Segmenting and Clustering Neighborhoods in New York City

Introduction

In this lab, you will learn how to convert addresses into their equivalent latitude and longitude values. Also, you will use the Foursquare API to explore various neighborhoods in New York City. You will then use the explored data to segment the neighborhoods in New York City into clusters using the k-means clustering algorithm and find the optimal number of clusters for k-means. Finally, you will use the Folium library to visualize the neighborhoods in New York City and the clusters that exist within them.

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

In [1]:
```
import numpy as np # library to handle data in a vectorized manner

import pandas as pd # library for data analysis
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 haven't completed the Foursquare API lab
from geopy.geocoders import Nominatim # convert an address into latitude and longitude values

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

# Matplotlib and associated plotting modules
import matplotlib as mpl
import matplotlib.pyplot as plt

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

#!conda install -c conda-forge folium=0.5.0 # uncomment this line if you haven't completed the Foundational Space lab
import folium # map rendering library

print('Libraries imported.')
```

```
Libraries imported.
```

1. Download and Explore Dataset

Neighborhood has a total of 5 boroughs and 306 neighborhoods. In order to segment the neighborhoods and explore them, we will essentially need a dataset that contains the 5 boroughs and the neighborhoods that exist in each borough as well as the the latitude and longitude coordinates of each neighborhood.

Luckily, this dataset exists for free on the web. Feel free to try to find this dataset on your own, but here is the link to the dataset: https://cocl.us/new_york_dataset

For your convenience, I downloaded the files and placed it on the server, so you can simply run a `!wget` command and access the data. So let us go ahead and do so.

In [2]:
```
!wget -q -O 'new_york_data.json' https://cocl.us/new_york_dataset
print('Data downloaded!')
```

```
Data downloaded!
```

Load and explore the data

Next, let us load the data.

In [3]:
```
with open('new_york_data.json') as json_data:
    newyork_data = json.load(json_data)
```

Let's take a quick look at the data.

```
In [4]: newyork_data
```


```
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```

However, for illustration purposes, let's simplify the above map and segment and cluster only the neighborhoods in Manhattan. So let's slice the original dataframe and create a new dataframe of the Manhattan data.

In [14]:
```
manhattan_data = neighborhoods[neighborhoods['Borough'] == 'Manhattan'].reset_index(drop=True)
manhattan_data.head()
```

Out[14]:

	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

Let's get the geographical coordinates of Manhattan.

In [15]:
```
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, longitude))
```

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

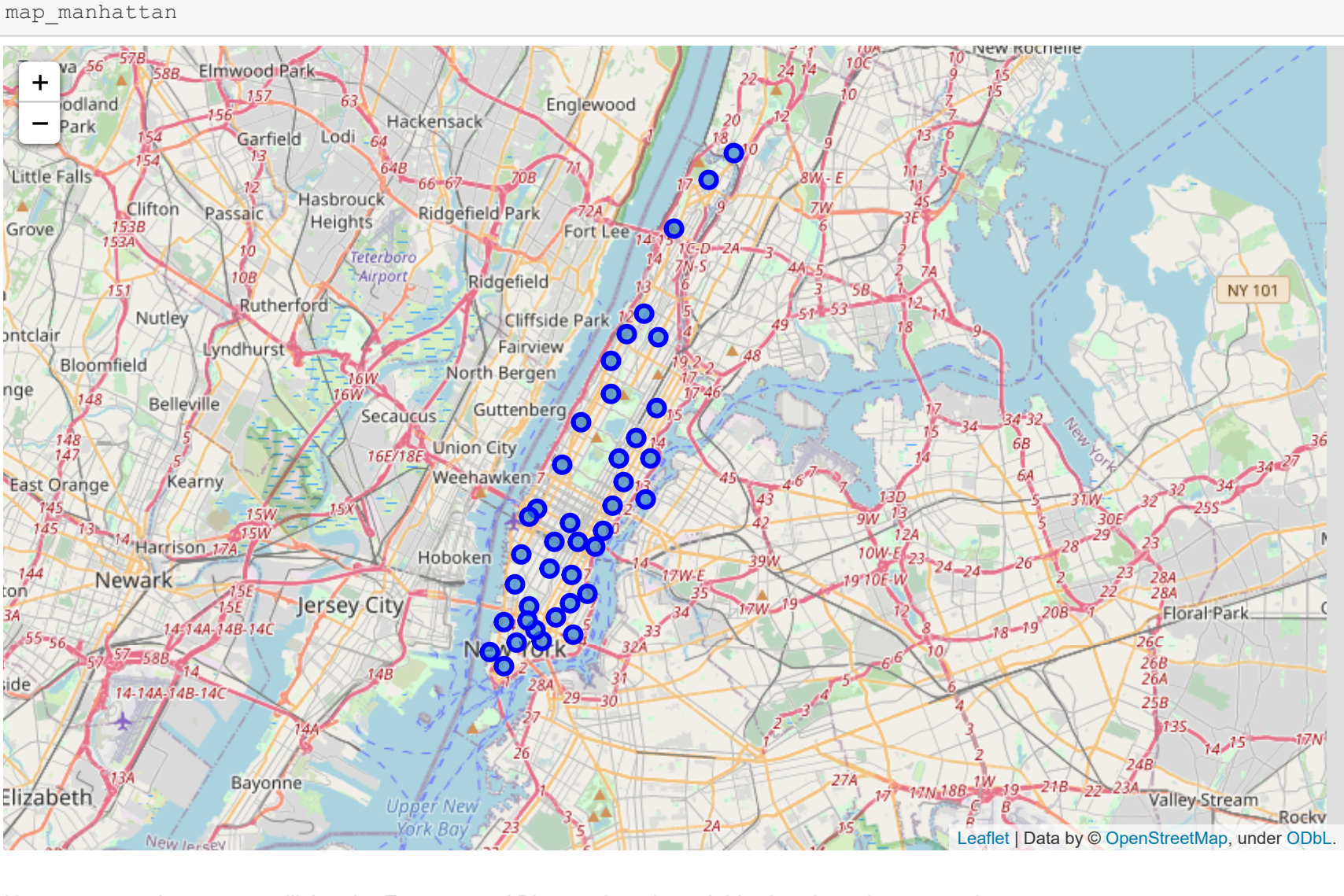
As we did with all of New York City, let's visualizat Manhattan the neighborhoods in it.

In [16]:
```
# create map of Manhattan using latitude and longitude values
map_manhattan = folium.Map(location=[latitude, longitude], zoom_start=11)

# add markers to map
for lat, lng, label in zip(manhattan_data['Latitude'], manhattan_data['Longitude'], manhattan_data['Nei
ghborhood']):
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_manhattan)

map_manhattan
```

Out[16]:



Next, we are going to start utilizing the Foursquare API to explore the neighborhoods and segment them.

Define Foursquare Credentials and Version

In [17]:
```
CLIENT_ID = 'G5ETWK2SC3RW405O1EELGLJCOFWTL2WGQJ5WXKJFB5NZST3Z' # your Foursquare ID
CLIENT_SECRET = 'F4LEZEDAHXLETDPUPFQCTMII5LIQL4J34L2EZGGUYGVOKF4C' # your Foursquare Secret
VERSION = '20180605' # Foursquare API version
LIMIT = 100 # A default Foursquare API limit value

print('Your credentails:')
print('CLIENT_ID: ' + CLIENT_ID)
print('CLIENT_SECRET:' + CLIENT_SECRET)
```

```
Your credentails:
CLIENT_ID: G5ETWK2SC3RW405O1EELGLJCOFWTL2WGQJ5WXKJFB5NZST3Z
CLIENT_SECRET:F4LEZEDAHXLETDPUPFQCTMII5LIQL4J34L2EZGGUYGVOKF4C
```

Let's explore the first neighborhood in our dataframe.

Get the neighborhood's name.

In [18]:
```
manhattan_data.loc[0, 'Neighborhood']
```

Out[18]:
```
'Marble Hill'
```

Get the neighborhood's latitude and longitude values.

In [19]:
```
neighborhood_latitude = manhattan_data.loc[0, 'Latitude'] # neighborhood latitude value
neighborhood_longitude = manhattan_data.loc[0, 'Longitude'] # neighborhood longitude value

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

print('Latitude and longitude values of {} are {}, {}.'.format(neighborhood_name,
                                                               neighborhood_latitude,
                                                               neighborhood_longitude))
```

```
Latitude and longitude values of Marble Hill are 40.87655077879964, -73.91065965862981.
```

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

First, let's create the GET request URL. Name your URL **url**.

In [20]:
```
# type your answer here
LIMIT = 100 # limit of number of venues returned by Foursquare API
radius = 500 # define radius

# create URL
url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius
={}&limit={}'.format(
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    neighborhood_latitude,
    neighborhood_longitude,
    radius,
    LIMIT)

url
```

Out[20]:
```
'https://api.foursquare.com/v2/venues/explore?&client_id=G5ETWK2SC3RW405O1EELGLJCOFWTL2WGQJ5WXKJFB5NZ
ST3Z&client_secret=F4LEZEDAHXLETDPUPFQCTMII5LIQL4J34L2EZGGUYGVOKF4C&v=20180605&ll=40.87655077879964,-
73.91065965862981&radius=500&limit=100'
```

Double-click **here** for the solution.

Send the GET request and examine the resutls

In [21]:
```python
results = requests.get(url).json()
results
```

Out[21]:


```
{'meta': {'code': 200, 'requestId': '5fafa9c2c4e5cf3a838e17a8'},
 'response': {'suggestedFilters': {'header': 'Tap to show:',
   'filters': [{'name': 'Open now', 'key': 'openNow'}]},
  'headerLocation': 'Marble Hill',
  'headerFullLocation': 'Marble Hill, New York',
  'headerLocationGranularity': 'neighborhood',
  'totalResults': 22,
  '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},
         {'label': 'entrance', 'lat': 40.874401, 'lng': -73.910339}],
        '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/pizza_',
          'suffix': '.png'},
         'primary': True}],
       'delivery': {'id': '72548',
        'url': 'https://www.seamless.com/menu/arturos-pizza-5189-broadway-ave-new-york/72548?affiliat
e=1131&utm_source=foursquare-affiliate-network&utm_medium=affiliate&utm_campaign=1131&utm_content=725
48',
        '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}],
        'distance': 376,
        '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},
         {'label': 'entrance', 'lat': 40.880388, 'lng': -73.90896}],
        '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/diner_',
          '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}],
        'distance': 342,
        '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/donuts_',
          'suffix': '.png'},
         'primary': True}],
       'delivery': {'id': '2200464',
        'url': 'https://www.seamless.com/menu/dunkin-5501-broadway-bronx/2200464?affiliate=1131&utm_s
ource=foursquare-affiliate-network&utm_medium=affiliate&utm_campaign=1131&utm_content=2200464',
        '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-0-4b5357adf964a520319827e3-3'},
     {'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}],
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        '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/coffeeshop_',
          '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': 40.87670526507199,
        'lng': -73.90637207670373,
        'labeledLatLngs': [{'label': 'display',
          'lat': 40.87670526507199,
          'lng': -73.90637207670373},
         {'label': 'entrance', 'lat': 40.87685, 'lng': -73.906058}],
        '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',
          'lat': 40.877271495944626,
          'lng': -73.90559491338075}],
        'distance': 433,
        'postalCode': '10463',
        'cc': 'US',
        'neighborhood': 'Kingsbridge',
        'city': 'Bronx',
        'state': 'NY',
        'country': 'United States',
        'formattedAddress': ['5520 Broadway (at W 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': []}},
      'referralId': 'e-0-55f751ca498eacc0307d1cfe-6'},
     {'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',
          'lat': 40.875466574434704,
          'lng': -73.90890629016033}],
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        'postalCode': '10463',
        '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/pharmacy_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-4b88e053f964a5208a1132e3-7'},
     {'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},
         {'label': 'entrance', 'lat': 40.873502, 'lng': -73.907986}],
        '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']},
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         'name': 'Coffee Shop',
         'pluralName': 'Coffee Shops',
         'shortName': 'Coffee Shop',
         'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/coffeeshop_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-57655be738faa66160da7527-8'},
     {'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},
         {'label': 'entrance', 'lat': 40.877906, 'lng': -73.905722}],
        '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/seafood_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-4b9c9c6af964a520b27236e3-9'},
     {'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_entertainment/stadium_tennis
_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []},
       'venuePage': {'id': '40358759'}},
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       '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',
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          'lng': -73.90504239962168}],
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        '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/departmentstore_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-546d31ca498e561c698a0320-11'},
     {'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},
         {'label': 'entrance', 'lat': 40.87828, 'lng': -73.905466}],
        'distance': 492,
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        '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/discountstore_',
          '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},
         {'label': 'entrance', 'lat': 40.877165, 'lng': -73.905673}],
        '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/education/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': '4b4f7b65f964a5205a0827e3',
       'name': 'Subway',
       '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-0-4b4f7b65f964a5205a0827e3-14'},
     {'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},
         {'label': 'entrance', 'lat': 40.877129, 'lng': -73.906608}],
        '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/icecream_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-4e4e4517bd4101d0d7a67568-15'},
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       'items': [{'summary': 'This spot is popular',
         'type': 'general',
         'reasonName': 'globalInteractionReason'}]},
      'venue': {'id': '4b9f030af964a520eb0f37e3',
       'name': 'GameStop',
       'location': {'address': '90 W 225th St Ste A-B',
        'crossStreet': 'btw Broadway & Exterior St.',
        'lat': 40.874266802124836,
        'lng': -73.90934218062803,
        'labeledLatLngs': [{'label': 'display',
          'lat': 40.874266802124836,
          'lng': -73.90934218062803}],
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        'cc': 'US',
        'city': 'Bronx',
        'state': 'NY',
        'country': 'United States',
        'formattedAddress': ['90 W 225th St Ste A-B (btw Broadway & Exterior St.)',
         'Bronx, NY 10463',
         'United States']},
       'categories': [{'id': '4bf58dd8d48988d10b951735',
         'name': 'Video Game Store',
         'pluralName': 'Video Game Stores',
         'shortName': 'Video Games',
         'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/videogames_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-4b9f030af964a520eb0f37e3-16'},
     {'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,
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        'cc': 'US',
        'city': 'Bronx',
        'state': 'NY',
        'country': 'United States',
        'formattedAddress': ['171 W 230th St',
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         'United States']},
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         'name': 'Discount Store',
         'pluralName': 'Discount Stores',
         'shortName': 'Discount Store',
         'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/discountstore_',
          'suffix': '.png'},
         'primary': True}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-56229ff8498e2abb44b6f12b-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},
         {'label': 'entrance', 'lat': 40.878473, 'lng': -73.905329}],
        'distance': 482,
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        '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}],
       'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-4e4ce4debd413c4cc66d05d0-18'},
     {'reasons': {'count': 0,
       'items': [{'summary': 'This spot is popular',
         'type': 'general',
         'reasonName': 'globalInteractionReason'}]},
      'venue': {'id': '4dfe40df8877333e195b68fc',
       'name': 'Parrilla Latina',
       'location': {'address': '230th St & Broadway',
        'lat': 40.87747294351472,
        'lng': -73.90607346968568,
        'labeledLatLngs': [{'label': 'display',
          'lat': 40.87747294351472,
          'lng': -73.90607346968568}],
        'distance': 399,
        '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/steakhouse_',
          '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,
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        '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/apparel_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': '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},
         {'label': 'entrance', 'lat': 40.875964, 'lng': -73.912985}],
        '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-0-4ed7956b8b81b2bf28adc714-21'}]}]}}
```


From the Foursquare lab in the previous module, we know that all the information is in the *items* key. Before we proceed, let's borrow the **get_category_type** function from the Foursquare lab.

In [22]:
```python
# 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']
```

Now we are ready to clean the json and structure it into a *pandas* dataframe.

In [24]:
```python
venues = results['response']['groups'][0]['items']

nearby_venues = pd.json_normalize(venues) # flatten JSON

# filter columns
filtered_columns = ['venue.name', 'venue.categories', 'venue.location.lat', 'venue.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, axis=1)

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

nearby_venues.head()
```

Out[24]:

	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

And how many venues were returned by Foursquare?

In [25]:
```python
print('{} venues were returned by Foursquare.'.format(nearby_venues.shape[0]))
```

```
22 venues were returned by Foursquare.
```

2. Explore Neighborhoods in Manhattan

Let's create a function to repeat the same process to all the neighborhoods in Manhattan

In [26]:
```python
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={}&client_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)
```

Now write the code to run the above function on each neighborhood and create a new dataframe called _manhattan*venues*.

In [27]:
```
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
```

Double-click **here** for the solution.

Let's check the size of the resulting dataframe

In [28]:
```
print(manhattan_venues.shape)
manhattan_venues.head()
```

```
(3204, 7)
```

Out[28]:

	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

Let's check how many venues were returned for each neighborhood

In [29]:
```
manhattan_venues.groupby('Neighborhood').count()
```

Out[29]:

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Battery Park City	66	66	66	66	66	66
Carnegie Hill	86	86	86	86	86	86
Central Harlem	45	45	45	45	45	45
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	40	40	40	40	40	40
East Village	100	100	100	100	100	100
Financial District	100	100	100	100	100	100
Flatiron	100	100	100	100	100	100
Gramercy	94	94	94	94	94	94
Greenwich Village	100	100	100	100	100	100
Hamilton Heights	63	63	63	63	63	63
Hudson Yards	62	62	62	62	62	62
Inwood	57	57	57	57	57	57
Lenox Hill	100	100	100	100	100	100
Lincoln Square	92	92	92	92	92	92
Little Italy	100	100	100	100	100	100
Lower East Side	47	47	47	47	47	47
Manhattan Valley	49	49	49	49	49	49
Manhattanville	47	47	47	47	47	47
Marble Hill	22	22	22	22	22	22
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	26	26	26	26	26	26
Soho	100	100	100	100	100	100
Stuyvesant Town	17	17	17	17	17	17
Sutton Place	100	100	100	100	100	100
Tribeca	88	88	88	88	88	88
Tudor City	81	81	81	81	81	81
Turtle Bay	100	100	100	100	100	100
Upper East Side	97	97	97	97	97	97
Upper West Side	98	98	98	98	98	98
Washington Heights	84	84	84	84	84	84
West Village	100	100	100	100	100	100
Yorkville	100	100	100	100	100	100

Let's find out how many unique categories can be curated from all the returned venues

In [30]:
```
print('There are {} uniques categories.'.format(len(manhattan_venues['Venue Category'].unique())))
```

```
There are 322 uniques categories.
```

3. Analyze Each Neighborhood

In [31]:
```
# 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[31]:

	Neighborhood	Accessories Store	Adult Boutique	African Restaurant	American Restaurant	Antique Shop	Arepa Restaurant	Argentinian Restaurant	Art Gallery	Art Museum	Arts & Crafts Store	Asian Restaurant
0	Marble Hill	0	0	0	0	0	0	0	0	0	0	0
1	Marble Hill	0	0	0	0	0	0	0	0	0	0	0
2	Marble Hill	0	0	0	0	0	0	0	0	0	0	0
3	Marble Hill	0	0	0	0	0	0	0	0	0	0	0
4	Marble Hill	0	0	0	0	0	0	0	0	0	0	0

And let's examine the new dataframe size.

In [32]:
```
manhattan_onehot.shape
```

Out[32]: (3204, 323)

Next, let's group rows by neighborhood and by taking the mean of the frequency of occurrence of each category

In [33]:
```
manhattan_grouped = manhattan_onehot.groupby('Neighborhood').mean().reset_index()
manhattan_grouped
```

Out[33]:

	Neighborhood	Accessories Store	Adult Boutique	African Restaurant	American Restaurant	Antique Shop	Arepa Restaurant	Argentinian Restaurant	Art Gallery	Art Museum	Arts & Crafts Store	A Restau
0	Battery Park City	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
1	Carnegie Hill	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.011628	0.000000	0.011628	0.000000	0.00
2	Central Harlem	0.000000	0.00	0.066667	0.044444	0.00	0.000000	0.000000	0.022222	0.000000	0.000000	0.00
3	Chelsea	0.000000	0.00	0.000000	0.040000	0.00	0.000000	0.000000	0.050000	0.000000	0.000000	0.01
4	Chinatown	0.000000	0.00	0.000000	0.040000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.02
5	Civic Center	0.000000	0.00	0.000000	0.030000	0.01	0.000000	0.000000	0.000000	0.000000	0.000000	0.01
6	Clinton	0.000000	0.00	0.000000	0.050000	0.00	0.000000	0.000000	0.010000	0.000000	0.000000	0.00
7	East Harlem	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
8	East Village	0.000000	0.00	0.000000	0.010000	0.00	0.000000	0.010000	0.010000	0.000000	0.010000	0.00
9	Financial District	0.000000	0.00	0.000000	0.040000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
10	Flatiron	0.000000	0.00	0.000000	0.030000	0.00	0.000000	0.000000	0.020000	0.000000	0.010000	0.00
11	Gramercy	0.000000	0.00	0.000000	0.042553	0.00	0.000000	0.000000	0.010638	0.000000	0.000000	0.00
12	Greenwich Village	0.010000	0.00	0.000000	0.030000	0.00	0.000000	0.000000	0.010000	0.000000	0.000000	0.00
13	Hamilton Heights	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
14	Hudson Yards	0.000000	0.00	0.000000	0.048387	0.00	0.000000	0.000000	0.016129	0.000000	0.000000	0.00
15	Inwood	0.000000	0.00	0.000000	0.035088	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
16	Lenox Hill	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.020000	0.000000	0.000000	0.00
17	Lincoln Square	0.000000	0.00	0.000000	0.021739	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
18	Little Italy	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
19	Lower East Side	0.000000	0.00	0.000000	0.021277	0.00	0.000000	0.021277	0.042553	0.000000	0.000000	0.00
20	Manhattan Valley	0.000000	0.00	0.000000	0.020408	0.00	0.000000	0.000000	0.000000	0.000000	0.020408	0.00
21	Manhattanville	0.000000	0.00	0.000000	0.021277	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
22	Marble Hill	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
23	Midtown	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.010000	0.000000	0.000000	0.00
24	Midtown South	0.000000	0.00	0.000000	0.030000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
25	Morningside Heights	0.000000	0.00	0.000000	0.069767	0.00	0.000000	0.000000	0.000000	0.000000	0.023256	0.00
26	Murray Hill	0.000000	0.00	0.000000	0.040000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
27	Noho	0.000000	0.00	0.000000	0.010000	0.00	0.000000	0.010000	0.040000	0.000000	0.000000	0.01
28	Roosevelt Island	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
29	Soho	0.000000	0.00	0.000000	0.010000	0.00	0.000000	0.000000	0.010000	0.000000	0.010000	0.00
30	Stuyvesant Town	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.00
31	Sutton Place	0.000000	0.01	0.000000	0.020000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.01
32	Tribeca	0.000000	0.00	0.000000	0.056818	0.00	0.000000	0.011364	0.022727	0.000000	0.000000	0.00
33	Tudor City	0.000000	0.00	0.000000	0.012346	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.03
34	Turtle Bay	0.000000	0.00	0.000000	0.020000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.02
35	Upper East Side	0.000000	0.00	0.000000	0.020619	0.00	0.000000	0.000000	0.000000	0.010309	0.000000	0.00
36	Upper West Side	0.010204	0.00	0.000000	0.020408	0.00	0.000000	0.000000	0.000000	0.000000	0.010204	0.01
37	Washington Heights	0.011905	0.00	0.000000	0.011905	0.00	0.011905	0.000000	0.000000	0.000000	0.000000	0.00
38	West Village	0.010000	0.00	0.000000	0.060000	0.00	0.000000	0.000000	0.010000	0.000000	0.000000	0.00
39	Yorkville	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000	0.000000	0.01

Let's confirm the new size

In [34]:
```
manhattan_grouped.shape
```

Out[34]: (40, 323)

Let's print each neighborhood along with the top 5 most common venues

In [35]:
```
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           Park  0.09
1          Hotel  0.08
2            Gym  0.06
3    Coffee Shop  0.06
4  Memorial Site  0.05


----Carnegie Hill----
                  venue  freq
0           Coffee Shop  0.09
1                  Café  0.05
2     French Restaurant  0.03
3  Gym / Fitness Center  0.03
4                   Gym  0.03


----Central Harlem----
                 venue  freq
0   African Restaurant  0.07
1   Chinese Restaurant  0.04
2  American Restaurant  0.04
3                  Bar  0.04
4       Cosmetics Shop  0.04


----Chelsea----
                 venue  freq
0          Coffee Shop  0.09
1          Art Gallery  0.05
2  American Restaurant  0.04
3               Bakery  0.04
4       Ice Cream Shop  0.03


----Chinatown----
                 venue  freq
0   Chinese Restaurant  0.09
1               Bakery  0.05
2         Dessert Shop  0.05
3         Cocktail Bar  0.05
4  American Restaurant  0.04


----Civic Center----
                  venue  freq
0           Coffee Shop  0.05
1                   Spa  0.05
2  Gym / Fitness Center  0.05
3           Yoga Studio  0.04
4          Cocktail Bar  0.04


----Clinton----
                  venue  freq
0               Theater  0.07
1   American Restaurant  0.05
2  Gym / Fitness Center  0.05
3           Coffee Shop  0.04
4                   Gym  0.04


----East Harlem----
                venue  freq
0  Mexican Restaurant  0.12
1              Bakery  0.10
2     Thai Restaurant  0.08
3       Deli / Bodega  0.05
4      Sandwich Place  0.05


----East Village----
                venue  freq
0                 Bar  0.08
1      Ice Cream Shop  0.05
2         Pizza Place  0.05
3  Mexican Restaurant  0.05
4            Wine Bar  0.04


----Financial District----
                 venue  freq
0          Coffee Shop  0.10
1          Pizza Place  0.05
2  American Restaurant  0.04
3         Cocktail Bar  0.04
4                  Bar  0.03


----Flatiron----
                     venue  freq
0       Italian Restaurant  0.05
1  New American Restaurant  0.04
2      Japanese Restaurant  0.04
3     Gym / Fitness Center  0.03
4      American Restaurant  0.03


----Gramercy----
                 venue  freq
0                  Bar  0.06
1   Italian Restaurant  0.05
2  American Restaurant  0.04
3          Coffee Shop  0.04
4      Thai Restaurant  0.04


----Greenwich Village----
                venue  freq
0  Italian Restaurant  0.12
1    Sushi Restaurant  0.05
2      Clothing Store  0.04
3                Café  0.04
4     Bubble Tea Shop  0.03


----Hamilton Heights----
                venue  freq
0         Pizza Place  0.10
1         Coffee Shop  0.06
2                Café  0.06
3  Mexican Restaurant  0.05
4         Yoga Studio  0.03


----Hudson Yards----
                  venue  freq
0    Italian Restaurant  0.06
1                 Hotel  0.06
2  Gym / Fitness Center  0.06
3   American Restaurant  0.05
4           Coffee Shop  0.03


----Inwood----
                venue  freq
0  Mexican Restaurant  0.07
1              Lounge  0.05
2                Café  0.05
3          Restaurant  0.05
4         Pizza Place  0.04


----Lenox Hill----
                venue  freq
0  Italian Restaurant  0.07
1    Sushi Restaurant  0.06
2         Coffee Shop  0.05
3         Pizza Place  0.05
4        Cocktail Bar  0.04


----Lincoln Square----
                  venue  freq
0                 Plaza  0.05
1               Theater  0.04
2          Concert Hall  0.04
3    Italian Restaurant  0.04
4  Performing Arts Venue  0.04


----Little Italy----
                venue  freq
0                Café  0.06
1              Bakery  0.06
2     Bubble Tea Shop  0.04
3  Chinese Restaurant  0.04
4  Italian Restaurant  0.04


----Lower East Side----
                venue  freq
0  Chinese Restaurant  0.09
1         Pizza Place  0.04
2    Ramen Restaurant  0.04
3         Coffee Shop  0.04
4         Art Gallery  0.04


----Manhattan Valley----
                venue  freq
0         Coffee Shop  0.06
1                 Bar  0.06
2          Playground  0.04
3  Mexican Restaurant  0.04
4     Thai Restaurant  0.04


----Manhattanville----
                venue  freq
0         Coffee Shop  0.06
1  Seafood Restaurant  0.06
2  Italian Restaurant  0.04
3  Mexican Restaurant  0.04
4       Deli / Bodega  0.04


----Marble Hill----
            venue  freq
0             Gym  0.09
1  Discount Store  0.09
2  Sandwich Place  0.09
3     Coffee Shop  0.09
4     Yoga Studio  0.05


----Midtown----
         venue  freq
0        Hotel  0.06
1  Coffee Shop  0.06
2       Bakery  0.05
3      Theater  0.04
4   Steakhouse  0.04


----Midtown South----
                 venue  freq
0    Korean Restaurant  0.18
1                Hotel  0.06
2       Cosmetics Shop  0.04
3  Japanese Restaurant  0.04
4         Dessert Shop  0.03


----Morningside Heights----
                 venue  freq
0                 Park  0.09
1  American Restaurant  0.07
2            Bookstore  0.07
3          Coffee Shop  0.07
4        Deli / Bodega  0.05


----Murray Hill----
                  venue  freq
0                 Hotel  0.04
1   American Restaurant  0.04
2        Sandwich Place  0.04
3           Coffee Shop  0.04
4  Gym / Fitness Center  0.04


----Noho----
                venue  freq
0  Italian Restaurant  0.06
1  Mexican Restaurant  0.04
2               Hotel  0.04
3         Art Gallery  0.04
4      Sandwich Place  0.03


----Roosevelt Island----
                   venue  freq
0          Deli / Bodega  0.08
1                Dog Run  0.04
2  Outdoors & Recreation  0.04
3      Food & Drink Shop  0.04
4                   Park  0.04


----Soho----
                venue  freq
0      Clothing Store  0.09
1  Italian Restaurant  0.08
2         Coffee Shop  0.06
3            Boutique  0.05
4          Shoe Store  0.03


----Stuyvesant Town----
          venue  freq
0          Park  0.18
1   Coffee Shop  0.06
2  Cocktail Bar  0.06
3   Gas Station  0.06
4        Bistro  0.06


----Sutton Place----
                  venue  freq
0    Italian Restaurant  0.05
1                  Park  0.04
2           Pizza Place  0.04
3           Coffee Shop  0.04
4  Gym / Fitness Center  0.04


----Tribeca----
                 venue  freq
0  American Restaurant  0.06
1                 Park  0.06
2             Wine Bar  0.05
3   Italian Restaurant  0.05
4     Greek Restaurant  0.03


----Tudor City----
                venue  freq
0                Park  0.06
1  Mexican Restaurant  0.06
2                Café  0.06
3               Diner  0.04
4         Coffee Shop  0.04


----Turtle Bay----
                 venue  freq
0          Coffee Shop  0.05
1   Italian Restaurant  0.05
2     Sushi Restaurant  0.04
3     Ramen Restaurant  0.03
4  Japanese Restaurant  0.03


----Upper East Side----
                  venue  freq
0    Italian Restaurant  0.07
1               Exhibit  0.07
2           Coffee Shop  0.06
3                Bakery  0.05
4  Gym / Fitness Center  0.04


----Upper West Side----
                venue  freq
0  Italian Restaurant  0.07
1                Café  0.04
2                 Bar  0.04
3         Pizza Place  0.03
4            Wine Bar  0.03


----Washington Heights----
                       venue  freq
0                       Café  0.07
1                     Bakery  0.05
2              Grocery Store  0.04
3  Latin American Restaurant  0.02
4                Supermarket  0.02


----West Village----
                     venue  freq
0       Italian Restaurant  0.10
1      American Restaurant  0.06
2  New American Restaurant  0.05
3                     Park  0.04
4             Cocktail Bar  0.04


----Yorkville----
                venue  freq
0  Italian Restaurant  0.08
1                 Bar  0.06
2                 Gym  0.06
3         Coffee Shop  0.06
4    Sushi Restaurant  0.04
```

Let's put that into a *pandas* dataframe

First, let's write a function to sort the venues in descending order.

In [36]:
```
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]
```

Now let's create the new dataframe and display the top 10 venues for each neighborhood.

In [37]:
```
num_top_venues = 10

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(manhattan_grouped.iloc[ind,
:], num_top_venues)

neighborhoods_venues_sorted.head()
```

Out[37]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Battery Park City	Park	Hotel	Gym	Coffee Shop	Memorial Site	Playground	Gourmet Shop	Boat or Ferry	Burger Joint	Plaza
1	Carnegie Hill	Coffee Shop	Café	Bookstore	Italian Restaurant	Gym / Fitness Center	Gym	French Restaurant	Yoga Studio	Wine Shop	Vietnamese Restaurant
2	Central Harlem	African Restaurant	Seafood Restaurant	French Restaurant	American Restaurant	Cosmetics Shop	Bar	Chinese Restaurant	Bookstore	Boutique	Gym
3	Chelsea	Coffee Shop	Art Gallery	Bakery	American Restaurant	Ice Cream Shop	Italian Restaurant	Japanese Restaurant	Park	Cycle Studio	Cupcake Shop
4	Chinatown	Chinese Restaurant	Cocktail Bar	Bakery	Dessert Shop	American Restaurant	Salon / Barbershop	Optical Shop	Noodle House	Hotpot Restaurant	Spa

4. Cluster Neighborhoods

Run *k*-means to cluster the neighborhood into 5 clusters.

In [38]:
```
# 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[38]: array([0, 2, 0, 0, 2, 2, 0, 4, 2, 0])

Let's create a new dataframe that includes the cluster as well as the top 10 venues for each neighborhood.

In [39]:
```
# add clustering labels
neighborhoods_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)

manhattan_merged = manhattan_data

# merge manhattan_grouped with manhattan_data to add latitude/longitude for each neighborhood
manhattan_merged = manhattan_merged.join(neighborhoods_venues_sorted.set_index('Neighborhood'), on='Nei
ghborhood')

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

Out[39]:

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Mo Comm Ven
0	Manhattan	Marble Hill	40.876551	-73.910660	0	Sandwich Place	Coffee Shop	Gym	Discount Store	Supplement Shop	Donut Shop	Seafo Restaura
1	Manhattan	Chinatown	40.715618	-73.994279	2	Chinese Restaurant	Cocktail Bar	Bakery	Dessert Shop	American Restaurant	Salon / Barbershop	Opti Sh
2	Manhattan	Washington Heights	40.851903	-73.936900	0	Café	Bakery	Grocery Store	Bank	Sandwich Place	Coffee Shop	Pa
3	Manhattan	Inwood	40.867684	-73.921210	4	Mexican Restaurant	Café	Restaurant	Lounge	Frozen Yogurt Shop	Bakery	Piz Pla
4	Manhattan	Hamilton Heights	40.823604	-73.949688	4	Pizza Place	Coffee Shop	Café	Mexican Restaurant	Cocktail Bar	Indian Restaurant	Liqu Sto

Finally, let's visualize the resulting clusters

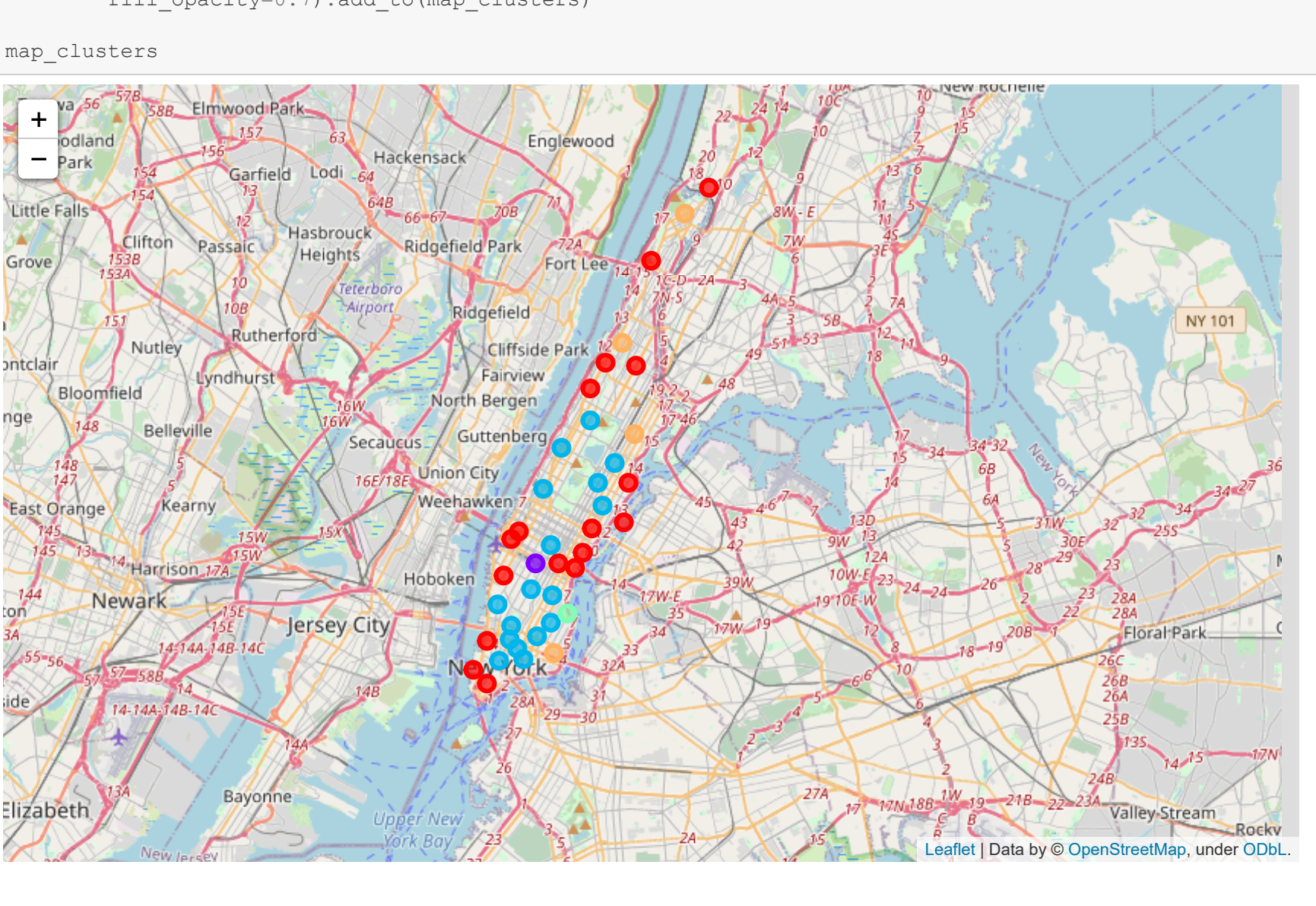
In [40]:
```
# create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

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

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

map_clusters
```

Out[40]:



5. Examine Clusters

Now, you can examine each cluster and determine the discriminating venue categories that distinguish each cluster. Based on the defining categories, you can then assign a name to each cluster. I will leave this exercise to you.

Cluster 1

In [41]:
```
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 0, manhattan_merged.columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```
Out[41]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Marble Hill	Sandwich Place	Coffee Shop	Gym	Discount Store	Supplement Shop	Donut Shop	Seafood Restaurant	Tennis Stadium	Pharmacy	Kids Store
2	Washington Heights	Café	Bakery	Grocery Store	Bank	Sandwich Place	Coffee Shop	Park	Spanish Restaurant	Deli / Bodega	New American Restaurant
5	Manhattanville	Seafood Restaurant	Coffee Shop	Deli / Bodega	Italian Restaurant	Mexican Restaurant	Indian Restaurant	Lounge	Boutique	Sushi Restaurant	Supermarket
6	Central Harlem	African Restaurant	Seafood Restaurant	French Restaurant	American Restaurant	Cosmetics Shop	Bar	Chinese Restaurant	Bookstore	Boutique	Gym
9	Yorkville	Italian Restaurant	Coffee Shop	Gym	Bar	Sushi Restaurant	Deli / Bodega	Japanese Restaurant	Wine Shop	Diner	Mexican Restaurant
11	Roosevelt Island	Deli / Bodega	Japanese Restaurant	Coffee Shop	Greek Restaurant	Supermarket	Bubble Tea Shop	Playground	Food & Drink Shop	Soccer Field	Farmers Market
14	Clinton	Theater	American Restaurant	Gym / Fitness Center	Coffee Shop	Sandwich Place	Gym	Cocktail Bar	Italian Restaurant	Spa	Hotel
16	Murray Hill	Japanese Restaurant	Coffee Shop	Hotel	Gym / Fitness Center	Sandwich Place	American Restaurant	Bar	Restaurant	Italian Restaurant	Grocery Store
17	Chelsea	Coffee Shop	Art Gallery	Bakery	American Restaurant	Ice Cream Shop	Italian Restaurant	Japanese Restaurant	Park	Cycle Studio	Cupcake Shop
21	Tribeca	Park	American Restaurant	Wine Bar	Italian Restaurant	Coffee Shop	Café	Spa	Greek Restaurant	Poke Place	Playground
26	Morningside Heights	Park	American Restaurant	Coffee Shop	Bookstore	Café	Deli / Bodega	Burger Joint	Indian Restaurant	Seafood Restaurant	Grocery Store
28	Battery Park City	Park	Hotel	Gym	Coffee Shop	Memorial Site	Playground	Gourmet Shop	Boat or Ferry	Burger Joint	Plaza
29	Financial District	Coffee Shop	Pizza Place	Cocktail Bar	American Restaurant	Hotel	Park	Café	Sandwich Place	Salad Place	Steakhouse
34	Sutton Place	Italian Restaurant	Park	Furniture / Home Store	Gym / Fitness Center	Coffee Shop	Pizza Place	Gym	Latin American Restaurant	Beer Garden	Mediterranean Restaurant
35	Turtle Bay	Italian Restaurant	Coffee Shop	Sushi Restaurant	Japanese Restaurant	Park	Ramen Restaurant	Seafood Restaurant	Deli / Bodega	Hotel	Pharmacy
36	Tudor City	Café	Park	Mexican Restaurant	Asian Restaurant	Diner	Deli / Bodega	Coffee Shop	Restaurant	Garden	Sushi Restaurant
39	Hudson Yards	Hotel	Gym / Fitness Center	Italian Restaurant	American Restaurant	Café	Coffee Shop	Boat or Ferry	Park	Dog Run	Gym

Cluster 2

In [42]:
```
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 1, manhattan_merged.columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```
Out[42]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
33	Midtown South	Korean Restaurant	Hotel	Japanese Restaurant	Cosmetics Shop	Burger Joint	Coffee Shop	Dessert Shop	Gym / Fitness Center	Bakery	American Restaurant

Cluster 3

In [43]:
```
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 2, manhattan_merged.columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```
Out[43]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10 C
1	Chinatown	Chinese Restaurant	Cocktail Bar	Bakery	Dessert Shop	American Restaurant	Salon / Barbershop	Optical Shop	Noodle House	Hotpot Restaurant	
8	Upper East Side	Exhibit	Italian Restaurant	Coffee Shop	Bakery	Gym / Fitness Center	Yoga Studio	Juice Bar	Cosmetics Shop	French Restaurant	
10	Lenox Hill	Italian Restaurant	Sushi Restaurant	Coffee Shop	Pizza Place	Cocktail Bar	Burger Joint	Gym	Gym / Fitness Center	Deli / Bodega	
12	Upper West Side	Italian Restaurant	Bar	Café	Indian Restaurant	Coffee Shop	Wine Bar	Pizza Place	Bakery	Ice Cream Shop	Medite Re
13	Lincoln Square	Plaza	Performing Arts Venue	Café	Theater	Concert Hall	Italian Restaurant	Wine Shop	French Restaurant	Gym / Fitness Center	Indi
15	Midtown	Hotel	Coffee Shop	Bakery	Steakhouse	Clothing Store	Sporting Goods Shop	Theater	Pizza Place	Bookstore	Sa
18	Greenwich Village	Italian Restaurant	Sushi Restaurant	Clothing Store	Café	Indian Restaurant	American Restaurant	Gym	Boutique	Bubble Tea Shop	(Re
19	East Village	Bar	Ice Cream Shop	Pizza Place	Mexican Restaurant	Wine Bar	Korean Restaurant	Italian Restaurant	Coffee Shop	Cocktail Bar	Veg Re
22	Little Italy	Bakery	Café	Italian Restaurant	Bubble Tea Shop	Chinese Restaurant	Mediterranean Restaurant	Ice Cream Shop	Cocktail Bar	Pizza Place	Coffe
23	Soho	Clothing Store	Italian Restaurant	Coffee Shop	Boutique	Mediterranean Restaurant	Shoe Store	Bakery	Café	French Restaurant	Pizz
24	West Village	Italian Restaurant	American Restaurant	New American Restaurant	Cocktail Bar	Park	Wine Bar	Theater	Jazz Club	Coffee Shop	Sa
25	Manhattan Valley	Bar	Coffee Shop	Yoga Studio	Pizza Place	Playground	Thai Restaurant	Mexican Restaurant	French Restaurant	Szechuan Restaurant	Re
27	Gramercy	Bar	Italian Restaurant	Coffee Shop	American Restaurant	Thai Restaurant	Pizza Place	Bagel Shop	Ice Cream Shop	Cocktail Bar	Thrift /
30	Carnegie Hill	Coffee Shop	Café	Bookstore	Italian Restaurant	Gym / Fitness Center	Gym	French Restaurant	Yoga Studio	Wine Shop	Viet Re
31	Noho	Italian Restaurant	Mexican Restaurant	Hotel	Art Gallery	Yoga Studio	Bookstore	Coffee Shop	Cocktail Bar	French Restaurant	Pizz
32	Civic Center	Spa	Gym / Fitness Center	Coffee Shop	Hotel	French Restaurant	Cocktail Bar	Yoga Studio	American Restaurant	Sushi Restaurant	
38	Flatiron	Italian Restaurant	Japanese Restaurant	New American Restaurant	Mediterranean Restaurant	Cycle Studio	Gym	Gym / Fitness Center	Furniture / Home Store	Sporting Goods Shop	

Cluster 4

In [44]:
```
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 3, manhattan_merged.columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```
Out[44]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
37	Stuyvesant Town	Park	Coffee Shop	Cocktail Bar	Gym / Fitness Center	Baseball Field	Bar	Bistro	Heliport	Farmers Market	Boat or Ferry

Cluster 5

In [45]:
```
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == 4, manhattan_merged.columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```
Out[45]:

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
3	Inwood	Mexican Restaurant	Café	Restaurant	Lounge	Frozen Yogurt Shop	Bakery	Pizza Place	Park	Chinese Restaurant	Deli / Bodega
4	Hamilton Heights	Pizza Place	Coffee Shop	Café	Mexican Restaurant	Cocktail Bar	Indian Restaurant	Liquor Store	Sushi Restaurant	Park	Deli / Bodega
7	East Harlem	Mexican Restaurant	Bakery	Thai Restaurant	Deli / Bodega	Latin American Restaurant	Sandwich Place	Taco Place	Beer Bar	Liquor Store	Grocery Store
20	Lower East Side	Chinese Restaurant	Pharmacy	Coffee Shop	Café	Bakery	Japanese Restaurant	Art Gallery	Pizza Place	Ramen Restaurant	Pet Café

Thank you for completing this lab!

This notebook was created by Alex Aklson and Polong Lin. I hope you found this lab interesting and educational. Feel free to contact us if you have any questions!

This notebook is part of a course on **Coursera** called *Applied Data Science Capstone*. If you accessed this notebook outside the course, you can take this course online by clicking here.
