Capstone Project – REPORT

Content

1. Introduction Section:

Discussion of the business problem and the audience who would be interested in this project.

1.1 Scenario and Background

I am a b.tech in artificial intelligence student currently residing in India. I enjoy many amenities in the neighbourhood, such as international cousin restaurants, cafes, food shops and entertainment. During the covid pandemic, i wanted to explore new interesting fields. Therefore, I decided to apply the learned skills during the Coursera course to explore data science.

1.2 Problem to be resolved:

The challenge to resolve is being able to find a rental apartment unit in Manhattan NY that offers similar characteristics and benefits to a person living in SINGAPORE. Therefore, in order to set a basis for comparison, I want to find a rental unit subject to the following conditions:

Apartment with min 2 bedrooms with monthly rent not to exceed US$7000/month Unit located within walking distance (<=1.0 mile, 1.6 km) from a subway metro station in Manhattan Area with amenities and venues similar to the ones described for current location (See item 2.1)

1.3 Interested Audience

I believe this is a relevant project for a person or entity considering moving to a major city in Europe, US or Asia, since the approach and methodologies used here are applicable in all cases. The use of foursquare data and mapping techniques combined with data analysis will help resolve the key questions arisen. Lastly, this project is a good practical case toward the development of Data Science skills.

2. Data Section:

Description of the data and its sources that will be used to solve the problem

2.1 Data of Current Situation

I use Foursquare to identify the venues around the area of residence which are then shown in the Singapore map shown in methodology and execution in section 3.0. It serves as a reference for comparison with the desired future location in Manhattan NY

2.2 Data required to resolve the problem

In order to make a good choice of a similar apartment in Manhattan NY, the following data is required: List/Information on neighbourhoods form Manhattan with their Geodata (latitude and longitude. List/Information about the subway metro stations in Manhattan with geodata. Listed apartments for rent in Manhattan area with descriptions (how many beds, price, location, address) Venues and amenities in the Manhattan neighbourhoods (e.g. top 10) 2.3

sources and manipulation the list of Manhattan neighbourhoods is worked out during Lab exercise during the course. A csv file was created which will be read in order to create a data frame and its mapping. The csv file 'mh_neigh_data.csv' has the following below data structure. The file will be directly read to the Jupiter Notebook for convenience and space savings. The clustering of neighbourhoods and mapping will be shown however. An algorithm was used to determine the geodata from Nominatim . The actual algorithm coding may be shown in 'markdown' mode because it takes time to run.

mh_neigh_data.tail():

	Borough	Neighbourhood	Latitude	Longitude
35	Manhattan	Turtle Bay	40.752042	-73.967708
36	Manhattan	Tudor City	40.746917	-73.971219
37	Manhattan	Stuyvesant Town	40.731000	-73.974052
38	Manhattan	Flatiron	40.739673	-73.990947
39	Manhattan	Hudson Yards	40.756658	-74.000111

A list of Manhattan subway metro stops was compiled in Numbers (Apple excel) and it was complemented with Wikipedia data (https://en.wikipedia.org/wiki/List_of_New_York_City_Subway_stations_in_Manhattan) and information from NY Transit authority and Google maps (https://www.google.com/maps/search/manhattan+subway+metro+stations/@40.7837297,-74.1033043,11z/data=!3m1!4b1) for a final consolidated list of subway stops names and their address. The geolocation was obtained via an algorithm using Nominatim. Details will be shown in the execution of methodology in section 3.0. The subway csv file is "MH_subway.csv"' and the data structure is: mhsub.tail(): sub_station sub_address lat long

17 190 Street Subway Station Bennett Ave, New York, NY 10040, USA 40.858113 -73.932983

18 59 St-Lexington Av Station E 60th St, New York, NY 10065, USA 40.762259 -73.966271

19 57 Street Station New York, NY 10019, United States 40.764250 -73.954525

20 14 Street / 8 Av New York, NY 10014, United States 40.730862 -73.987156

21 MTA New York City 525 11th Ave, New York, NY 10018, USA 40.759809 -73.999282 A list of places for rent was collected by web-browsing real estate companies in Manhattan
: http://www.rentmanhattan.com/index.cfm?page=search&state=results https://www.nestpick.com/search?city=new-york&page=1&order=relevance&district=manhattan&gclid=CjwKCAiAjNjgBRAgEiwAGLlf2hkP3A-cPxjZYkURqQEswQK2jKQEpv_MvKcrIhRWRzNkc_r-fGi0lxoCA7cQAvD_BwE&type=apartment&display=list https://www.realtor.com/apartments/Manhattan_NY A csv file was compiled with the rental place that indicated: areas of Manhattan, address, number of beds, area and monthly rental price. The csv file "nnnn.csv" had the following below structure. An algorithm was used to create all the geodata using Nominatim, as shown in section 3.0. The actual algorithm coding may be shown in 'markdown' mode because it takes time to run. With the use of geolocator = Nominatim() , it was possible to determine the latitude and longiude for the subway metro locations as well as for the geodata for each rental place listed. The loop algorithms used are shown in the execution of data in section 3.0 "Great circle" function from geolocator was used to calculate distances between two points, as in the case to calculate average rent price for units around each subway station and at 1.6 km radius. Foursquare is used to find the avenues at Manhattan neighbourhoods in general and a cluster is created to later be able to search for the venues depending of the location shown.

2.3 How the data will be used to solve the problem
The data will be used as follows: Use Foursquare and geopy data to map top 10 venues for all Manhattan neighbourhoods and clustered in groups (as per Course LAB) Use foursquare and geopy data to map the location of subway metro stations , separately and on top of the above clustered map in order to be able to identify the venues and amenities near each metro station, or explore each subway location separately Use Foursquare and geopy data to map the location of rental places, in some form, linked to the subway locations. Create a map that depicts, for instance, the average rental price per square ft., around a radius of 1.0 mile (1.6 km) around each subway station - or a similar metrics. I will be able to quickly point to the popups to know the relative price per subway area. Addresses from rental locations will be converted to geodata(lat, long)

using Geopy-distance and Nominatim. Data will be searched in open data sources if available, from real estate sites if open to reading, libraries or other government agencies such as Metro New York MTA, etc.

2.4 Mapping of Data

The following maps were created to facilitate the analysis and the choice of the palace to live. Manhattan map of Neighbourhoods Manhattan subway metro locations Manhattan map of places for rent Manhattan map of clustered venues and neighbourhoods Combined maps of Manhattan rent places with subway locations Combined maps of Manhattan rent places with subway locations and venues clusters

3. Methodology section:

This section represents the main component of the report where the data is gathered, prepared for analysis. The tools described are used here and the Notebook cells indicates the execution of steps.

The analysis and the strategy:

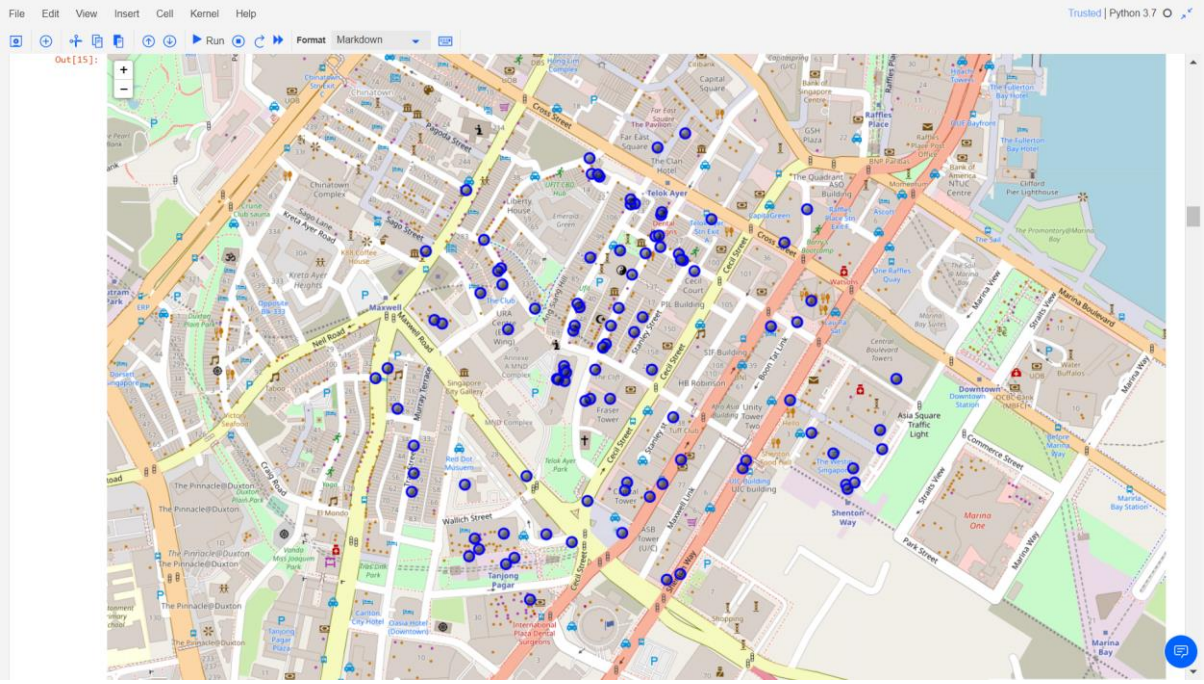
The strategy is based on mapping the above described data in section 2.0, in order to facilitate the choice of at least two candidate places for rent. The choice is made based on the demands imposed: location near a subway, rental price and similar venues to Singapore. This visual approach and maps with popups labels allow quick identification of location, price and feature, thus making the selection very easy.

The processing of these DATA and its mapping will allow to answer the key questions to make a decision:

- What is the cost of available rental places that meet the demands?
- What is the cost of rent around a mile radius from each subway metro station?
- What is the area of Manhattan with best rental pricing that meets criteria established?
- What is the distance from work place (Park Ave and 53 rd. St) and the tentative future rental home?
- What are the venues of the two best places to live? How the prices compare?
- How venues distribute among Manhattan neighbourhoods and around metro stations?
- Are there trade-offs between size and price and location?
- Any other interesting statistical data findings of the real estate and overall data.

4. Result:

Current Residence in Singapore:

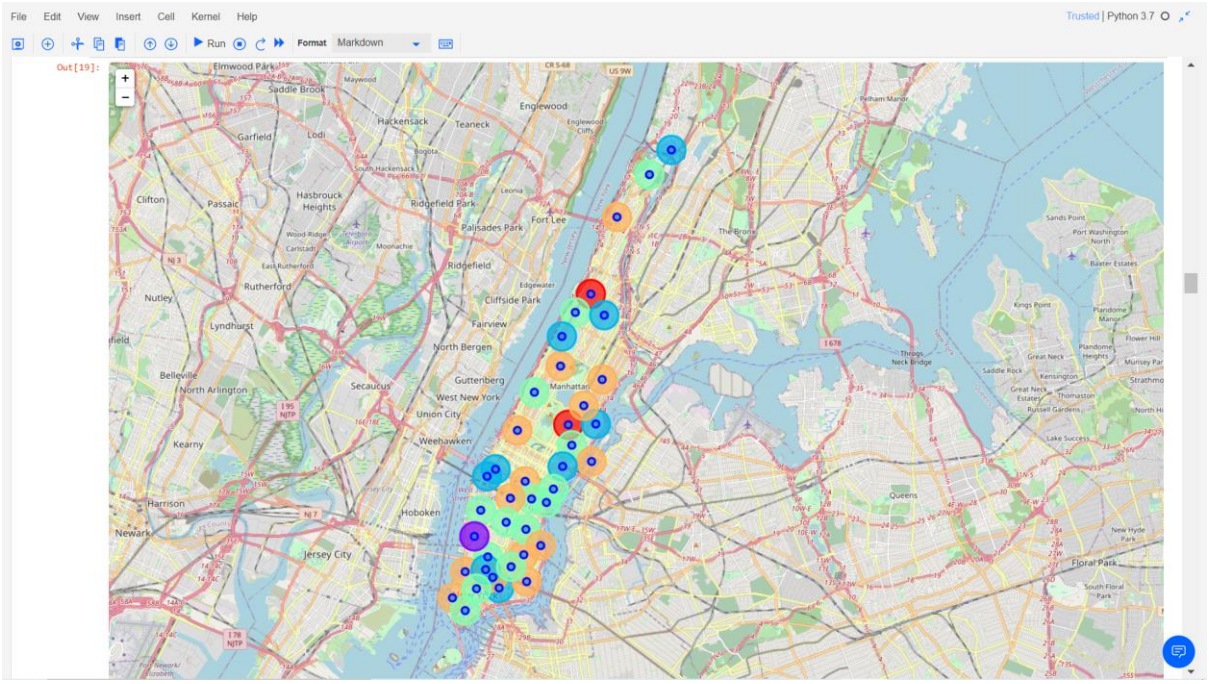


In [14]:
```
# Venues near current Singapore residence place
SGnearby_venues.head(10)
```

Out[14]:

	name	categories	lat	lng
0	Napoleon Food & Wine Bar	Wine Bar	1.279925	103.847333
1	Park Bench Deli	Deli / Bodega	1.279872	103.847287
2	Native	Cocktail Bar	1.280135	103.846844
3	Sofitel So Singapore	Hotel	1.280199	103.849829
4	Dumpling Darlings	Dumpling Restaurant	1.280483	103.846942
5	Pepper Bowl	Asian Restaurant	1.279371	103.846710
6	Anglo Indian Cafe & Bar	Indian Restaurant	1.279084	103.850127
7	Oven & Fried Chicken	Korean Restaurant	1.280479	103.847522
8	PS.Cafe	Café	1.280468	103.846264
9	Lau Pa Sat Satay Street	Street Food Gathering	1.280261	103.850235

Clusters of Neighbourhoods in Manhattan:



In [20]:
```
## kk is the cluster number to explore
kk = 2
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == kk, manhattan_merged.columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```

Out[20]:

Borough	Latitude	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
Manhattan	40.876551	Discount Store	Yoga Studio	Steakhouse	Supplement Shop	Tennis Stadium	Shoe Store	Gym	Bank	Seafood Restaurant
Manhattan	40.715618	Cocktail Bar	Dim Sum Restaurant	American Restaurant	Vietnamese Restaurant	Salon / Barbershop	Noodle House	Bakery	Bubble Tea Shop	Ice Cream Shop
Manhattan	40.815976	Seafood Restaurant	French Restaurant	American Restaurant	Cosmetics Shop	Chinese Restaurant	Event Space	Liquor Store	Beer Bar	Gym / Fitness Center
Manhattan	40.775930	Gym	Bar	Italian Restaurant	Sushi Restaurant	Pizza Place	Mexican Restaurant	Deli / Bodega	Japanese Restaurant	Pub
Manhattan	40.759101	Italian Restaurant	Coffee Shop	American Restaurant	Gym / Fitness Center	Hotel	Wine Shop	Spa	Gym	Indie Theater
Manhattan	40.722184	Boutique	Women's Store	Shoe Store	Men's Store	Furniture / Home Store	Italian Restaurant	Mediterranean Restaurant	Art Gallery	Design Studio
Manhattan	40.808000	American Restaurant	Park	Bookstore	Pizza Place	Sandwich Place	Burger Joint	Café	Deli / Bodega	Tennis Court
Manhattan	40.760280	Italian Restaurant	Furniture / Home Store	Indian Restaurant	Dessert Shop	American Restaurant	Bakery	Juice Bar	Boutique	Sushi Restaurant
Manhattan	40.756658	Italian Restaurant	Hotel	Theater	American Restaurant	Café	Gym / Fitness Center	Thai Restaurant	Restaurant	Gym

Venue Selection

1. Using the "one map" above, I was able to explore all possibilities since the popups provide the information needed for a good decision.
2. Financial District having Gyms, Hotels and Restaurants similar to Singapore residence is my preferable choice for a future residence.
3. Based on current Singapore venues, I feel that Cluster 2 type of venues is a closer resemblance to my current place. That means that APARTMENT 1 is a better choice since the extra monthly rent is worth the conveniences it provides.

4. Apartment 1 rent cost is US7500 slightly above the US7000 budget. Apt 1 is located 400 meters from subway station at 59th Street and work place (Park Ave and 53rd) is another 600 meters way. I can walk to work place and use subway for other places around. Venues for this apt are as of Cluster 2 and it is located in a fine district in the East side of Manhattan.

5. Apartment 2 rent cost is US6935, just under the US7000 budget. Apt 2 is located 60 meters from subway station at Fulton Street, but I will have to

ride the subway daily to work, possibly 40-60 min ride. Venues for this apt are as of Cluster 3.

5 DISCUSSION

In general, I am positively impressed with the overall organization, content and lab works presented during the Coursera IBM Certification Course

I feel this Capstone project presented me a great opportunity to practice and apply the Data Science tools and methodologies learned.

I have created a good project that I can present as an example to show my potential.

I feel I have acquired a good starting point to become a professional Data Scientist and I will continue exploring to creating examples of practical cases.

6 CONCLUSIONS

I feel rewarded with the efforts, time and money spent. I believe this course with all the topics covered is well worthy of appreciation.

This project has shown me a practical application to resolve a real situation that has impacting personal and financial impact using Data Science tools.

The mapping with Folium is a very powerful technique to consolidate information and make the analysis and decision thoroughly and with confidence. I would recommend for use in similar situations.

One must keep abreast of new tools for DS that continue to appear for application in several business fields.