Recommender System for health care

Availability of medical centers in Manhattan neighborhoods

A regular medical examination for pregnant women or elderly people might not be easy during a pandemic. People try to find nearest medical centers as one of the good choices to reduce the risk factor.

There are few questions that must be addressed, such as:

- What kind of medical centers are available (such as Hospital, Maternity Clinic, Eye Doctor, Dentist etc.) in a particular neighborhood?
- Where are these medical centers located?

Many health care professionals would show interest in a place where a medical center has to be established and people in the near neighborhoods find it easy to visit the hospital and have a checkup.

Target Audience

- People who are in need of regular medical examination or critical health care.
  - Our project goal for the above group is:
    - To provide the information about the available medical centers in a particular neighborhood.
    - Locate the nearest medical center for all the neighborhoods in Manhattan.
- Medical professionals who are about to open new medical centers.
  - Our project goal for the above group is:
    - To find the neighborhoods/locations that are far away from a certain kind of medical center (for example – hospital). Medical professionals can then use this information to establish new medical centers in those areas.

Data acquisition

- New York state boroughs, neighborhoods, latitudes and longitudes are taken from https://cocl.us/new_york_dataset .
- Here is a sample data, which has the neighborhood name, its latitude and longitude for the Boroughs that are present first in the DataFrame of neighborhoods grouped by 'Borough'.

```
neighborhoods_grouped=neighborhoods.groupby('Borough')
neighborhoods_grouped.first()
```

Borough	Neighborhood	Latitude	Longitude
Bronx	Wakefield	40.894705	-73.847201
Brooklyn	Bay Ridge	40.625801	-74.030621
Manhattan	Marble Hill	40.876551	-73.910660
Queens	Astoria	40.768509	-73.915654
Staten Island	St. George	40.644982	-74.079353

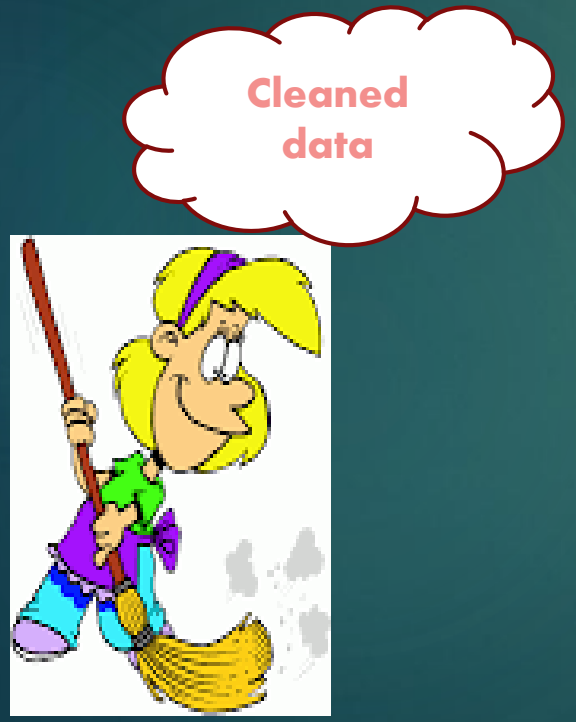
Data acquisition

- To establish a new medical center one important factor is taken into consideration:
  - To find densely populated neighborhoods with few or no hospitals, we scrape data from https://data.cityofnewyork.us/City-Government/Manhattan-populations-by-neighborhood/8m6s-esnp to get population of each neighborhood in Manhattan.

	Borough	Year	FIPS County Code	NTA Code	NTA Name	Population
0	Manhattan	2010	61	MN01	Marble Hill-Inwood	46746
1	Manhattan	2010	61	MN03	Central Harlem North-Polo Grounds	75282
2	Manhattan	2010	61	MN04	Hamilton Heights	48520
3	Manhattan	2010	61	MN06	Manhattanville	22950
4	Manhattan	2010	61	MN09	Morningside Heights	55929
5	Manhattan	2010	61	MN11	Central Harlem South	43383
6	Manhattan	2010	61	MN12	Upper West Side	132378
7	Manhattan	2010	61	MN13	Hudson Yards-Chelsea-Flat Iron-Union Square	70150
8	Manhattan	2010	61	MN14	Lincoln Square	61489
9	Manhattan	2010	61	MN15	Clinton	45884
10	Manhattan	2010	61	MN17	Midtown-Midtown South	28630
11	Manhattan	2010	61	MN19	Turtle Bay-East Midtown	51231

Data Cleaning

- In our project, we consider one Borough – Manhattan, to make our analysis more clear.
- Here is the filtered data, which has only the information for neighborhoods in Manhattan.




```
[13]: manhattan_data = neighborhoods[neighborhoods['Borough'] == 'Manhattan'].reset_index(drop=True)
      manhattan_data.head()
```

[13]:

	Borough	Neighborhood	Latitude	Longitude
0	Manhattan	Marble Hill	40.876551	-73.910660
1	Manhattan	Chinatown	40.715618	-73.994279
2	Manhattan	Washington Heights	40.851903	-73.936900
3	Manhattan	Inwood	40.867684	-73.921210
4	Manhattan	Hamilton Heights	40.823604	-73.949688

Medical centers data

- First, we get the information about all the venues present in each of the neighborhoods in Manhattan using FOURSQUARE.
- We then filter the data to retain the venues that fall under a category of medical centers of our interest (such as Dentist's Office, Hospital , Emergency Room, Maternity Clinic, Urgent Care Center , Eye Doctor , Veterinarian, Physical Therapist).
- The following information about different medical centers present in Manhattan is obtained: category, name, address, latitude and longitude

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Address	Venue Category
3	Marble Hill	40.876551	-73.910660	Marble Hill Dental Office	40.875783	-73.908366	112 W 228th St	Dentist's Office
41	Chinatown	40.715618	-73.994279	Chinatown Medical & Dental Group	40.716229	-73.992755	58 Eldridge St	Dentist's Office
78	Washington Heights	40.851903	-73.936900	Washington Heights Physical Therapy	40.850043	-73.938506	452 Fort Washington Ave Apt 7	Physical Therapist
80	Washington Heights	40.851903	-73.936900	Washington Heights Dental Clinic	40.849570	-73.939161	427 Fort Washington Ave	Dentist's Office
102	Washington Heights	40.851903	-73.936900	New Heights Dental Office, P.C	40.849755	-73.938761	436 Fort Washington Ave Apt 1B	Dentist's Office

Find nearest hospital

- Distance between each neighborhood and the nearest hospital is calculated, for this we follow the following steps:
  - Calculate the distances of all hospitals from each neighborhood in Manhattan.
  - Find the hospitals with least distance from each neighborhood.
- Now we have the information for our first group of target audience.

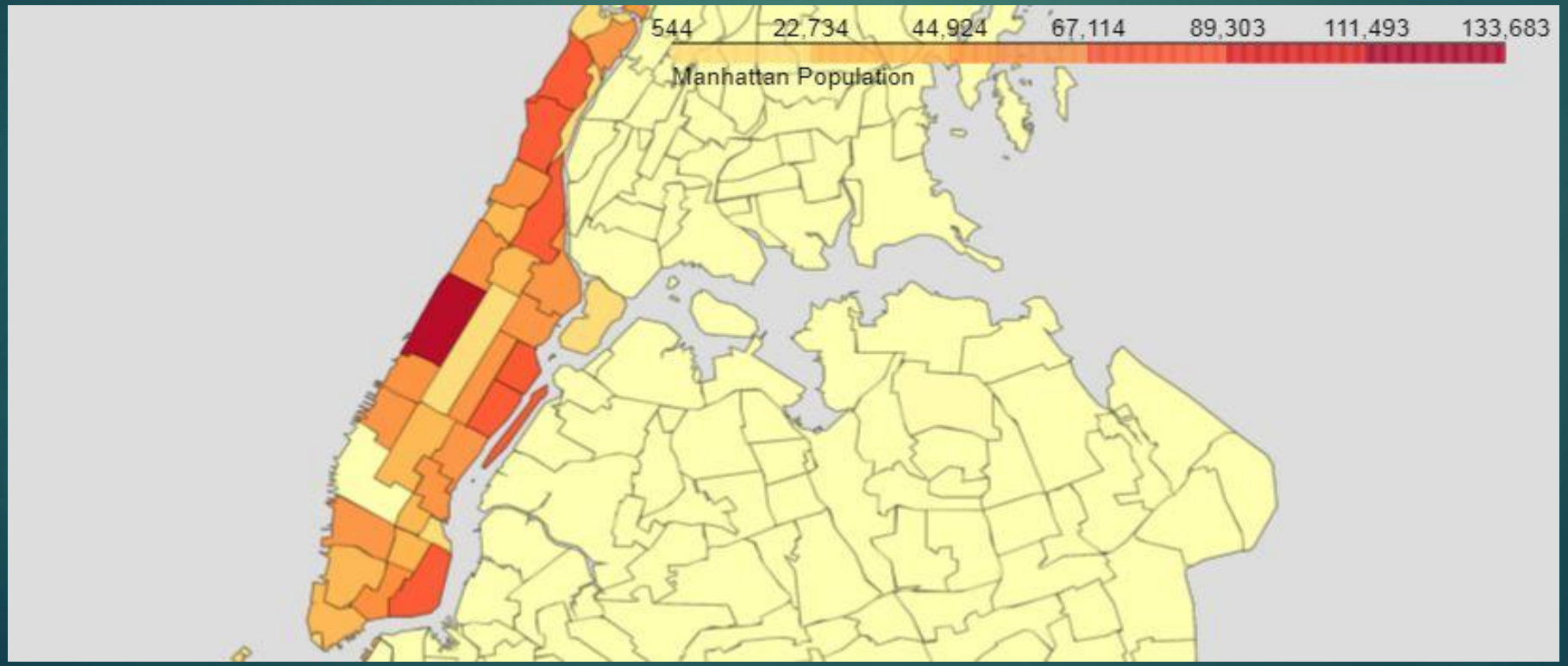
	Neighborhood	Dist to nearest Hospital	Name of hospital	Address	Latitude	Longitude
0	Marble Hill	2.219362	CityMD West 181st Urgent Care - NYC	617-625 W 181st St	40.8499	-73.9344
1	Chinatown	0.430749	CityMD Lower East Side	138 Delancey St.	40.7184	-73.9869
2	Washington Heights	0.188641	CityMD West 181st Urgent Care - NYC	617-625 W 181st St	40.8499	-73.9344
3	Inwood	1.407498	CityMD West 181st Urgent Care - NYC	617-625 W 181st St	40.8499	-73.9344
4	Hamilton Heights	0.217358	CityMD W 146th St.	3556 Broadway	40.8268	-73.9496
5	Manhattanville	0.791695	CityMD W 146th St.	3556 Broadway	40.8268	-73.9496
6	Central Harlem	0.177776	Harlem Hospital Center	506 Malcolm X Blvd	40.8144	-73.9405
7	East Harlem	1.092570	CityMD E 86th St	336 East 86th Street	40.7771	-73.9504

Data visualization for nearest hospital

This is useful for our first set of target audience.

Population density

- To establish a hospital, we should find neighborhoods that are densely populated (with less number of hospitals). So, a Choropleth map which shows population density of a neighborhood is plotted.



Got the boundaries of neighborhood

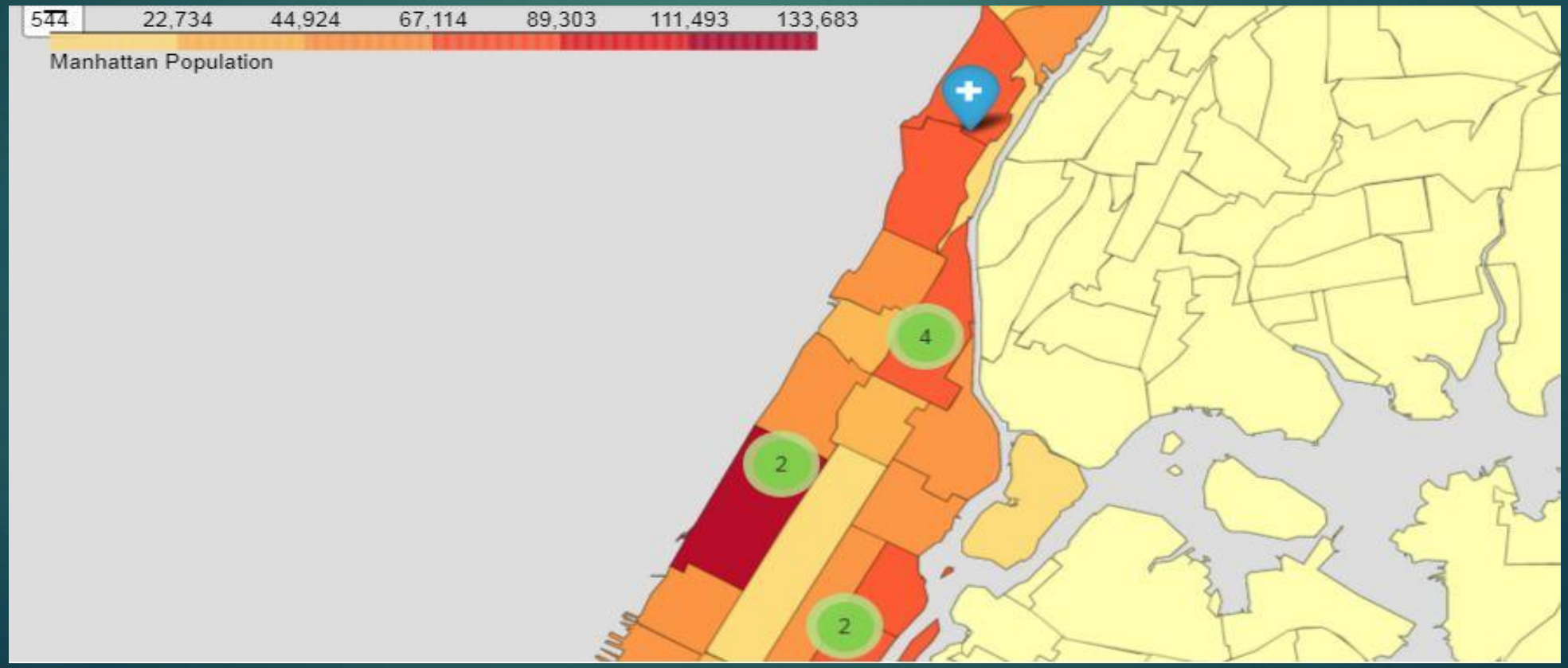
Hospitals in each neighborhood

- Almost every neighborhood in Manhattan has a hospital but few neighborhoods are highly populated and they have fewer or no hospitals. This might be useful for medical professionals to establish a new medical center.
- Get the count of hospitals in each neighborhood

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Address	Venue Category	Distance from Neig to Venue
Central Harlem	40.815976	-73.943211	4	4	4	4	4	4
Financial District	40.707107	-74.010665	2	2	2	2	2	2
Flatiron	40.739673	-73.990947	1	1	1	1	1	1
Greenwich Village	40.726933	-73.999914	1	1	1	1	1	1
Hamilton Heights	40.823604	-73.949688	1	1	1	1	1	1
Lenox Hill	40.768113	-73.958860	1	1	1	1	1	1
Lower East Side	40.717807	-73.980890	1	1	1	1	1	1
Morningside Heights	40.808000	-73.963896	1	1	1	1	1	1
Murray Hill	40.748303	-73.978332	1	1	1	1	1	1
Tudor City	40.746917	-73.971219	1	1	1	1	1	1

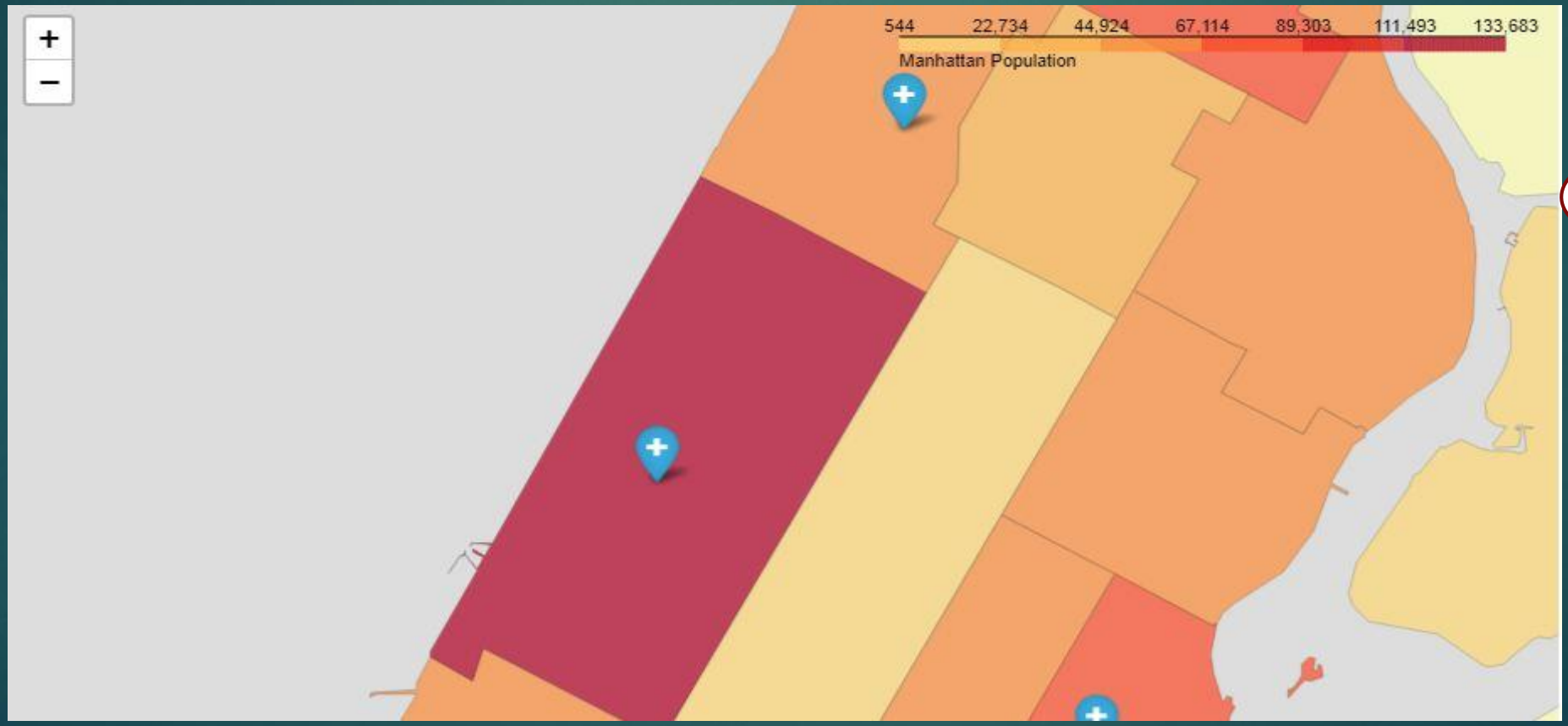
Locations for hospital establishment

- Plot number of hospitals in each neighborhood.
- In the below figure, we could see that few neighborhoods which are overcrowded have less number of hospitals. This might help medical professionals to establish a medical center.



Data Visualization to establish a new hospital

- On zooming the above map, it is clear that crowded neighborhood has only one hospital, as shown in below figure.



Good data. What about a new hospital there?

This might be useful for our second set of target audience.

Conclusion

- Built useful models to predict whether a hospital is near to a particular neighborhood or not, along with the address of the hospital.

- Also found the population density of each neighborhood and plotted number of hospitals along with population density on a map, to establish a new hospital where there are few, by a health care professional.

Future directions

- Capture more traits of hospitals.
- Ideas include:
  - Patient interaction data (Strengths of a hospital)
  - Ratings (for Medical equipment / medical staff)
  - Financial data (Minimum and maximum amount to be paid for a hospital based on the type of treatment)
- Expand the data set by considering other medical centers such as Urgent Care Centers