# Recommender System for Health Care

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# 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.

Cleaned data



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

| | 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

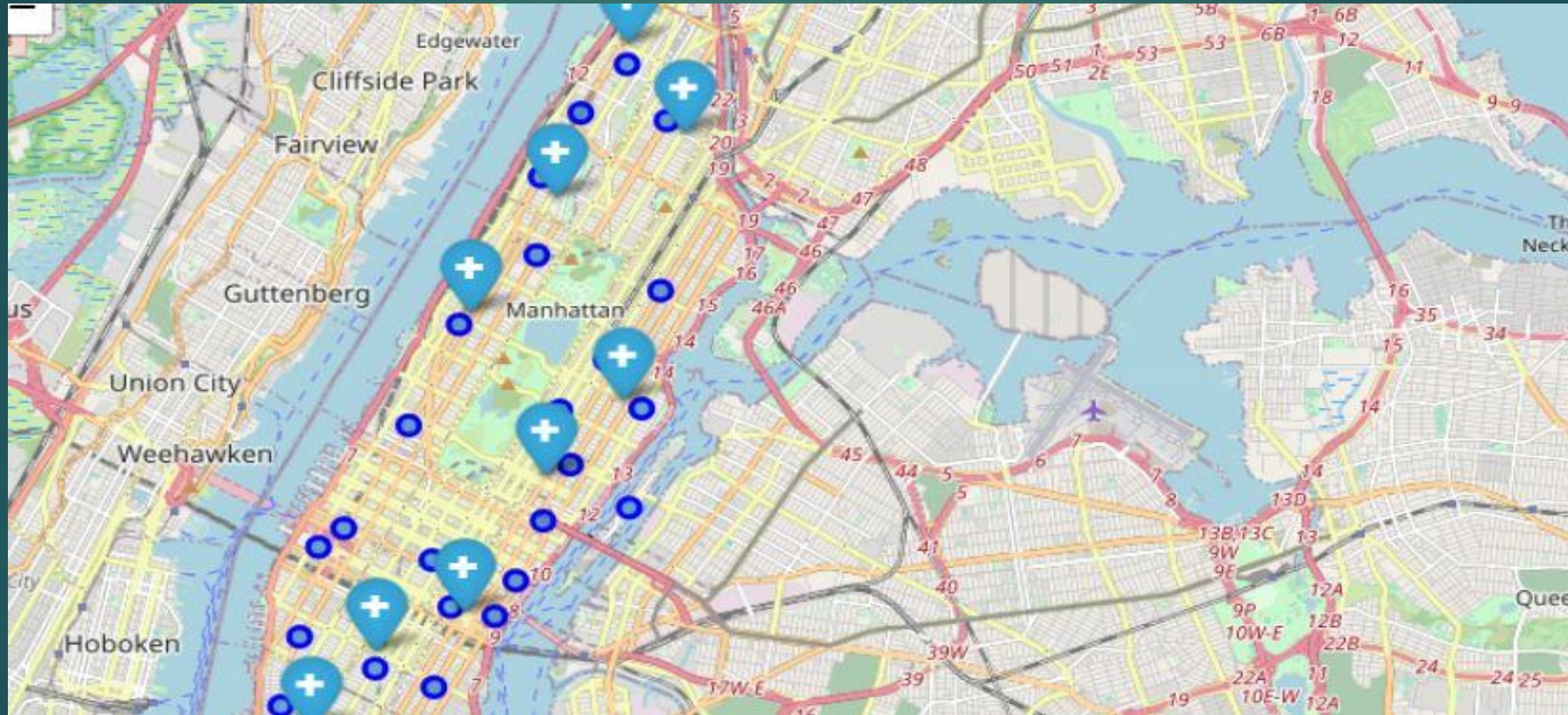| | Neighborhood | Neighborhood Latitude | Neighborhood Longitude | Venue | Venue Latitude | Venue Longitude | Venue Address | Venue Category |
|---|---|---|---|---|---|---|---|---|
| 3 | Marble Hill | 40.876551 | -73.910660 | Marble Hill Dental Office | 40.875783 | -73.908366 | 112 W 228th St | Dentist's 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.

**Found nearest hospital.**

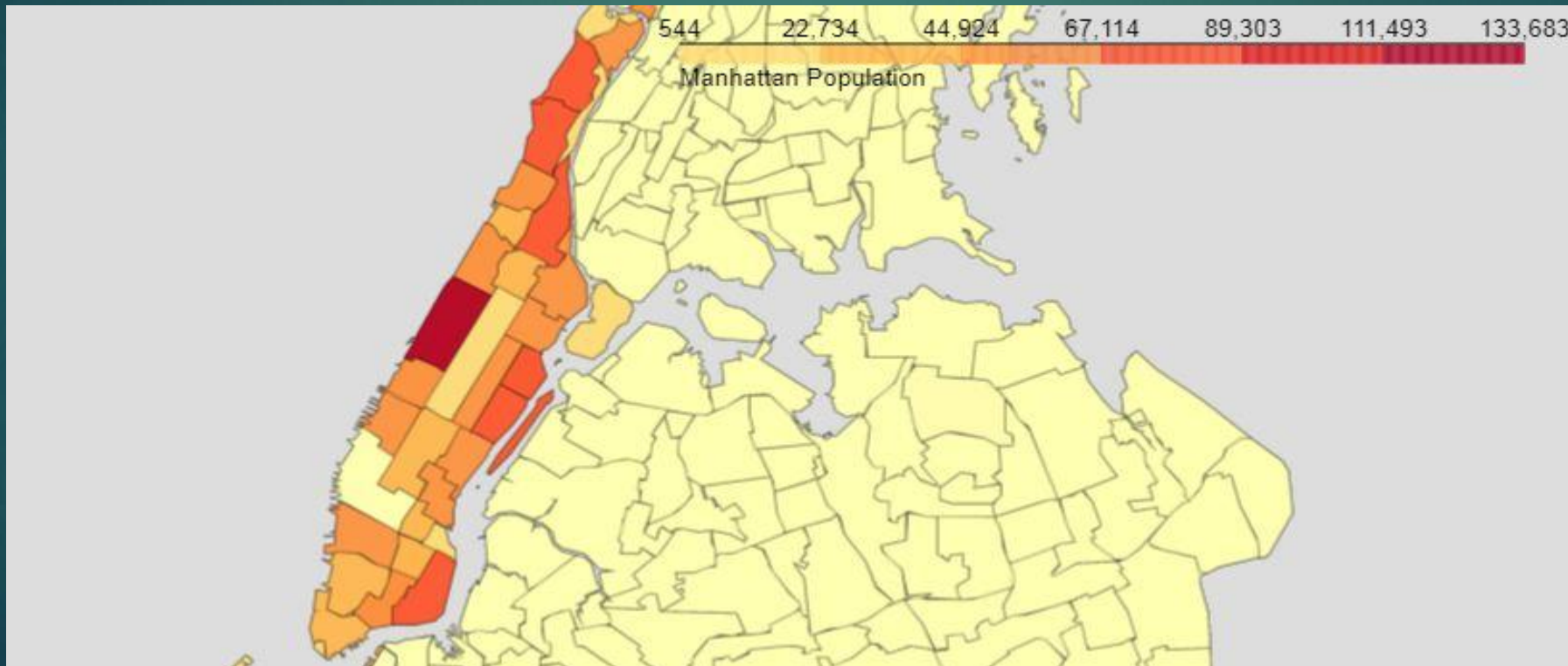| | Neighborhood | Dist to nearest Hospital | Name of hospital | Address | Latitude | Longitude |
|---|---|---|---|---|---|---|
| 0 | Marble Hill | 2.219362 | CityMD West 181st Urgent Care - NYC | 617-625 W 181st St | 40.8499 | -73.9344 |
| 1 | Chinatown | 0.430749 | CityMD Lower East Side | 138 Delancey 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.
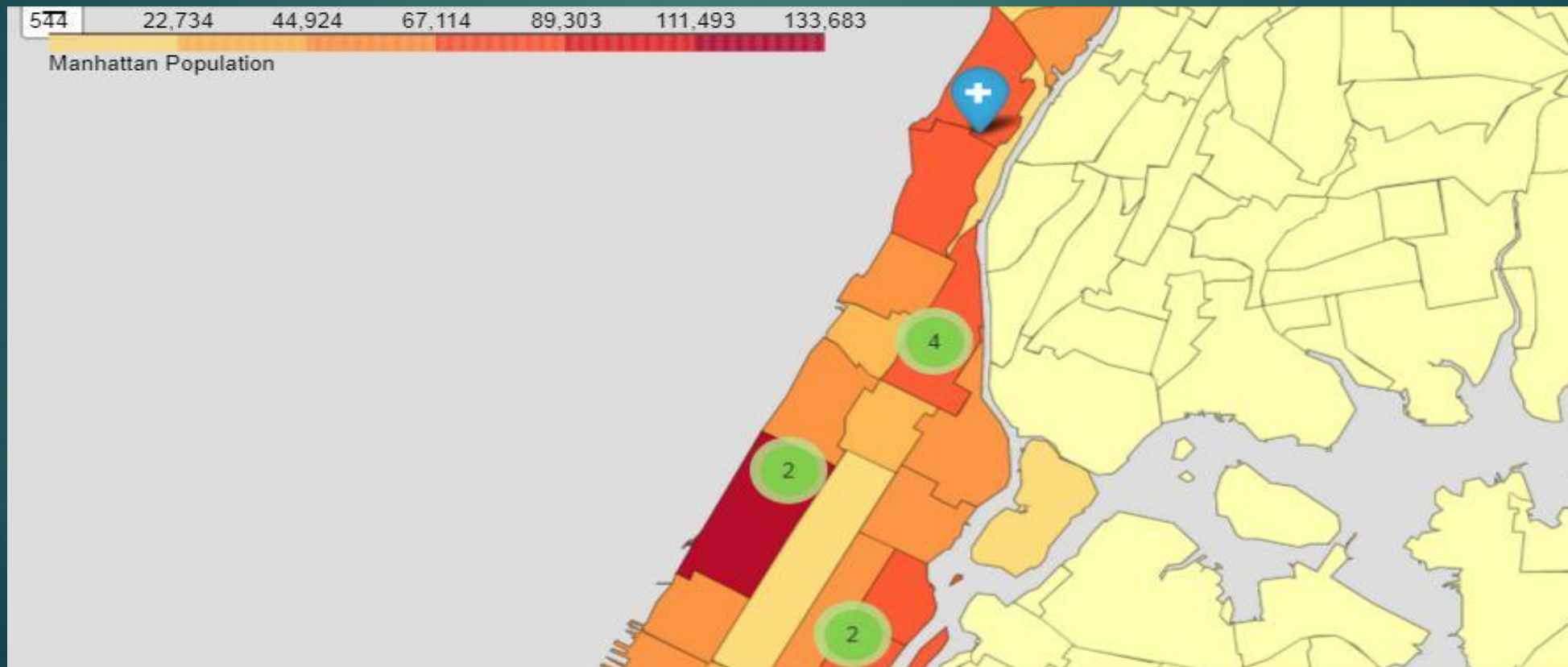


Got the boundaries of neighborhood

# 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

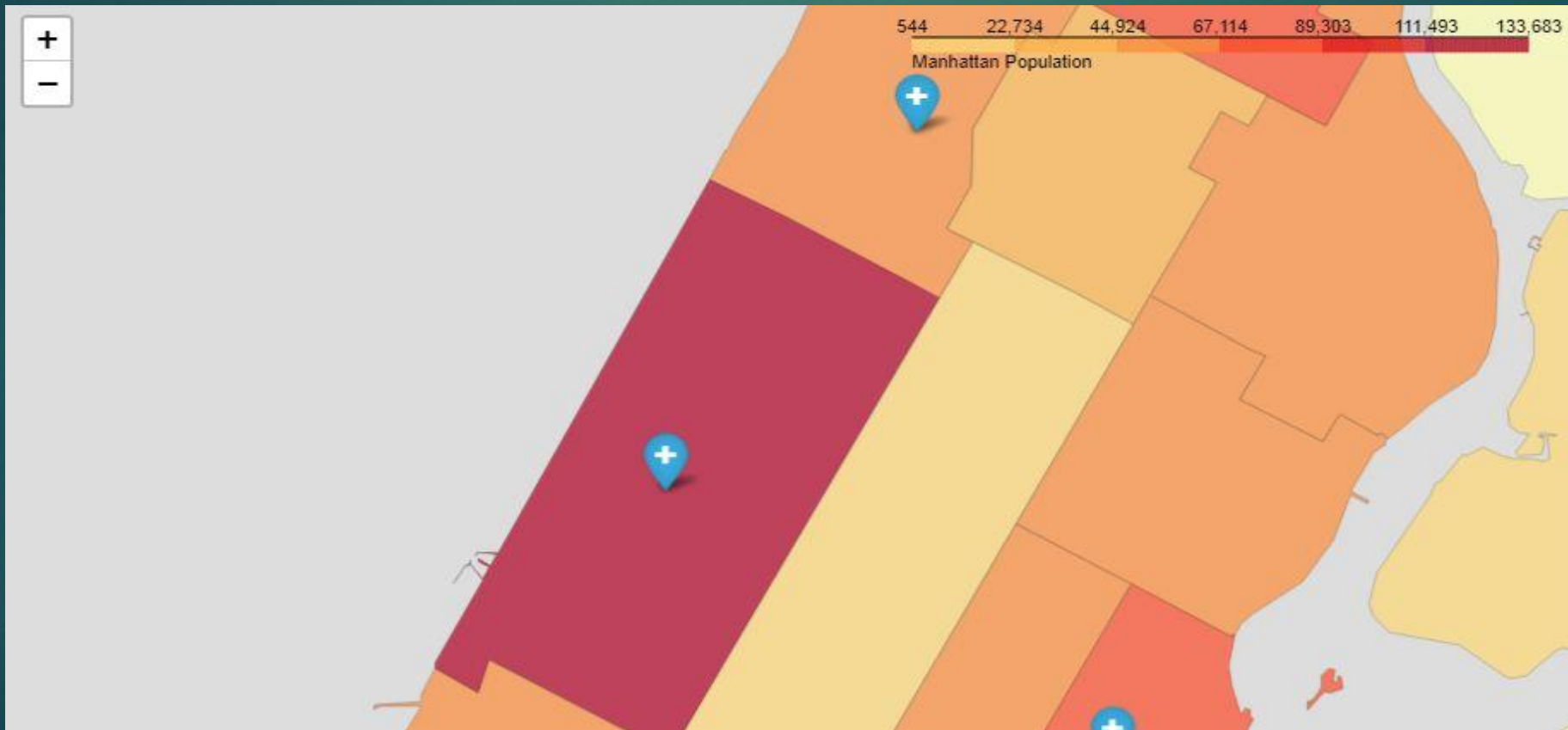| Neighborhood | Neighborhood Latitude | Neighborhood Longitude | Venue | Venue Latitude | Venue Longitude | Venue Address | Venue Category | Distance from Neig to Venue |
|---|---|---|---|---|---|---|---|---|
| Central Harlem | 40.815976 | -73.943211 | 4 | 4 | 4 | 4 | 4 | 4 |
| Financial District | 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.



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


Future Directions for Curriculum