clusters
```




The next step is to display and view a list of each cluster, here to see what the clusters have in common, from which to draw useful information.

## 2. Results and Discussion

**Cluster 1**

```
HN_merged.loc[HN_merged['Cluster_Labels'] == 0, HN_merged.columns[[0] + list(range(5, HN_merged.shape[1]))]]
```

| | ward | 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 | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Phường Đồng Xuân | 0 | Noodle House | Vietnamese Restaurant | Hostel | Hotel | Dessert Shop | Sandwich Place | Coffee Shop | Pub | Food | Tea Room |
| 2 | Phường Hàng Mã | 0 | Coffee Shop | Noodle House | Dessert Shop | Vietnamese Restaurant | Food | Cocktail Bar | Salad Place | Sandwich Place | Seafood Restaurant | Hotel |
| 5 | Phường Hàng Bồ | 0 | Hotel | Noodle House | Vietnamese Restaurant | Hostel | Sandwich Place | Coffee Shop | Dessert Shop | Café | Food | Massage Studio |

**Cluster 2**

```
HN_merged.loc[HN_merged['Cluster_Labels'] == 1, HN_merged.columns[[0] + list(range(5, HN_merged.shape[1]))]]
```

| | ward | 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 | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Phường Phúc Tân | 1 | Vietnamese Restaurant | Hotel | Noodle House | Coffee Shop | Café | Vegetarian / Vegan Restaurant | Hostel | Sandwich Place | Ice Cream Shop | Dessert Shop |
| 3 | Phường Hàng Buồm | 1 | Vietnamese Restaurant | Hotel | Noodle House | Coffee Shop | Café | Hostel | Sandwich Place | Dessert Shop | French Restaurant | Vegetarian / Vegan Restaurant |
| 4 | Phường Hàng Đào | 1 | Vietnamese Restaurant | Hotel | Noodle House | Coffee Shop | Hostel | Café | Sandwich Place | Vegetarian / Vegan Restaurant | Dessert Shop | Pub |
| 6 | Phường Cửa Đông | 1 | Hotel | Vietnamese Restaurant | Noodle House | Coffee Shop | Café | Dessert Shop | Spa | Hostel | Juice Bar | Bed & Breakfast |
| 7 | Phường Lý Thái Tổ | 1 | Vietnamese Restaurant | Hotel | Coffee Shop | Café | Noodle House | Spa | Sandwich Place | French Restaurant | Vegetarian / Vegan Restaurant | Italian Restaurant |
| 8 | Phường Hàng Bạc | 1 | Hotel | Vietnamese Restaurant | Coffee Shop | Noodle House | Café | Hostel | Sandwich Place | Dessert Shop | Vegetarian / Vegan Restaurant | Pub |
| 9 | Phường Hàng Gai | 1 | Hotel | Vietnamese Restaurant | Noodle House | Coffee Shop | Café | Hostel | Spa | Dessert Shop | Ice Cream Shop | Beer Garden |
| 11 | Phường Hàng Trống | 1 | Hotel | Café | Coffee Shop | Noodle House | Vietnamese Restaurant | Spa | Hostel | Market | Park | Mobile Phone Shop |
| 12 | Phường Cửa Nam | 1 | Vietnamese Restaurant | Hotel | Coffee Shop | Café | Bakery | Sandwich Place | Bar | Asian Restaurant | Korean Restaurant | Restaurant |
| 13 | Phường | 1 | Vietnamese | Hotel | Coffee Shop | Café | Noodle House | Restaurant | Ice Cream Shop | Sandwich Place | Hotpot | Japanese |

**Cluster 3**

```
HN_merged.loc[HN_merged['Cluster_Labels'] == 2, HN_merged.columns[[0] + list(range(5, HN_merged.shape[1]))]]
```

| | ward | 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 | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | Phường Tràng Tiền | 2 | Coffee Shop | Café | Vietnamese Restaurant | Ice Cream Shop | Restaurant | Hotel Bar | Hotel | History Museum | Italian Restaurant | Cultural Center |
| 16 | Phường Phan Chu Trinh | 2 | Vietnamese Restaurant | Restaurant | Café | Coffee Shop | Hotel | Ice Cream Shop | Cultural Center | Noodle House | Hotel Bar | Hotpot Restaurant |
| 17 | Phường Hàng Bài | 2 | Coffee Shop | Vietnamese Restaurant | Dessert Shop | Noodle House | Café | Hotel | Steakhouse | Wine Bar | Cultural Center | French Restaurant |

**Cluster 4**

```
HN_merged.loc[HN_merged['Cluster_Labels'] == 3, HN_merged.columns[[0] + list(range(5, HN_merged.shape[1]))]]
```

| | ward | 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 | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | Phường Trần Hưng Đạo | 3 | Hotel | Chocolate Shop | Supermarket | Vietnamese Restaurant | French Restaurant | Lounge | Cultural Center | Noodle House | Coffee Shop | Restaurant |

**Cluster 5**

```
HN_merged.loc[HN_merged['Cluster_Labels'] == 4, HN_merged.columns[[0] + list(range(5, HN_merged.shape[1]))]]
```

| | ward | 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 | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | Phường Chương Dương | 4 | Café | Coffee Shop | Italian Restaurant | Seafood Restaurant | Smoothie Shop | Noodle House | Supermarket | Juice Bar | Nightclub | Vietnamese Restaurant |

After reviewing the data of each cluster, I have some discussions:

- At Cluster 1, 2 ,3 focus mainly on Vietnamese restaurants, Cafe, Hotels. So need to be careful when you intend to open a Vietnamese restaurant or cafe
- At Cluster 4, mainly hotels and supermarkets. Cafe is only ranked 9 out of 10 most popular places, so it is possible to open a cafe in Cluster4
- Cluster 5, the most popular is cafe and Italian restaurant. However, the location here is quite limited in sight. Need to consider carefully when intending to open a new business in this area

## 3. Conclusion

Finally, I have got a small glimpse of how real-life data-science projects look like. I used various types of APIs to collect data, used the Pandas library to eliminate redundant data, used it, and used Python libraries to draw graphs, using unsupervised machine learning algorithms to group data into similar characteristics. From that it is possible to discover the information that is hidden in it, making it easier to make decisions such as where to open a restaurant or a cafe is appropriate and less competitive.