Coursera Applied Data Science Capstone Project: Battle of the Neighborhoods

Introduction

Clearly define a problem or an idea of your choice, where you would need to leverage the Foursquare location data to solve or execute. Remember that data science problems always target an audience and are meant to help a group of stakeholders solve a problem, so make sure that you explicitly describe your audience and why they would care about your problem.

Currently, the COVID-19 virus has spread across the globe, resulting in the latest pandemic. Since March 2020, New York City has seen rapid increase in confirmed cases, leading to a "shelter in place" order issued by the state officials. This means that healthy or sick, all New Yorkers must stay home unless they are essential workers or need urgent health care. All non-essential businesses that are normally open to the public must remain closed. Which neighborhoods are more affected by the latest orders? It would be helpful to understand which businesses are closed / remain open, in order to better redirect resources to support each of the neighborhoods.

Dataset

Describe the data that you will be using to solve the problem or execute your idea. Remember that you will need to use the Foursquare location data to solve the problem or execute your idea. You can absolutely use other datasets in combination with the Foursquare location data. So make sure that you provide adequate explanation and discussion, with examples, of the data that you will be using, even if it is only Foursquare location data.

In this exercise, Foursquare API data of New York City will be used. The explore function will be used to understand the venue types and counts in each neighborhood. Then based on the venue categories, we can assess the imapct of a "shelter in place" order on each neighborhood, mainly whether there are essential businesses (pharmacies and grocery stores, for example) in the area.

Before we get the data and start exploring it, let's download all the dependencies that we will need.

```
In [102]: import numpy as np # library to handle data in a vectorized manner

          import pandas as pd # library for data analsysis
          pd.set_option('display.max_columns', None)
          pd.set_option('display.max_rows', None)

          import json # library to handle JSON files

          #!conda install -c conda-forge geopy --yes # uncomment this line if you have
          n't completed the Foursquare API lab
          from geopy.geocoders import Nominatim # convert an address into latitude and l
          ongitude values

          import requests # library to handle requests
          from pandas.io.json import json_normalize # tranform JSON file into a pandas d
          ataframe

          # Matplotlib and associated plotting modules
          import matplotlib.cm as cm
          import matplotlib.colors as colors

          # import k-means from clustering stage
          from sklearn.cluster import KMeans

          print('Libraries imported.')
```

```
Libraries imported.
```

Dataset 1: NYC location data

We first need to access to a dataset that contains New York City boroughs and the neighborhoods that exist in each of the boroughs, including their latitude and longtitude coordinates in order to segment them.

```
In [103]: !wget -q -O 'newyork_data.json' https://cocl.us/new_york_dataset
          print('Data downloaded!')
```

```
Data downloaded!
```

```
In [104]: # load the data
          with open('newyork_data.json') as json_data:
              newyork_data = json.load(json_data)
```

```python
# preview data set
newyork_data
```

```
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      'annoline3': None,
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      'annoline2': 'Hills',
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```

In [106]: # define new variable for new data
           neighborhoods_data = newyork_data['features']
           neighborhoods_data[0]

Out[106]: {'type': 'Feature',
            'id': 'nyu_2451_34572.1',
            'geometry': {'type': 'Point',
             'coordinates': [-73.84720052054902, 40.89470517661]},
            'geometry_name': 'geom',
            'properties': {'name': 'Wakefield',
             'stacked': 1,
             'annoline1': 'Wakefield',
             'annoline2': None,
             'annoline3': None,
             'annoangle': 0.0,
             'borough': 'Bronx',
             'bbox': [-73.84720052054902,
              40.89470517661,
              -73.84720052054902,
              40.89470517661]}}

The next task is to transform this data of nested Python dictionaries into a pandas dataframe.

```
In [107]:  # define the dataframe columns
           column_names = ['Borough', 'Neighborhood', 'Latitude', 'Longitude']

           # instantiate the dataframe
           neighborhoods = pd.DataFrame(columns=column_names)

           # make sure data is loaded as intended
           neighborhoods

Out[107]:
```

Borough	Neighborhood	Latitude	Longitude

```
In [108]:  # loop through data and fill dataframe one row at a time
           for data in neighborhoods_data:
               borough = neighborhood_name = data['properties']['borough']
               neighborhood_name = data['properties']['name']

               neighborhood_latlon = data['geometry']['coordinates']
               neighborhood_lat = neighborhood_latlon[1]
               neighborhood_lon = neighborhood_latlon[0]

               neighborhoods = neighborhoods.append({'Borough': borough,
                                                     'Neighborhood': neighborhood_name,
                                                     'Latitude': neighborhood_lat,
                                                     'Longitude': neighborhood_lon}, igno
           re_index=True)
```

```
In [109]:  # preview the dataframe
           neighborhoods.head()
```

Out[109]:

	Borough	Neighborhood	Latitude	Longitude
0	Bronx	Wakefield	40.894705	-73.847201
1	Bronx	Co-op City	40.874294	-73.829939
2	Bronx	Eastchester	40.887556	-73.827806
3	Bronx	Fieldston	40.895437	-73.905643
4	Bronx	Riverdale	40.890834	-73.912585

```
In [110]:  # confirm the counts of boroughs and neightborhoods
           print('The dataframe has {} boroughs and {} neighborhoods.'.format(
                   len(neighborhoods['Borough'].unique()),
                   neighborhoods.shape[0]
               )
           )
```

           The dataframe has 5 boroughs and 306 neighborhoods.

Use geopy library to get the latitude and longitude values of New York City.

```
In [111]:  # In order to define an instance of the geocoder, we need to define a user_age
           nt.
           address = 'New York City, NY'

           geolocator = Nominatim(user_agent="ny_explorer")
           location = geolocator.geocode(address)
           latitude = location.latitude
           longitude = location.longitude
           print('The geograpical coordinate of New York City are {}, {}.'.format(latitud
           e, longitude))
```

           The geograpical coordinate of New York City are 40.7127281, -74.0060152.

Dataset 2: Venue data from Foursquare

We are going to start utilizing the Foursquare API to explore the neighborhoods and segment them.

```
In [112]:  # first connect to Foursquare
           CLIENT_ID = 'XYBBZ53ERCZVWM31JLR23FENUE52G0DLBDHQZ3NCV2HZAVNO' # your Foursqua
           re ID
           CLIENT_SECRET = 'FI5Z1KGO3PHTXFB1TQZGJXGGLXZZARJIEU23MXN0CCDU0ZUS' # your Four
           square Secret
           VERSION = '20200323' # Foursquare API version

           print('Your credentials:')
           print('CLIENT_ID: ' + CLIENT_ID)
           print('CLIENT_SECRET:' + CLIENT_SECRET)

           Your credentials:
           CLIENT_ID: XYBBZ53ERCZVWM31JLR23FENUE52G0DLBDHQZ3NCV2HZAVNO
           CLIENT_SECRET:FI5Z1KGO3PHTXFB1TQZGJXGGLXZZARJIEU23MXN0CCDU0ZUS
```

We first explore a single neighborhood in NYC to verify that the two datasets that we have identified could be used together. For the sake of simplicity we focus on the central area in NYC, Manhattan.

```
In [113]:  # filter for manhattan only and reset index
           manhattan_data = neighborhoods[neighborhoods['Borough'] == 'Manhattan'].reset_
           index(drop=True)
           manhattan_data.head()
```

Out[113]:

	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

```
In [114]:  address = 'Manhattan, NY'

           geolocator = Nominatim(user_agent="ny_explorer")
           location = geolocator.geocode(address)
           latitude = location.latitude
           longitude = location.longitude
           print('The geograpical coordinate of Manhattan are {}, {}.'.format(latitude, l
           ongitude))

           The geograpical coordinate of Manhattan are 40.7896239, -73.9598939.
```

```
In [115]:  # get the first neighborhood in manhattan
           manhattan_data.loc[0, 'Neighborhood']
```

Out[115]: 'Marble Hill'

```
In [116]:  neighborhood_latitude = manhattan_data.loc[0, 'Latitude'] # neighborhood latit
           ude value
           neighborhood_longitude = manhattan_data.loc[0, 'Longitude'] # neighborhood lon
           gitude value

           neighborhood_name = manhattan_data.loc[0, 'Neighborhood'] # neighborhood name

           print('Latitude and longitude values of {} are {}, {}.'.format(neighborhood_na
           me,
                                                                   neighborhood_la
           titude,
                                                                   neighborhood_lo
           ngitude))
```

```
Latitude and longitude values of Marble Hill are 40.87655077879964, -73.91065
965862981.
```

Now, let's get the top 100 venues that are in Marble Hill within a radius of 500 meters.

```
In [117]:  LIMIT = 100 # limit of number of venues returned by Foursquare API
           radius = 500 # define radius
           url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secre
           t={}&v={}&ll={},{}&radius={}&limit={}'.format(
               CLIENT_ID,
               CLIENT_SECRET,
               VERSION,
               neighborhood_latitude,
               neighborhood_longitude,
               radius,
               LIMIT) #create URL
           url # display URL
```

```
Out[117]:  'https://api.foursquare.com/v2/venues/explore?&client_id=XYBBZ53ERCZVWM31JLR2
           3FENUE52G0DLBDHQZ3NCV2HZAVNO&client_secret=FI5Z1KGO3PHTXFB1TQZGJXGGLXZZARJIEU
           23MXN0CCDU0ZUS&v=20200323&ll=40.87655077879964,-73.91065965862981&radius=500&
           limit=100'
```

```
In [118]:  # send ET request to Foursquare
           results = requests.get(url).json()
           results
```

```
Out[118]: {'meta': {'code': 200, 'requestId': '5e7c51a8f7706a0023eb5adf'},
          'response': {'headerLocation': 'Marble Hill',
           'headerFullLocation': 'Marble Hill, New York',
           'headerLocationGranularity': 'neighborhood',
           'totalResults': 24,
           'suggestedBounds': {'ne': {'lat': 40.88105078329964,
             'lng': -73.90471933917806},
            'sw': {'lat': 40.87205077429964, 'lng': -73.91659997808156}},
           'groups': [{'type': 'Recommended Places',
             'name': 'recommended',
             'items': [{'reasons': {'count': 0,
                'items': [{'summary': 'This spot is popular',
                  'type': 'general',
                  'reasonName': 'globalInteractionReason'}]},
               'venue': {'id': '4b4429abf964a52037f225e3',
                'name': "Arturo's",
                'location': {'address': '5198 Broadway',
                 'crossStreet': 'at 225th St.',
                 'lat': 40.87441177110231,
                 'lng': -73.91027100981574,
                 'labeledLatLngs': [{'label': 'display',
                   'lat': 40.87441177110231,
                   'lng': -73.91027100981574}],
                 'distance': 240,
                 'postalCode': '10463',
                 'cc': 'US',
                 'city': 'New York',
                 'state': 'NY',
                 'country': 'United States',
                 'formattedAddress': ['5198 Broadway (at 225th St.)',
                  'New York, NY 10463',
                  'United States']},
                'categories': [{'id': '4bf58dd8d48988d1ca941735',
                  'name': 'Pizza Place',
                  'pluralName': 'Pizza Places',
                  'shortName': 'Pizza',
                  'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/pizz
a_',
                   'suffix': '.png'},
                  'primary': True}],
                'delivery': {'id': '72548',
                 'url': 'https://www.seamless.com/menu/arturos-pizza-5189-broadway-ave
-new-york/72548?affiliate=1131&utm_source=foursquare-affiliate-network&utm_me
dium=affiliate&utm_campaign=1131&utm_content=72548',
                 'provider': {'name': 'seamless',
                  'icon': {'prefix': 'https://fastly.4sqi.net/img/general/cap/',
                   'sizes': [40, 50],
                   'name': '/delivery_provider_seamless_20180129.png'}}},
                'photos': {'count': 0, 'groups': []}},
               'referralId': 'e-0-4b4429abf964a52037f225e3-0'},
              {'reasons': {'count': 0,
                'items': [{'summary': 'This spot is popular',
                  'type': 'general',
                  'reasonName': 'globalInteractionReason'}]},
               'venue': {'id': '4baf59e8f964a520a6f93be3',
                'name': 'Bikram Yoga',
                'location': {'address': '5500 Broadway',
```

              'crossStreet': '230th Street',
              'lat': 40.876843690797934,
              'lng': -73.90620384419528,
              'labeledLatLngs': [{'label': 'display',
                'lat': 40.876843690797934,
                'lng': -73.90620384419528}],
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              'postalCode': '10463',
              'cc': 'US',
              'city': 'Bronx',
              'state': 'NY',
              'country': 'United States',
              'formattedAddress': ['5500 Broadway (230th Street)',
                'Bronx, NY 10463',
                'United States']},
             'categories': [{'id': '4bf58dd8d48988d102941735',
                'name': 'Yoga Studio',
                'pluralName': 'Yoga Studios',
                'shortName': 'Yoga Studio',
                'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/gym
yogastudio',
                 'suffix': '.png'},
                'primary': True}],
             'photos': {'count': 0, 'groups': []}},
           'referralId': 'e-0-4baf59e8f964a520a6f93be3-1'},
          {'reasons': {'count': 0,
            'items': [{'summary': 'This spot is popular',
                'type': 'general',
                'reasonName': 'globalInteractionReason'}]},
           'venue': {'id': '4b79cc46f964a520c5122fe3',
            'name': 'Tibbett Diner',
            'location': {'address': '3033 Tibbett Ave',
              'crossStreet': 'btwn 230th & 231st',
              'lat': 40.8804044222466,
              'lng': -73.90893738006402,
              'labeledLatLngs': [{'label': 'display',
                'lat': 40.8804044222466,
                'lng': -73.90893738006402}],
              'distance': 452,
              'postalCode': '10463',
              'cc': 'US',
              'city': 'Bronx',
              'state': 'NY',
              'country': 'United States',
              'formattedAddress': ['3033 Tibbett Ave (btwn 230th & 231st)',
                'Bronx, NY 10463',
                'United States']},
             'categories': [{'id': '4bf58dd8d48988d147941735',
                'name': 'Diner',
                'pluralName': 'Diners',
                'shortName': 'Diner',
                'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/dine
r_',
                 'suffix': '.png'},
                'primary': True}],
             'photos': {'count': 0, 'groups': []}},
           'referralId': 'e-0-4b79cc46f964a520c5122fe3-2'},

{'reasons': {'count': 0,
  'items': [{'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason'}]},
 'venue': {'id': '4b5357adf964a520319827e3',
  'name': "Dunkin'",
  'location': {'address': '5501 Broadway',
   'crossStreet': 'W 230th St',
   'lat': 40.87713584201589,
   'lng': -73.90666550701411,
   'labeledLatLngs': [{'label': 'display',
     'lat': 40.87713584201589,
     'lng': -73.90666550701411}],
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   'postalCode': '10463',
   'cc': 'US',
   'city': 'Bronx',
   'state': 'NY',
   'country': 'United States',
   'formattedAddress': ['5501 Broadway (W 230th St)',
    'Bronx, NY 10463',
    'United States']},
  'categories': [{'id': '4bf58dd8d48988d148941735',
    'name': 'Donut Shop',
    'pluralName': 'Donut Shops',
    'shortName': 'Donuts',
    'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/donu
ts_',
     'suffix': '.png'},
    'primary': True}],
  'photos': {'count': 0, 'groups': []}},
 'referralId': 'e-0-4b5357adf964a520319827e3-3'},
{'reasons': {'count': 0,
  'items': [{'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason'}]},
 'venue': {'id': '55f81cd2498ee903149fcc64',
  'name': 'Starbucks',
  'location': {'address': '171 W 230th St',
   'crossStreet': 'Kimberly Pl',
   'lat': 40.87753134921497,
   'lng': -73.90558216359267,
   'labeledLatLngs': [{'label': 'display',
     'lat': 40.87753134921497,
     'lng': -73.90558216359267}],
   'distance': 441,
   'postalCode': '10463',
   'cc': 'US',
   'city': 'Bronx',
   'state': 'NY',
   'country': 'United States',
   'formattedAddress': ['171 W 230th St (Kimberly Pl)',
    'Bronx, NY 10463',
    'United States']},
  'categories': [{'id': '4bf58dd8d48988d1e0931735',
    'name': 'Coffee Shop',
    'pluralName': 'Coffee Shops',

              'shortName': 'Coffee Shop',
              'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/coff
eeshop_',
                'suffix': '.png'},
              'primary': True}],
          'photos': {'count': 0, 'groups': []}},
        'referralId': 'e-0-55f81cd2498ee903149fcc64-4'},
      {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
          'type': 'general',
          'reasonName': 'globalInteractionReason'}]},
       'venue': {'id': '4cf6ae55d3a8a1cd71a9d243',
        'name': 'Astral Fitness & Wellness Center',
        'location': {'address': '5500 Broadway',
          'crossStreet': '230th St',
          'lat': 40.876670526507199,
          'lng': -73.90637207670373,
          'labeledLatLngs': [{'label': 'display',
            'lat': 40.87670526507199,
            'lng': -73.90637207670373}],
          'distance': 361,
          'postalCode': '10463',
          'cc': 'US',
          'city': 'Bronx',
          'state': 'NY',
          'country': 'United States',
          'formattedAddress': ['5500 Broadway (230th St)',
           'Bronx, NY 10463',
           'United States']},
        'categories': [{'id': '4bf58dd8d48988d176941735',
            'name': 'Gym',
            'pluralName': 'Gyms',
            'shortName': 'Gym',
            'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/building/
gym_',
              'suffix': '.png'},
            'primary': True}],
          'photos': {'count': 0, 'groups': []},
          'venuePage': {'id': '75803748'}},
        'referralId': 'e-0-4cf6ae55d3a8a1cd71a9d243-5'},
      {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
          'type': 'general',
          'reasonName': 'globalInteractionReason'}]},
       'venue': {'id': '55f751ca498eacc0307d1cfe',
        'name': 'Blink Fitness',
        'location': {'address': '5520 Broadway',
          'crossStreet': 'at W 230th St',
          'lat': 40.877271495944626,
          'lng': -73.90559491338075,
          'labeledLatLngs': [{'label': 'display',
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            'lng': -73.90559491338075}],
          'distance': 433,
          'postalCode': '10463',
          'cc': 'US',
          'neighborhood': 'Kingsbridge',

         'city': 'Bronx',
         'state': 'NY',
         'country': 'United States',
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          'Bronx, NY 10463',
          'United States']},
        'categories': [{'id': '4bf58dd8d48988d176941735',
          'name': 'Gym',
          'pluralName': 'Gyms',
          'shortName': 'Gym',
          'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/building/
gym_',
          'suffix': '.png'},
          'primary': True}],
        'photos': {'count': 0, 'groups': []}},
       'referralId': 'e-0-55f751ca498eacc0307d1cfe-6'},
      {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
          'type': 'general',
          'reasonName': 'globalInteractionReason'}]},
       'venue': {'id': '546d31ca498e561c698a0320',
        'name': 'T.J. Maxx',
        'location': {'lat': 40.87723198343352,
         'lng': -73.90504239962168,
         'labeledLatLngs': [{'label': 'display',
           'lat': 40.87723198343352,
           'lng': -73.90504239962168}],
         'distance': 478,
         'cc': 'US',
         'city': 'Bronx',
         'state': 'NY',
         'country': 'United States',
         'formattedAddress': ['Bronx, NY', 'United States']},
        'categories': [{'id': '4bf58dd8d48988d1f6941735',
          'name': 'Department Store',
          'pluralName': 'Department Stores',
          'shortName': 'Department Store',
          'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/dep
artmentstore_',
          'suffix': '.png'},
          'primary': True}],
        'photos': {'count': 0, 'groups': []}},
       'referralId': 'e-0-546d31ca498e561c698a0320-7'},
      {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
          'type': 'general',
          'reasonName': 'globalInteractionReason'}]},
       'venue': {'id': '4b9c9c6af964a520b27236e3',
        'name': 'Land & Sea Restaurant',
        'location': {'address': '5535 Broadway',
         'crossStreet': '231st St',
         'lat': 40.87788463309788,
         'lng': -73.90587282193539,
         'labeledLatLngs': [{'label': 'display',
           'lat': 40.87788463309788,
           'lng': -73.90587282193539}],
         'distance': 429,

                'postalCode': '10463',
                'cc': 'US',
                'city': 'Bronx',
                'state': 'NY',
                'country': 'United States',
                'formattedAddress': ['5535 Broadway (231st St)',
                'Bronx, NY 10463',
                'United States']},
            'categories': [{'id': '4bf58dd8d48988d1ce941735',
                'name': 'Seafood Restaurant',
                'pluralName': 'Seafood Restaurants',
                'shortName': 'Seafood',
                'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/seaf
ood_',
                'suffix': '.png'},
                'primary': True}],
            'photos': {'count': 0, 'groups': []}},
        'referralId': 'e-0-4b9c9c6af964a520b27236e3-8'},
        {'reasons': {'count': 0,
            'items': [{'summary': 'This spot is popular',
                'type': 'general',
                'reasonName': 'globalInteractionReason'}]},
        'venue': {'id': '4a725fa1f964a520f6da1fe3',
            'name': 'TCR The Club of Riverdale',
            'location': {'address': '2600 Netherland Ave',
            'lat': 40.8786283,
            'lng': -73.9145678,
            'labeledLatLngs': [{'label': 'display',
                'lat': 40.8786283,
                'lng': -73.9145678}],
            'distance': 402,
            'postalCode': '10463',
            'cc': 'US',
            'city': 'Bronx',
            'state': 'NY',
            'country': 'United States',
            'formattedAddress': ['2600 Netherland Ave',
            'Bronx, NY 10463',
            'United States']},
            'categories': [{'id': '4e39a891bd410d7aed40cbc2',
                'name': 'Tennis Stadium',
                'pluralName': 'Tennis Stadiums',
                'shortName': 'Tennis',
                'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/arts_ente
rtainment/stadium_tennis_',
                'suffix': '.png'},
                'primary': True}],
            'photos': {'count': 0, 'groups': []},
            'venuePage': {'id': '40358759'}},
        'referralId': 'e-0-4a725fa1f964a520f6da1fe3-9'},
        {'reasons': {'count': 0,
            'items': [{'summary': 'This spot is popular',
                'type': 'general',
                'reasonName': 'globalInteractionReason'}]},
        'venue': {'id': '4b88e053f964a5208a1132e3',
            'name': 'Rite Aid',
            'location': {'address': '5237 Broadway',

            'crossStreet': '228th Street',
            'lat': 40.875466574434704,
            'lng': -73.90890629016033,
            'labeledLatLngs': [{'label': 'display',
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              'lng': -73.90890629016033}],
            'distance': 190,
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            'cc': 'US',
            'city': 'Bronx',
            'state': 'NY',
            'country': 'United States',
            'formattedAddress': ['5237 Broadway (228th Street)',
             'Bronx, NY 10463',
             'United States']},
           'categories': [{'id': '4bf58dd8d48988d10f951735',
             'name': 'Pharmacy',
             'pluralName': 'Pharmacies',
             'shortName': 'Pharmacy',
             'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/pha
rmacy_',
              'suffix': '.png'},
             'primary': True}],
           'photos': {'count': 0, 'groups': []}},
          'referralId': 'e-0-4b88e053f964a5208a1132e3-10'},
         {'reasons': {'count': 0,
           'items': [{'summary': 'This spot is popular',
             'type': 'general',
             'reasonName': 'globalInteractionReason'}]},
          'venue': {'id': '57655be738faa66160da7527',
           'name': 'Starbucks',
           'location': {'address': '50 W 225th St',
            'lat': 40.873754554218515,
            'lng': -73.90861305343668,
            'labeledLatLngs': [{'label': 'display',
              'lat': 40.873754554218515,
              'lng': -73.90861305343668}],
            'distance': 355,
            'postalCode': '10463',
            'cc': 'US',
            'city': 'New York',
            'state': 'NY',
            'country': 'United States',
            'formattedAddress': ['50 W 225th St',
             'New York, NY 10463',
             'United States']},
           'categories': [{'id': '4bf58dd8d48988d1e0931735',
             'name': 'Coffee Shop',
             'pluralName': 'Coffee Shops',
             'shortName': 'Coffee Shop',
             'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/coff
eeshop_',
              'suffix': '.png'},
             'primary': True}],
           'photos': {'count': 0, 'groups': []}},
          'referralId': 'e-0-57655be738faa66160da7527-11'},
         {'reasons': {'count': 0,

       'items': [{'summary': 'This spot is popular',
         'type': 'general',
         'reasonName': 'globalInteractionReason'}]},
      'venue': {'id': '4b9c9c43f964a520ac7236e3',
       'name': 'Lot Less Closeouts',
       'location': {'address': '5545 Broadway',
        'crossStreet': '231st St',
        'lat': 40.878270422202085,
        'lng': -73.9052646742604,
        'labeledLatLngs': [{'label': 'display',
          'lat': 40.878270422202085,
          'lng': -73.9052646742604}],
        'distance': 492,
        'postalCode': '10463',
        'cc': 'US',
        'city': 'Bronx',
        'state': 'NY',
        'country': 'United States',
        'formattedAddress': ['5545 Broadway (231st St)',
         'Bronx, NY 10463',
         'United States']},
       'categories': [{'id': '52dea92d3cf9994f4e043dbb',
         'name': 'Discount Store',
         'pluralName': 'Discount Stores',
         'shortName': 'Discount Store',
         'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/dis
countstore_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-4b9c9c43f964a520ac7236e3-12'},
     {'reasons': {'count': 0,
       'items': [{'summary': 'This spot is popular',
         'type': 'general',
         'reasonName': 'globalInteractionReason'}]},
      'venue': {'id': '5631194e498e2de074de661c',
       'name': 'Vitamin Shoppe',
       'location': {'address': '5510 Broadway',
        'lat': 40.87716,
        'lng': -73.905632,
        'labeledLatLngs': [{'label': 'display',
          'lat': 40.87716,
          'lng': -73.905632}],
        'distance': 428,
        'postalCode': '10463',
        'cc': 'US',
        'city': 'Bronx',
        'state': 'NY',
        'country': 'United States',
        'formattedAddress': ['5510 Broadway',
         'Bronx, NY 10463',
         'United States']},
       'categories': [{'id': '5744ccdfe4b0c0459246b4cd',
         'name': 'Supplement Shop',
         'pluralName': 'Supplement Shops',
         'shortName': 'Supplement Shop',
         'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/educatio

n/lab_',
            'suffix': '.png'},
           'primary': True}],
         'photos': {'count': 0, 'groups': []}},
        'referralId': 'e-0-5631194e498e2de074de661c-13'},
       {'reasons': {'count': 0,
         'items': [{'summary': 'This spot is popular',
           'type': 'general',
           'reasonName': 'globalInteractionReason'}]},
        'venue': {'id': '4e4e4517bd4101d0d7a67568',
         'name': 'Baskin-Robbins',
         'location': {'address': '5501 Broadway',
          'lat': 40.87714929478882,
          'lng': -73.90665810372622,
          'labeledLatLngs': [{'label': 'display',
            'lat': 40.87714929478882,
            'lng': -73.90665810372622}],
          'distance': 343,
          'postalCode': '10463',
          'cc': 'US',
          'city': 'Bronx',
          'state': 'NY',
          'country': 'United States',
          'formattedAddress': ['5501 Broadway',
           'Bronx, NY 10463',
           'United States']},
         'categories': [{'id': '4bf58dd8d48988d1c9941735',
           'name': 'Ice Cream Shop',
           'pluralName': 'Ice Cream Shops',
           'shortName': 'Ice Cream',
           'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/icec
ream_',
            'suffix': '.png'},
           'primary': True}],
         'photos': {'count': 0, 'groups': []}},
        'referralId': 'e-0-4e4e4517bd4101d0d7a67568-14'},
       {'reasons': {'count': 0,
         'items': [{'summary': 'This spot is popular',
           'type': 'general',
           'reasonName': 'globalInteractionReason'}]},
        'venue': {'id': '4b4f7b65f964a5205a0827e3',
         'name': 'Subway Sandwiches',
         'location': {'address': '5209 Broadway',
          'lat': 40.8746665302951,
          'lng': -73.9095858429637,
          'labeledLatLngs': [{'label': 'display',
            'lat': 40.8746665302951,
            'lng': -73.9095858429637}],
          'distance': 228,
          'postalCode': '10463',
          'cc': 'US',
          'city': 'Bronx',
          'state': 'NY',
          'country': 'United States',
          'formattedAddress': ['5209 Broadway',
           'Bronx, NY 10463',
           'United States']},

              'categories': [{'id': '4bf58dd8d48988d1c5941735',
                'name': 'Sandwich Place',
                'pluralName': 'Sandwich Places',
                'shortName': 'Sandwiches',
                'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/deli
_',
                'suffix': '.png'},
                'primary': True}],
              'photos': {'count': 0, 'groups': []}},
            'referralId': 'e-0-4b4f7b65f964a5205a0827e3-15'},
          {'reasons': {'count': 0,
            'items': [{'summary': 'This spot is popular',
                'type': 'general',
                'reasonName': 'globalInteractionReason'}]},
            'venue': {'id': '56229ff8498e2abb44b6f12b',
              'name': 'Five Below',
              'location': {'address': '171 W 230th St',
                'lat': 40.8772564,
                'lng': -73.9049384,
                'labeledLatLngs': [{'label': 'display',
                  'lat': 40.8772564,
                  'lng': -73.9049384}],
                'distance': 487,
                'postalCode': '10463',
                'cc': 'US',
                'city': 'Bronx',
                'state': 'NY',
                'country': 'United States',
                'formattedAddress': ['171 W 230th St',
                  'Bronx, NY 10463',
                  'United States']},
              'categories': [{'id': '4bf58dd8d48988d1ff941735',
                'name': 'Miscellaneous Shop',
                'pluralName': 'Miscellaneous Shops',
                'shortName': 'Shop',
                'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/def
ault_',
                'suffix': '.png'},
                'primary': True}],
              'photos': {'count': 0, 'groups': []}},
            'referralId': 'e-0-56229ff8498e2abb44b6f12b-16'},
          {'reasons': {'count': 0,
            'items': [{'summary': 'This spot is popular',
                'type': 'general',
                'reasonName': 'globalInteractionReason'}]},
            'venue': {'id': '585c205665e7c70a2f1055ea',
              'name': 'Boston Market',
              'location': {'address': '5520 Broadway',
                'lat': 40.87743,
                'lng': -73.9054121,
                'labeledLatLngs': [{'label': 'display',
                  'lat': 40.87743,
                  'lng': -73.9054121}],
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                'cc': 'US',
                'city': 'Bronx',

              'state': 'NY',
              'country': 'United States',
              'formattedAddress': ['5520 Broadway',
               'Bronx, NY 10463',
               'United States']},
            'categories': [{'id': '4bf58dd8d48988d14e941735',
              'name': 'American Restaurant',
              'pluralName': 'American Restaurants',
              'shortName': 'American',
              'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/defa
ult_',
              'suffix': '.png'},
              'primary': True}],
            'delivery': {'id': '1436334',
             'url': 'https://www.seamless.com/menu/boston-market-5520-broadway-bro
nx/1436334?affiliate=1131&utm_source=foursquare-affiliate-network&utm_medium=
affiliate&utm_campaign=1131&utm_content=1436334',
             'provider': {'name': 'seamless',
              'icon': {'prefix': 'https://fastly.4sqi.net/img/general/cap/',
               'sizes': [40, 50],
               'name': '/delivery_provider_seamless_20180129.png'}}},
            'photos': {'count': 0, 'groups': []}},
          'referralId': 'e-0-585c205665e7c70a2f1055ea-17'},
         {'reasons': {'count': 0,
           'items': [{'summary': 'This spot is popular',
             'type': 'general',
             'reasonName': 'globalInteractionReason'}]},
          'venue': {'id': '4e4ce4debd413c4cc66d05d0',
           'name': 'SUBWAY',
           'location': {'address': '5549 Broadway',
            'lat': 40.878464979323944,
            'lng': -73.9055176422437,
            'labeledLatLngs': [{'label': 'display',
              'lat': 40.878464979323944,
              'lng': -73.9055176422437}],
            'distance': 482,
            'postalCode': '10463',
            'cc': 'US',
            'city': 'Bronx',
            'state': 'NY',
            'country': 'United States',
            'formattedAddress': ['5549 Broadway',
             'Bronx, NY 10463',
             'United States']},
           'categories': [{'id': '4bf58dd8d48988d1c5941735',
             'name': 'Sandwich Place',
             'pluralName': 'Sandwich Places',
             'shortName': 'Sandwiches',
             'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/deli
_',
              'suffix': '.png'},
             'primary': True}],
           'delivery': {'id': '774886',
            'url': 'https://www.seamless.com/menu/subway-5549-broadway-bronx/7748
86?affiliate=1131&utm_source=foursquare-affiliate-network&utm_medium=affiliat
e&utm_campaign=1131&utm_content=774886',
            'provider': {'name': 'seamless',

                'icon': {'prefix': 'https://fastly.4sqi.net/img/general/cap/',
                 'sizes': [40, 50],
                 'name': '/delivery_provider_seamless_20180129.png'}}},
             'photos': {'count': 0, 'groups': []}},
          'referralId': 'e-0-4e4ce4debd413c4cc66d05d0-18'},
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           'items': [{'summary': 'This spot is popular',
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             'reasonName': 'globalInteractionReason'}]},
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           'name': 'Parrilla Latina',
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            'lat': 40.87747294351472,
            'lng': -73.90607346968568,
            'labeledLatLngs': [{'label': 'display',
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              'lng': -73.90607346968568}],
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            'postalCode': '10463',
            'cc': 'US',
            'city': 'Bronx',
            'state': 'NY',
            'country': 'United States',
            'formattedAddress': ['230th St & Broadway',
             'Bronx, NY 10463',
             'United States']},
           'categories': [{'id': '4bf58dd8d48988d1cc941735',
             'name': 'Steakhouse',
             'pluralName': 'Steakhouses',
             'shortName': 'Steakhouse',
             'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/stea
khouse_',
              'suffix': '.png'},
             'primary': True}],
           'photos': {'count': 0, 'groups': []}},
          'referralId': 'e-0-4dfe40df8877333e195b68fc-19'},
         {'reasons': {'count': 0,
           'items': [{'summary': 'This spot is popular',
             'type': 'general',
             'reasonName': 'globalInteractionReason'}]},
          'venue': {'id': '4c852173dc018cfa2bc3e56c',
           'name': "The Children's Place",
           'location': {'address': '44 W 225th St',
            'lat': 40.873671591133125,
            'lng': -73.90815619608166,
            'labeledLatLngs': [{'label': 'display',
              'lat': 40.873671591133125,
              'lng': -73.90815619608166}],
            'distance': 383,
            'postalCode': '10463',
            'cc': 'US',
            'city': 'Bronx',
            'state': 'NY',
            'country': 'United States',
            'formattedAddress': ['44 W 225th St',
             'Bronx, NY 10463',
             'United States']},

          'categories': [{'id': '4bf58dd8d48988d105951735',
            'name': 'Kids Store',
            'pluralName': 'Kids Stores',
            'shortName': 'Kids Store',
            'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/app
arel_kids_',
              'suffix': '.png'},
            'primary': True}],
          'photos': {'count': 0, 'groups': []}},
         'referralId': 'e-0-4c852173dc018cfa2bc3e56c-20'},
        {'reasons': {'count': 0,
          'items': [{'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason'}]},
         'venue': {'id': '53319bb511d2ef06787f02b4',
          'name': 'Broadway Plaza',
          'location': {'address': '171 W 231st St',
           'lat': 40.87753906779665,
           'lng': -73.90539578168178,
           'labeledLatLngs': [{'label': 'display',
             'lat': 40.87753906779665,
             'lng': -73.90539578168178}],
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           'city': 'Bronx',
           'state': 'NY',
           'country': 'United States',
           'formattedAddress': ['171 W 231st St',
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            'United States']},
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            'name': 'Shopping Mall',
            'pluralName': 'Shopping Malls',
            'shortName': 'Mall',
            'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/mal
l_',
              'suffix': '.png'},
            'primary': True}],
          'photos': {'count': 0, 'groups': []}},
         'referralId': 'e-0-53319bb511d2ef06787f02b4-21'},
        {'reasons': {'count': 0,
          'items': [{'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason'}]},
         'venue': {'id': '4d0a529133d6b60cf4cf9985',
          'name': 'Subway',
          'location': {'address': '5209 Broadway',
           'lat': 40.877720351115315,
           'lng': -73.90537973066263,
           'labeledLatLngs': [{'label': 'display',
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             'lng': -73.90537973066263}],
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           'city': 'Bronx',

          'state': 'NY',
           'country': 'United States',
           'formattedAddress': ['5209 Broadway',
            'Bronx, NY 10463',
            'United States']},
          'categories': [{'id': '4bf58dd8d48988d1c5941735',
            'name': 'Sandwich Place',
            'pluralName': 'Sandwich Places',
            'shortName': 'Sandwiches',
            'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/deli
_',
            'suffix': '.png'},
            'primary': True}],
          'photos': {'count': 0, 'groups': []}},
         'referralId': 'e-0-4d0a529133d6b60cf4cf9985-22'},
        {'reasons': {'count': 0,
          'items': [{'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason'}]},
         'venue': {'id': '4ed7956b8b81b2bf28adc714',
          'name': 'Terrace View Delicatessen',
          'location': {'address': '135 Terrace View Ave.',
           'lat': 40.875995,
           'lng': -73.913151,
           'labeledLatLngs': [{'label': 'display',
             'lat': 40.875995,
             'lng': -73.913151}],
           'distance': 218,
           'postalCode': '10034',
           'cc': 'US',
           'city': 'New York',
           'state': 'NY',
           'country': 'United States',
           'formattedAddress': ['135 Terrace View Ave.',
            'New York, NY 10034',
            'United States']},
          'categories': [{'id': '4bf58dd8d48988d146941735',
            'name': 'Deli / Bodega',
            'pluralName': 'Delis / Bodegas',
            'shortName': 'Deli / Bodega',
            'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/deli
_',
            'suffix': '.png'},
            'primary': True}],
          'photos': {'count': 0, 'groups': []}},
         'referralId': 'e-0-4ed7956b8b81b2bf28adc714-23'}]}]}}

```
In [119]:   # function that extracts the category of the venue
            def get_category_type(row):
                try:
                    categories_list = row['categories']
                except:
                    categories_list = row['venue.categories']

                if len(categories_list) == 0:
                    return None
                else:
                    return categories_list[0]['name']
```

```
In [120]:   # clean the json file and transform into a pandas dataframe
            venues = results['response']['groups'][0]['items']

            nearby_venues = json_normalize(venues) # flatten JSON

            # filter columns
            filtered_columns = ['venue.name', 'venue.categories', 'venue.location.lat', 'v
            enue.location.lng']
            nearby_venues =nearby_venues.loc[:, filtered_columns]

            # filter the category for each row
            nearby_venues['venue.categories'] = nearby_venues.apply(get_category_type, axi
            s=1)

            # clean columns
            nearby_venues.columns = [col.split(".")[-1] for col in nearby_venues.columns]

            nearby_venues.head()
```

Out[120]:

	name	categories	lat	lng
0	Arturo's	Pizza Place	40.874412	-73.910271
1	Bikram Yoga	Yoga Studio	40.876844	-73.906204
2	Tibbett Diner	Diner	40.880404	-73.908937
3	Dunkin'	Donut Shop	40.877136	-73.906666
4	Starbucks	Coffee Shop	40.877531	-73.905582

```
In [121]:   print('{} venues were returned by Foursquare.'.format(nearby_venues.shape[0]))
```

```
            24 venues were returned by Foursquare.
```

We can then extend this analysis to all neighborhoods in Manhattan.

```python
In [122]: def getNearbyVenues(names, latitudes, longitudes, radius=500):

              venues_list=[]
              for name, lat, lng in zip(names, latitudes, longitudes):
                  print(name)

                  # create the API request URL
                  url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&clie
          nt_secret={}&v={}&ll={},{}&radius={}&limit={}'.format(
                      CLIENT_ID,
                      CLIENT_SECRET,
                      VERSION,
                      lat,
                      lng,
                      radius,
                      LIMIT)

                  # make the GET request
                  results = requests.get(url).json()["response"]['groups'][0]['items']

                  # return only relevant information for each nearby venue
                  venues_list.append([(
                      name,
                      lat,
                      lng,
                      v['venue']['name'],
                      v['venue']['location']['lat'],
                      v['venue']['location']['lng'],
                      v['venue']['categories'][0]['name']) for v in results])

              nearby_venues = pd.DataFrame([item for venue_list in venues_list for item
          in venue_list])
              nearby_venues.columns = ['Neighborhood',
                          'Neighborhood Latitude',
                          'Neighborhood Longitude',
                          'Venue',
                          'Venue Latitude',
                          'Venue Longitude',
                          'Venue Category']

              return(nearby_venues)
```

```
In [123]:  # run the above code for venues in all neighborhoods in Manhattan
           manhattan_venues = getNearbyVenues(names=manhattan_data['Neighborhood'],
                                              latitudes=manhattan_data['Latitude'],
                                              longitudes=manhattan_data['Longitude']
                                              )
```

Marble Hill
Chinatown
Washington Heights
Inwood
Hamilton Heights
Manhattanville
Central Harlem
East Harlem
Upper East Side
Yorkville
Lenox Hill
Roosevelt Island
Upper West Side
Lincoln Square
Clinton
Midtown
Murray Hill
Chelsea
Greenwich Village
East Village
Lower East Side
Tribeca
Little Italy
Soho
West Village
Manhattan Valley
Morningside Heights
Gramercy
Battery Park City
Financial District
Carnegie Hill
Noho
Civic Center
Midtown South
Sutton Place
Turtle Bay
Tudor City
Stuyvesant Town
Flatiron
Hudson Yards

```
In [124]:  # check the size of the dataframe
           print(manhattan_venues.shape)
           manhattan_venues.head()
```

(3312, 7)

Out[124]:

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Marble Hill	40.876551	-73.91066	Arturo's	40.874412	-73.910271	Pizza Place
1	Marble Hill	40.876551	-73.91066	Bikram Yoga	40.876844	-73.906204	Yoga Studio
2	Marble Hill	40.876551	-73.91066	Tibbett Diner	40.880404	-73.908937	Diner
3	Marble Hill	40.876551	-73.91066	Dunkin'	40.877136	-73.906666	Donut Shop
4	Marble Hill	40.876551	-73.91066	Starbucks	40.877531	-73.905582	Coffee Shop

```
In [125]:  # check venue counts returned for each of the neighborhoods
           manhattan_venues.groupby('Neighborhood').count()
```

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Battery Park City	94	94	94	94	94	94
Carnegie Hill	100	100	100	100	100	100
Central Harlem	43	43	43	43	43	43
Chelsea	100	100	100	100	100	100
Chinatown	100	100	100	100	100	100
Civic Center	100	100	100	100	100	100
Clinton	100	100	100	100	100	100
East Harlem	44	44	44	44	44	44
East Village	100	100	100	100	100	100
Financial District	100	100	100	100	100	100
Flatiron	100	100	100	100	100	100
Gramercy	100	100	100	100	100	100
Greenwich Village	100	100	100	100	100	100
Hamilton Heights	61	61	61	61	61	61
Hudson Yards	83	83	83	83	83	83
Inwood	55	55	55	55	55	55
Lenox Hill	100	100	100	100	100	100
Lincoln Square	100	100	100	100	100	100
Little Italy	100	100	100	100	100	100
Lower East Side	61	61	61	61	61	61
Manhattan Valley	50	50	50	50	50	50
Manhattanville	46	46	46	46	46	46
Marble Hill	24	24	24	24	24	24
Midtown	100	100	100	100	100	100
Midtown South	100	100	100	100	100	100
Morningside Heights	43	43	43	43	43	43
Murray Hill	100	100	100	100	100	100
Noho	100	100	100	100	100	100
Roosevelt Island	25	25	25	25	25	25
Soho	100	100	100	100	100	100

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Stuyvesant Town	17	17	17	17	17	17
Sutton Place	100	100	100	100	100	100
Tribeca	100	100	100	100	100	100
Tudor City	80	80	80	80	80	80
Turtle Bay	100	100	100	100	100	100
Upper East Side	100	100	100	100	100	100
Upper West Side	100	100	100	100	100	100
Washington Heights	86	86	86	86	86	86
West Village	100	100	100	100	100	100
Yorkville	100	100	100	100	100	100

In [126]:
```python
# check unique venue categories in neighborhoods of Manhattan
print('There are {} uniques categories.'.format(len(manhattan_venues['Venue Category'].unique()))))
```

There are 341 uniques categories.

We now analyze venue categories by neigborhood.

```python
In [127]: # one hot encoding
          manhattan_onehot = pd.get_dummies(manhattan_venues[['Venue Category']], prefix
          ="", prefix_sep="")

          # add neighborhood column back to dataframe
          manhattan_onehot['Neighborhood'] = manhattan_venues['Neighborhood']

          # move neighborhood column to the first column
          fixed_columns = [manhattan_onehot.columns[-1]] + list(manhattan_onehot.columns
          [:-1])
          manhattan_onehot = manhattan_onehot[fixed_columns]

          manhattan_onehot.head()
```

Out[127]:

	Neighborhood	Accessories Store	Adult Boutique	Afghan Restaurant	African Restaurant	American Restaurant	Antique Shop	Arcade	
0	Marble Hill	0	0	0	0	0	0	0	
1	Marble Hill	0	0	0	0	0	0	0	
2	Marble Hill	0	0	0	0	0	0	0	
3	Marble Hill	0	0	0	0	0	0	0	
4	Marble Hill	0	0	0	0	0	0	0	

```python
In [128]: # select categories that we care about, namely categories that are essential -
          Convenience Store, Grocery Store, Organic Grocery, Pharmacy, Supermarket
          manhattan_essentials = manhattan_onehot[['Neighborhood','Convenience Store','G
          rocery Store','Organic Grocery','Pharmacy','Supermarket']]
          manhattan_essentials.head()
```

Out[128]:

	Neighborhood	Convenience Store	Grocery Store	Organic Grocery	Pharmacy	Supermarket
0	Marble Hill	0	0	0	0	0
1	Marble Hill	0	0	0	0	0
2	Marble Hill	0	0	0	0	0
3	Marble Hill	0	0	0	0	0
4	Marble Hill	0	0	0	0	0

```python
In [129]: print('Size of the one hot encoded dataframe is',manhattan_onehot.shape)
```

Size of the one hot encoded dataframe is (3312, 342)

```python
In [130]: print('Size of the essentials-only dataframe is',manhattan_essentials.shape)
```

Size of the essentials-only dataframe is (3312, 6)

```
In [131]: # Check essentials venue counts for each neighborhood
manhattan_essentials.groupby('Neighborhood').count()
```

Neighborhood	Convenience Store	Grocery Store	Organic Grocery	Pharmacy	Supermarket
Battery Park City	94	94	94	94	94
Carnegie Hill	100	100	100	100	100
Central Harlem	43	43	43	43	43
Chelsea	100	100	100	100	100
Chinatown	100	100	100	100	100
Civic Center	100	100	100	100	100
Clinton	100	100	100	100	100
East Harlem	44	44	44	44	44
East Village	100	100	100	100	100
Financial District	100	100	100	100	100
Flatiron	100	100	100	100	100
Gramercy	100	100	100	100	100
Greenwich Village	100	100	100	100	100
Hamilton Heights	61	61	61	61	61
Hudson Yards	83	83	83	83	83
Inwood	55	55	55	55	55
Lenox Hill	100	100	100	100	100
Lincoln Square	100	100	100	100	100
Little Italy	100	100	100	100	100
Lower East Side	61	61	61	61	61
Manhattan Valley	50	50	50	50	50
Manhattanville	46	46	46	46	46
Marble Hill	24	24	24	24	24
Midtown	100	100	100	100	100
Midtown South	100	100	100	100	100
Morningside Heights	43	43	43	43	43
Murray Hill	100	100	100	100	100
Noho	100	100	100	100	100
Roosevelt Island	25	25	25	25	25
Soho	100	100	100	100	100
Stuyvesant Town	17	17	17	17	17
Sutton Place	100	100	100	100	100
Tribeca	100	100	100	100	100

Neighborhood	Convenience Store	Grocery Store	Organic Grocery	Pharmacy	Supermarket
Tudor City	80	80	80	80	80
Turtle Bay	100	100	100	100	100
Upper East Side	100	100	100	100	100
Upper West Side	100	100	100	100	100
Washington Heights	86	86	86	86	86
West Village	100	100	100	100	100
Yorkville	100	100	100	100	100

```
In [132]: manhattan_grouped = manhattan_essentials.groupby('Neighborhood').mean().reset_
          index()
          manhattan_grouped
```

	Neighborhood	Convenience Store	Grocery Store	Organic Grocery	Pharmacy	Supermarket
0	Battery Park City	0.000000	0.021277	0.00	0.000000	0.000000
1	Carnegie Hill	0.000000	0.030000	0.00	0.000000	0.020000
2	Central Harlem	0.000000	0.000000	0.00	0.000000	0.000000
3	Chelsea	0.000000	0.010000	0.00	0.000000	0.000000
4	Chinatown	0.000000	0.000000	0.01	0.000000	0.010000
5	Civic Center	0.000000	0.000000	0.00	0.000000	0.000000
6	Clinton	0.000000	0.010000	0.01	0.000000	0.010000
7	East Harlem	0.022727	0.022727	0.00	0.022727	0.000000
8	East Village	0.000000	0.000000	0.01	0.000000	0.000000
9	Financial District	0.010000	0.010000	0.00	0.000000	0.000000
10	Flatiron	0.000000	0.010000	0.00	0.010000	0.000000
11	Gramercy	0.000000	0.030000	0.00	0.000000	0.000000
12	Greenwich Village	0.000000	0.000000	0.00	0.000000	0.000000
13	Hamilton Heights	0.000000	0.000000	0.00	0.000000	0.000000
14	Hudson Yards	0.000000	0.000000	0.00	0.000000	0.012048
15	Inwood	0.000000	0.018182	0.00	0.018182	0.018182
16	Lenox Hill	0.000000	0.010000	0.00	0.000000	0.000000
17	Lincoln Square	0.000000	0.020000	0.00	0.010000	0.000000
18	Little Italy	0.000000	0.000000	0.00	0.000000	0.010000
19	Lower East Side	0.000000	0.000000	0.00	0.016393	0.000000
20	Manhattan Valley	0.000000	0.020000	0.00	0.000000	0.000000
21	Manhattanville	0.000000	0.021739	0.00	0.000000	0.021739
22	Marble Hill	0.000000	0.000000	0.00	0.041667	0.000000
23	Midtown	0.000000	0.010000	0.00	0.000000	0.000000
24	Midtown South	0.000000	0.010000	0.00	0.000000	0.000000
25	Morningside Heights	0.000000	0.023256	0.00	0.023256	0.023256
26	Murray Hill	0.000000	0.020000	0.00	0.010000	0.000000
27	Noho	0.000000	0.030000	0.00	0.000000	0.000000
28	Roosevelt Island	0.000000	0.000000	0.00	0.000000	0.040000
29	Soho	0.000000	0.000000	0.00	0.000000	0.010000
30	Stuyvesant Town	0.000000	0.000000	0.00	0.000000	0.000000
31	Sutton Place	0.000000	0.020000	0.00	0.000000	0.000000
32	Tribeca	0.000000	0.000000	0.00	0.000000	0.000000
33	Tudor City	0.012500	0.000000	0.00	0.000000	0.000000

	Neighborhood	Convenience Store	Grocery Store	Organic Grocery	Pharmacy	Supermarket
34	Turtle Bay	0.000000	0.010000	0.00	0.000000	0.000000
35	Upper East Side	0.000000	0.020000	0.00	0.000000	0.000000
36	Upper West Side	0.000000	0.000000	0.00	0.000000	0.000000
37	Washington Heights	0.000000	0.046512	0.00	0.000000	0.023256
38	West Village	0.000000	0.000000	0.00	0.000000	0.010000
39	Yorkville	0.000000	0.000000	0.00	0.010000	0.000000

```python
# print new neighborhood along with top 5 most common venues

num_top_venues = 5

for hood in manhattan_grouped['Neighborhood']:
    print("----"+hood+"----")
    temp = manhattan_grouped[manhattan_grouped['Neighborhood'] == hood].T.reset_index()
    temp.columns = ['venue','freq']
    temp = temp.iloc[1:]
    temp['freq'] = temp['freq'].astype(float)
    temp = temp.round({'freq': 2})
    print(temp.sort_values('freq', ascending=False).reset_index(drop=True).head(num_top_venues))
    print('\n')
```

```
        ----Battery Park City----
                  venue  freq
0        Grocery Store  0.02
1    Convenience Store  0.00
2      Organic Grocery  0.00
3             Pharmacy  0.00
4          Supermarket  0.00


        ----Carnegie Hill----
                  venue  freq
0        Grocery Store  0.03
1          Supermarket  0.02
2    Convenience Store  0.00
3      Organic Grocery  0.00
4             Pharmacy  0.00


        ----Central Harlem----
                  venue  freq
0    Convenience Store   0.0
1        Grocery Store   0.0
2      Organic Grocery   0.0
3             Pharmacy   0.0
4          Supermarket   0.0


        ----Chelsea----
                  venue  freq
0        Grocery Store  0.01
1    Convenience Store  0.00
2      Organic Grocery  0.00
3             Pharmacy  0.00
4          Supermarket  0.00


        ----Chinatown----
                  venue  freq
0      Organic Grocery  0.01
1          Supermarket  0.01
2    Convenience Store  0.00
3        Grocery Store  0.00
4             Pharmacy  0.00


        ----Civic Center----
                  venue  freq
0    Convenience Store   0.0
1        Grocery Store   0.0
2      Organic Grocery   0.0
3             Pharmacy   0.0
4          Supermarket   0.0


        ----Clinton----
                  venue  freq
0        Grocery Store  0.01
```

```
1     Organic Grocery  0.01
2        Supermarket  0.01
3  Convenience Store  0.00
4           Pharmacy  0.00


----East Harlem----
              venue  freq
0  Convenience Store  0.02
1      Grocery Store  0.02
2           Pharmacy  0.02
3    Organic Grocery  0.00
4        Supermarket  0.00


----East Village----
              venue  freq
0    Organic Grocery  0.01
1  Convenience Store  0.00
2      Grocery Store  0.00
3           Pharmacy  0.00
4        Supermarket  0.00


----Financial District----
              venue  freq
0  Convenience Store  0.01
1      Grocery Store  0.01
2    Organic Grocery  0.00
3           Pharmacy  0.00
4        Supermarket  0.00


----Flatiron----
              venue  freq
0      Grocery Store  0.01
1           Pharmacy  0.01
2  Convenience Store  0.00
3    Organic Grocery  0.00
4        Supermarket  0.00


----Gramercy----
              venue  freq
0      Grocery Store  0.03
1  Convenience Store  0.00
2    Organic Grocery  0.00
3           Pharmacy  0.00
4        Supermarket  0.00


----Greenwich Village----
              venue  freq
0  Convenience Store   0.0
1      Grocery Store   0.0
2    Organic Grocery   0.0
3           Pharmacy   0.0
```

```
4         Supermarket    0.0


----Hamilton Heights----
                venue   freq
0  Convenience Store    0.0
1       Grocery Store    0.0
2     Organic Grocery    0.0
3            Pharmacy    0.0
4         Supermarket    0.0


----Hudson Yards----
                venue   freq
0         Supermarket    0.01
1   Convenience Store    0.00
2       Grocery Store    0.00
3     Organic Grocery    0.00
4            Pharmacy    0.00


----Inwood----
                venue   freq
0       Grocery Store    0.02
1            Pharmacy    0.02
2         Supermarket    0.02
3   Convenience Store    0.00
4     Organic Grocery    0.00


----Lenox Hill----
                venue   freq
0       Grocery Store    0.01
1   Convenience Store    0.00
2     Organic Grocery    0.00
3            Pharmacy    0.00
4         Supermarket    0.00


----Lincoln Square----
                venue   freq
0       Grocery Store    0.02
1            Pharmacy    0.01
2   Convenience Store    0.00
3     Organic Grocery    0.00
4         Supermarket    0.00


----Little Italy----
                venue   freq
0         Supermarket    0.01
1   Convenience Store    0.00
2       Grocery Store    0.00
3     Organic Grocery    0.00
4            Pharmacy    0.00
```

```
----Lower East Side----
              venue  freq
0          Pharmacy  0.02
1  Convenience Store  0.00
2     Grocery Store  0.00
3   Organic Grocery  0.00
4       Supermarket  0.00


----Manhattan Valley----
              venue  freq
0     Grocery Store  0.02
1  Convenience Store  0.00
2   Organic Grocery  0.00
3          Pharmacy  0.00
4       Supermarket  0.00


----Manhattanville----
              venue  freq
0     Grocery Store  0.02
1       Supermarket  0.02
2  Convenience Store  0.00
3   Organic Grocery  0.00
4          Pharmacy  0.00


----Marble Hill----
              venue  freq
0          Pharmacy  0.04
1  Convenience Store  0.00
2     Grocery Store  0.00
3   Organic Grocery  0.00
4       Supermarket  0.00


----Midtown----
              venue  freq
0     Grocery Store  0.01
1  Convenience Store  0.00
2   Organic Grocery  0.00
3          Pharmacy  0.00
4       Supermarket  0.00


----Midtown South----
              venue  freq
0     Grocery Store  0.01
1  Convenience Store  0.00
2   Organic Grocery  0.00
3          Pharmacy  0.00
4       Supermarket  0.00


----Morningside Heights----
              venue  freq
0     Grocery Store  0.02
```

```
1         Pharmacy  0.02
2       Supermarket  0.02
3  Convenience Store  0.00
4    Organic Grocery  0.00


----Murray Hill----
              venue  freq
0      Grocery Store  0.02
1          Pharmacy  0.01
2  Convenience Store  0.00
3    Organic Grocery  0.00
4       Supermarket  0.00


----Noho----
              venue  freq
0      Grocery Store  0.03
1  Convenience Store  0.00
2    Organic Grocery  0.00
3          Pharmacy  0.00
4       Supermarket  0.00


----Roosevelt Island----
              venue  freq
0       Supermarket  0.04
1  Convenience Store  0.00
2      Grocery Store  0.00
3    Organic Grocery  0.00
4          Pharmacy  0.00


----Soho----
              venue  freq
0       Supermarket  0.01
1  Convenience Store  0.00
2      Grocery Store  0.00
3    Organic Grocery  0.00
4          Pharmacy  0.00


----Stuyvesant Town----
              venue  freq
0  Convenience Store   0.0
1      Grocery Store   0.0
2    Organic Grocery   0.0
3          Pharmacy   0.0
4       Supermarket   0.0


----Sutton Place----
              venue  freq
0      Grocery Store  0.02
1  Convenience Store  0.00
2    Organic Grocery  0.00
3          Pharmacy  0.00
```

```
4         Supermarket  0.00


----Tribeca----
              venue  freq
0  Convenience Store   0.0
1      Grocery Store   0.0
2    Organic Grocery   0.0
3           Pharmacy   0.0
4        Supermarket   0.0


----Tudor City----
              venue  freq
0  Convenience Store  0.01
1      Grocery Store  0.00
2    Organic Grocery  0.00
3           Pharmacy  0.00
4        Supermarket  0.00


----Turtle Bay----
              venue  freq
0      Grocery Store  0.01
1  Convenience Store  0.00
2    Organic Grocery  0.00
3           Pharmacy  0.00
4        Supermarket  0.00


----Upper East Side----
              venue  freq
0      Grocery Store  0.02
1  Convenience Store  0.00
2    Organic Grocery  0.00
3           Pharmacy  0.00
4        Supermarket  0.00


----Upper West Side----
              venue  freq
0  Convenience Store   0.0
1      Grocery Store   0.0
2    Organic Grocery   0.0
3           Pharmacy   0.0
4        Supermarket   0.0


----Washington Heights----
              venue  freq
0      Grocery Store  0.05
1        Supermarket  0.02
2  Convenience Store  0.00
3    Organic Grocery  0.00
4           Pharmacy  0.00
```

```
----West Village----
                venue  freq
0        Supermarket   0.01
1  Convenience Store   0.00
2      Grocery Store   0.00
3    Organic Grocery   0.00
4           Pharmacy   0.00


----Yorkville----
                venue  freq
0           Pharmacy   0.01
1  Convenience Store   0.00
2      Grocery Store   0.00
3    Organic Grocery   0.00
4        Supermarket   0.00
```

In [134]:
```python
def return_most_common_venues(row, num_top_venues):
    row_categories = row.iloc[1:]
    row_categories_sorted = row_categories.sort_values(ascending=False)

    return row_categories_sorted.index.values[0:num_top_venues]


num_top_venues = 5

indicators = ['st', 'nd', 'rd']

# create columns according to number of top venues
columns = ['Neighborhood']
for ind in np.arange(num_top_venues):
    try:
        columns.append('{}{} Most Common Venue'.format(ind+1, indicators[ind
]))
    except:
        columns.append('{}th Most Common Venue'.format(ind+1))

# create a new dataframe
neighborhoods_venues_sorted = pd.DataFrame(columns=columns)
neighborhoods_venues_sorted['Neighborhood'] = manhattan_grouped['Neighborhood'
]

for ind in np.arange(manhattan_grouped.shape[0]):
    neighborhoods_venues_sorted.iloc[ind, 1:] = return_most_common_venues(manh
attan_grouped.iloc[ind, :], num_top_venues)

neighborhoods_venues_sorted.head()
```

Out[134]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Battery Park City	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
1	Carnegie Hill	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
2	Central Harlem	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
3	Chelsea	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
4	Chinatown	Supermarket	Organic Grocery	Pharmacy	Grocery Store	Convenience Store

```
In [135]:  # print new neighborhood along with essential venues

           manhattan_ess_grouped = manhattan_essentials.groupby('Neighborhood').mean().re
           set_index()
           manhattan_ess_grouped
```

	Neighborhood	Convenience Store	Grocery Store	Organic Grocery	Pharmacy	Supermarket
0	Battery Park City	0.000000	0.021277	0.00	0.000000	0.000000
1	Carnegie Hill	0.000000	0.030000	0.00	0.000000	0.020000
2	Central Harlem	0.000000	0.000000	0.00	0.000000	0.000000
3	Chelsea	0.000000	0.010000	0.00	0.000000	0.000000
4	Chinatown	0.000000	0.000000	0.01	0.000000	0.010000
5	Civic Center	0.000000	0.000000	0.00	0.000000	0.000000
6	Clinton	0.000000	0.010000	0.01	0.000000	0.010000
7	East Harlem	0.022727	0.022727	0.00	0.022727	0.000000
8	East Village	0.000000	0.000000	0.01	0.000000	0.000000
9	Financial District	0.010000	0.010000	0.00	0.000000	0.000000
10	Flatiron	0.000000	0.010000	0.00	0.010000	0.000000
11	Gramercy	0.000000	0.030000	0.00	0.000000	0.000000
12	Greenwich Village	0.000000	0.000000	0.00	0.000000	0.000000
13	Hamilton Heights	0.000000	0.000000	0.00	0.000000	0.000000
14	Hudson Yards	0.000000	0.000000	0.00	0.000000	0.012048
15	Inwood	0.000000	0.018182	0.00	0.018182	0.018182
16	Lenox Hill	0.000000	0.010000	0.00	0.000000	0.000000
17	Lincoln Square	0.000000	0.020000	0.00	0.010000	0.000000
18	Little Italy	0.000000	0.000000	0.00	0.000000	0.010000
19	Lower East Side	0.000000	0.000000	0.00	0.016393	0.000000
20	Manhattan Valley	0.000000	0.020000	0.00	0.000000	0.000000
21	Manhattanville	0.000000	0.021739	0.00	0.000000	0.021739
22	Marble Hill	0.000000	0.000000	0.00	0.041667	0.000000
23	Midtown	0.000000	0.010000	0.00	0.000000	0.000000
24	Midtown South	0.000000	0.010000	0.00	0.000000	0.000000
25	Morningside Heights	0.000000	0.023256	0.00	0.023256	0.023256
26	Murray Hill	0.000000	0.020000	0.00	0.010000	0.000000
27	Noho	0.000000	0.030000	0.00	0.000000	0.000000
28	Roosevelt Island	0.000000	0.000000	0.00	0.000000	0.040000
29	Soho	0.000000	0.000000	0.00	0.000000	0.010000
30	Stuyvesant Town	0.000000	0.000000	0.00	0.000000	0.000000
31	Sutton Place	0.000000	0.020000	0.00	0.000000	0.000000
32	Tribeca	0.000000	0.000000	0.00	0.000000	0.000000
33	Tudor City	0.012500	0.000000	0.00	0.000000	0.000000

	Neighborhood	Convenience Store	Grocery Store	Organic Grocery	Pharmacy	Supermarket
34	Turtle Bay	0.000000	0.010000	0.00	0.000000	0.000000
35	Upper East Side	0.000000	0.020000	0.00	0.000000	0.000000
36	Upper West Side	0.000000	0.000000	0.00	0.000000	0.000000
37	Washington Heights	0.000000	0.046512	0.00	0.000000	0.023256
38	West Village	0.000000	0.000000	0.00	0.000000	0.010000
39	Yorkville	0.000000	0.000000	0.00	0.010000	0.000000

In [136]:
```python
# set number of clusters
kclusters = 5

manhattan_grouped_clustering = manhattan_grouped.drop('Neighborhood', 1)

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

# check cluster labels generated for each row in the dataframe
kmeans.labels_[0:10]
```

Out[136]: array([1, 3, 0, 0, 0, 0, 0, 1, 0, 0], dtype=int32)

In [137]:
```python
neighborhoods_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)

manhattan_merged = manhattan_data

# merge data and add latitude/longitude for each neighborhood
manhattan_merged = manhattan_merged.join(neighborhoods_venues_sorted.set_index('Neighborhood'), on='Neighborhood')

# check the last columns!
manhattan_merged.head()
```

Out[137]:

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
0	Manhattan	Marble Hill	40.876551	-73.910660	2	Pharmacy	Supermarket	Organic Grocery
1	Manhattan	Chinatown	40.715618	-73.994279	0	Supermarket	Organic Grocery	Pharmacy
2	Manhattan	Washington Heights	40.851903	-73.936900	3	Grocery Store	Supermarket	Pharmacy
3	Manhattan	Inwood	40.867684	-73.921210	3	Supermarket	Pharmacy	Grocery Store
4	Manhattan	Hamilton Heights	40.823604	-73.949688	0	Supermarket	Pharmacy	Organic Grocery

Examining clusters

```
In [138]: manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 0, manhattan_merged
          .columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
1	Chinatown	Supermarket	Organic Grocery	Pharmacy	Grocery Store	Convenience Store
4	Hamilton Heights	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
6	Central Harlem	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
9	Yorkville	Pharmacy	Supermarket	Organic Grocery	Grocery Store	Convenience Store
10	Lenox Hill	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
12	Upper West Side	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
14	Clinton	Supermarket	Organic Grocery	Grocery Store	Pharmacy	Convenience Store
15	Midtown	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
17	Chelsea	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
18	Greenwich Village	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
19	East Village	Organic Grocery	Supermarket	Pharmacy	Grocery Store	Convenience Store
20	Lower East Side	Pharmacy	Supermarket	Organic Grocery	Grocery Store	Convenience Store
21	Tribeca	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
22	Little Italy	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
23	Soho	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
24	West Village	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
29	Financial District	Grocery Store	Convenience Store	Supermarket	Pharmacy	Organic Grocery
32	Civic Center	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store
33	Midtown South	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
35	Turtle Bay	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
36	Tudor City	Convenience Store	Supermarket	Pharmacy	Organic Grocery	Grocery Store
37	Stuyvesant Town	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
38	Flatiron	Pharmacy	Grocery Store	Supermarket	Organic Grocery	Convenience Store
39	Hudson Yards	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store

```
In [139]: manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 1, manhattan_merged
          .columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```

Out[139]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
7	East Harlem	Pharmacy	Grocery Store	Convenience Store	Supermarket	Organic Grocery
8	Upper East Side	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
13	Lincoln Square	Grocery Store	Pharmacy	Supermarket	Organic Grocery	Convenience Store
16	Murray Hill	Grocery Store	Pharmacy	Supermarket	Organic Grocery	Convenience Store
25	Manhattan Valley	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
27	Gramercy	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
28	Battery Park City	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
31	Noho	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
34	Sutton Place	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store

```
In [140]: manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 2, manhattan_merged
          .columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```

Out[140]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Marble Hill	Pharmacy	Supermarket	Organic Grocery	Grocery Store	Convenience Store

```
In [141]: manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 3, manhattan_merged
          .columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```

Out[141]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
2	Washington Heights	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store
3	Inwood	Supermarket	Pharmacy	Grocery Store	Organic Grocery	Convenience Store
5	Manhattanville	Supermarket	Grocery Store	Pharmacy	Organic Grocery	Convenience Store
26	Morningside Heights	Supermarket	Pharmacy	Grocery Store	Organic Grocery	Convenience Store
30	Carnegie Hill	Grocery Store	Supermarket	Pharmacy	Organic Grocery	Convenience Store

```
In [142]: manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 4, manhattan_merged
          .columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```

Out[142]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
11	Roosevelt Island	Supermarket	Pharmacy	Organic Grocery	Grocery Store	Convenience Store

Conclusion

By understanding the types and counts of essential businesses in each neighborhood, we can better direct resources to help residents in each area to cope with an emergency such as the pandemic at hand.

```
In [ ]:
```