Tuning-In To NYC’s Musical Neighborhoods

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2019/04/04

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Abstract

Machine learning allows for the creation of computational models capable of identifying patterns in multidimensional datasets. This project aims to leverage Foursquare location data and machine learning algorithms to identify ‘New York City’ neighborhoods of similar ‘music profile’.

Introduction

Background

Music is a form of art that has, and probably always will be, deeply embedded within the cultural activity of cities, communities, and groups of people more generally. Music is a means of communication, expression, and sometimes even protest with the power to peacefully bring together large amounts of like-minded people, influence popular culture, and hypnotize you with a memorable lyric that you end up singing in the shower subliminally for weeks on end even after consciously being disappointed in yourself for doing so…..I digress....

Problem

Cities are, in part, composed of musical entities such as record shops, instrument vendors, concert halls, amphitheaters, and more, that not only provide to the music needs of local citizens but also to tourists from around the world. For bigger cities, music entities can be spread apart, resulting in an ecosystem of hip niche neighborhoods that evolve and change over time. This ecosystem is often learned by humans looking for a cool music scene through either natural life experience (wandering/flaneur) or recommendations in the form of internet reviews, comments, and conversations with people in-real-life.

This project aims to quantify a ‘music profile’ for neighborhoods in a major metropolitan city, New York City, to identify clusters of similar music scenes.

Stakeholders

Different parties may be interested in a model that is able to quantify neighborhood similarity based on the types of music outlets available. Such a model would be able to inform renters and home buyers who prefer to live where the music is happening that they’re next home is properly located. Future music venue start-ups can utilize the model to identify neighborhoods lacking live music venues and ensure they are investing in an area that is not saturated. Future music retail vendors, sellers of things like records and instruments, can similarly utilize the model to ensure they are launching a business where competition is in their favor.

Methodology

Data Sources

NYU Spatial Data Repository

I am using the '2014 New York City Neighborhood Names' dataset hosted by NYU's Spatial Data Repository as the basis for the neighborhood names and associated location centroids [0]. The image to the right shows a sample of this information:

	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

Foursquare - 'Places API'

I will be using Foursquare's 'Places API' to acquire data related to 'venues' (as defined by Foursquare) categorized to be somehow associated with music [1]. It is important to note that Foursquare defines a 'venue' as a place that one can go to, or check-in to, and that a 'venue' is not necessarily a music venue but can be any establishment such as a restaurant or type of retail shop. Each Foursquare 'venue' is assigned a 'category' and each 'category' is associated with a particular 'categoryID'. The image to the right shows the 'categoryID' values provided by Foursquare that will be used to acquire music related venues within New York City:

Foursquare Music-Related Venue CategoryIDs

```
Music Venue = '4bf58dd8d48988d1e5931735'

Jazz Club = '4bf58dd8d48988d1e7931735'

Piano Bar = '4bf58dd8d48988d1e8931735'

Rock Club = '4bf58dd8d48988d1e9931735'

Concert Hall = '5032792091d4c4b30a586d5c'

Amphitheater = '56aa371be4b08b9a8d5734db'

Music Festival = '5267e4d9e4b0ec79466e48d1'

Nightlife Spot = '4d4b7105d754a06376d81259'

Music Store = '4bf58dd8d48988d1fe941735'

Record Shop = '4bf58dd8d48988d10d951735'

Recording Studio = '52f2ab2ebcbc57f1066b8b37'
```

Data Retrieval

Neighborhood Name & Location Centroid Data

The '2014 New York City Neighborhood Names' dataset hosted by NYU's Spatial Data Repository was easy to download as a JSON file and import into a Jupyter Notebook:

```
with open('newyork_data.json') as json_data:
    newyork_data = json.load(json_data)
nyc_neighborhood_data = newyork_data['features']
nyc_neighborhood_data[0]
```


```
{'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 'Borough', 'Neighborhood', 'Latitude', and 'Longitude' values associated with each neighborhood were then converted from JSON to a Pandas DataFrame that serves as the foundation of the analysis.

```
column_names = ['Borough', 'Neighborhood', 'Latitude', 'Longitude']

nyc_neighborhoods = pd.DataFrame(columns=column_names)

for data in nyc_neighborhood_data:
    borough = nyc_neighborhood_data = data['properties']['borough']
    neighborhood_name = data['properties']['name']

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

    nyc_neighborhoods = nyc_neighborhoods.append({'Borough': borough,
                                          'Neighborhood': neighborhood_name,
                                          'Latitude': neighborhood_lat,
                                          'Longitude': neighborhood_lon}, ignore_index=True)
nyc_neighborhoods.head(5)
```

	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

Foursquare Music-Related Venue Data

As mentioned in the Data Sources section of this report, Foursquare has numerous 'Venue Categories' that are used to identify each type of venue. A 'get' request to the 'api.foursquare.com/v2/venues/search?' endpoint that provides a category ID will return venues of that category. The example code below sends a 'get' request to Foursquare that asks for one venue with the "Music Store' category (categoryID = '4bf58dd8d48988d1fe941735'):

```
lat = 40.7484
lng = -73.9857
radius = 500 # Meters
categoryId = '4bf58dd8d48988d1fe941735'
limit = 1
endpoint = 'https://api.foursquare.com/v2/venues/search?'

url = '{}&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&categoryId={}&limit={}'.format(
    endpoint,
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    lat,
    lng,
    radius,
    categoryId,
    limit
)

results = requests.get(url).json()
results
```


```
{'meta': {'code': 200, 'requestId': '5ca3f0024c1f6715df23be42'},
 'response': {'venues': [{'id': '54f4f7a0498e300bbb8c5817',
    'name': 'Buffet Group Wind Instrumemts',
    'location': {'lat': 40.752005,
     'lng': -73.988876,
     'labeledLatLngs': [{'label': 'display',
       'lat': 40.752005,
       'lng': -73.988876}],
     'distance': 482,
     'cc': 'US',
     'city': 'New York',
     'state': 'NY',
     'country': 'United States',
     'formattedAddress': ['New York, NY', 'United States']},
    'categories': [{'id': '4bf58dd8d48988d1fe941735',
      'name': 'Music Store',
      'pluralName': 'Music Stores',
      'shortName': 'Music Store',
      'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/music_instruments_',
       'suffix': '.png'},
      'primary': True}],
    'referralId': 'v-1554247682',
    'hasPerk': False}],
  'confident': True}}
```

A preliminary dataset of music related venues associated with each New York City neighborhood was created by recursively sending ‘get’ requests to the previously mentioned endpoint, making sure the results are specific to venues with music related ‘category IDs’. For each neighborhood, we can include all of the selected category IDs in a single ‘get’ request by passing them as comma separated values. Shown below is a function that creates the required url and an example:

```
def createURL(endpoint, CLIENT_ID, CLIENT_SECRET, VERSION, lat, lng, radius, categoryId):
    url = '{}&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&categoryId={}&limit={}'.format(
            endpoint,
            CLIENT_ID,
            CLIENT_SECRET,
            VERSION,
            lat,
            lng,
            radius,
            categoryId,
            limit
        )
    return url

endpoint = 'https://api.foursquare.com/v2/venues/search?'
categoryIds = ['4bf58dd8d48988d1e5931735', '4bf58dd8d48988d1e7931735', '4bf58dd8d48988d1e8931735',
               '4bf58dd8d48988d1e9931735', '5032792091d4c4b30a586d5c', '56aa371be4b08b9a8d5734db',
               '5267e4d9e4b0ec79466e48d1', '4d4b7105d754a06376d81259', '4bf58dd8d48988d1fe941735',
               '4bf58dd8d48988d10d951735', '52f2ab2ebcbc57f1066b8b37',
              ]
limit=50
radius = 1000
lat = 45.0000000
lng = -70.0000000
categoryId = ','.join(categoryIds)
url_example = createURL(endpoint, CLIENT_ID, CLIENT_SECRET, VERSION, lat, lng, radius, categoryId)
print(url_example)
```

```
https://api.foursquare.com/v2/venues/search?&client_id=TTTYSUWFUMJXP00B4DT3JJU0RB4GZ5C25DIEK3EJ2QBMHWK0&client_secret
=XU5LCC4PNFPR0JBA41A45ZHHHTAVTTNX1VJUZINIY1X2SF0E&v=20180605&ll=45.0,-70.0&radius=1000&categoryId=4bf58dd8d48988d1e59
31735,4bf58dd8d48988d1e7931735,4bf58dd8d48988d1e8931735,4bf58dd8d48988d1e9931735,5032792091d4c4b30a586d5c,56aa371be4b
08b9a8d5734db,5267e4d9e4b0ec79466e48d1,4d4b7105d754a06376d81259,4bf58dd8d48988d1fe941735,4bf58dd8d48988d10d951735,52f
2ab2ebcbc57f1066b8b37&limit=50
```

The following function recursively sends a ‘get’ request to Foursquare for each neighborhood that requests all music related venues. While looping through each neighborhood from the NYU dataset, the function appends each music related venue entry to a list and, after looping through each neighborhood, creates a DataFrame of all of the results. Included for each entry in the dataset are neighborhood name and location, and venue name, location, and category.

```
def getNearbyMusicVenues(neighborhoods, latitudes, longitudes, radius=1000):
    endpoint = 'https://api.foursquare.com/v2/venues/search?'
    venues_list = []

    for hood_name, lat, lng in zip(neighborhoods, latitudes, longitudes):

        url = createURL(endpoint, CLIENT_ID, CLIENT_SECRET, VERSION, lat, lng, radius, categoryId, limit)

        results = requests.get(url).json()['response']['venues']

        for item in results:
            venue_name = item['name']
            venue_category = item['categories'][0]['name']
            venue_lat = item['location']['lat']
            venue_lng = item['location']['lng']
            try:
                venue_city = item['location']['city']
            except:
                venue_city = 'N/A'
            venue_state = item['location']['state']

            venues_list.append([(hood_name,
                                 lat,
                                 lng,
                                 venue_name,
                                 venue_category,
                                 venue_lat,
                                 venue_lng,
                                 venue_city,
                                 venue_state
                                )])

    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 Name',
                             'Venue Category',
                             'Venue Latitude',
                             'Venue Longitude',
                             'Venue City',
                             'Venue State'
                            ]
    return nearby_venues

prelim_venue_data = getNearbyMusicVenues(nyc_neighborhoods['Neighborhood'],
                                         nyc_neighborhoods['Latitude'],
                                         nyc_neighborhoods['Longitude'],
                                         radius
                                        )
```

```
prelim_venue_data.head(5)
```

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue Name	Venue Category	Venue Latitude	Venue Longitude	Venue City	Venue State
0	Wakefield	40.894705	-73.847201	Major League Music Group	Music Venue	40.891367	-73.850088	N/A	New York
1	Wakefield	40.894705	-73.847201	Dyme Life Radio	Music Venue	40.894541	-73.843266	Bronx	NY
2	Wakefield	40.894705	-73.847201	Par-City	Music Venue	40.890211	-73.847002	Bronx	NY
3	Wakefield	40.894705	-73.847201	The Upper Room	Music Venue	40.892567	-73.846406	N/A	New York
4	Wakefield	40.894705	-73.847201	Tavern	Bar	40.895898	-73.855731	Bronx	NY

The resulting preliminary venue dataframe includes 9,442 venues that were pulled from Foursquare:

```
1 prelim_venue_data.shape
```

```
(9442, 9)
```

Since I had some issues with exceeding Foursquare's API rate limits, after the preliminary dataset was acquired, a copy was saved to csv so that future development would not require re-requesting information from Foursquare.

```
1 prelim_venue_data.to_csv(path_or_buf='prelim_venue_data.csv')
```

prelim_venue_data.csv — Open with Microsoft Excel

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue Name	Venue Category	Venue Latitude	Venue Longitude	Venue City
0	Wakefield	40.89470517661	-73.84720052054902	Major League Music Group	Music Venue	40.89136668917538	-73.85008751159359	N/A
1	Wakefield	40.89470517661	-73.84720052054902	Dyme Life Radio	Music Venue	40.894541333333336	-73.84326600000001	Bronx
2	Wakefield	40.89470517661	-73.84720052054902	Par-City	Music Venue	40.89021141	-73.84700158	Bronx
3	Wakefield	40.89470517661	-73.84720052054902	The Upper Room	Music Venue	40.892567	-73.846406	N/A
4	Wakefield	40.89470517661	-73.84720052054902	Tavern	Bar	40.895898	-73.855731	Bronx

Exploratory Data Analysis

The series of images below are meant to capture my process for exploring the data retrieved from Foursquare in an effort to better understand what kind of venues were actually pulled during my requests. In a perfect world, each entry would be music-related and located in New York City, but that needed to be verified. The questions below informed how the preliminary venue data was pre-processed, shown in the Data-Preprocessing section of this report.

Question: What states are the venues located in?
Answer: Most entries pulled from the API request included a ‘state’ parameter equal to either ‘New York’ or ‘NY.’ Some entries included a ‘state’ parameter equal to ‘CA’, ‘MA’, and ‘NJ’ and will need to be removed.

```
1 prelim_venue_data.groupby('Venue State')['Venue State'].count()
```

```
Venue State
CA             1
MA             4
NJ            15
NY          8786
New York     636
Name: Venue State, dtype: int64
```

Question: What venue categories are the entries in?
Answer: There are 149 unique venue categories included in this dataset. Some of the categories are not music related, which was a result of using higher level ‘venue categories’ defined by Foursquare. Non-music related categories will be removed.

What venue categories are the entries in?

```
1 n_unique = len(prelim_venue_data['Venue Category'].unique())
2 print(f'There are {n_unique} unique venue categories in this dataframe')
3 prelim_venue_data.groupby('Venue Category')['Venue Category'].count().sort_values(ascending=False)
```

```
There are 149 unique venue categories in this dataframe

Venue Category
Bar                                   2124
Lounge                                 901
Cocktail Bar                           492
Music Venue                            477
Nightclub                              474
Other Nightlife                        469
Pub                                    365
Wine Bar                               277
Sports Bar                             276
Hookah Bar                             255
Beer Garden                            218
Dive Bar                               214
Karaoke Bar                            178
American Restaurant                    169
Concert Hall                           142
Speakeasy                              131
Nightlife Spot                         120
Brewery                                119
Record Shop                            119
Rock Club                              114
Music Store                            108
Gay Bar                                105
Hotel Bar                              102
Strip Club                              88
Recording Studio                        79
Italian Restaurant                      74
Beer Bar                                71
```

Question: How many venues did not have their 'city' parameter filled-out?
Answer: The image below shows that there were quite a few venues that did not have a ‘city’ parameter filled-out. At first I thought this would not be an issue because I still have a latitude and longitude associated with the each entry. Upon further analysis, it was determined that entries with no ‘city’ parameter were no longer active establishments and thus will be removed.

How many venues did not have their 'city' parameter filled-out

```
n_unknown_cities = prelim_venue_data[prelim_venue_data['Venue City']=='N/A']['Venue Name'].count()
print(f'There were {n_unknown_cities} entries in the dataset without the "city" parameter filled-out')
```

```
There were 636 entries in the dataset without the "city" parameter filled-out
```

```
prelim_venue_data[prelim_venue_data['Venue City']=='N/A']['Venue Name'][0:5]
```

```
0     Major League Music Group
3                The Upper Room
17                  Boohran Pub
22                    MY Studio
30                  Expressions
Name: Venue Name, dtype: object
```

Question: Are there any null values in the dataset?
Answer: No.

Are there any 'null' values in the dataset?

```
prelim_venue_data.isnull().values.any()
```

```
False
```

Question: How many unique venues were retrieved?
Answer: In the preliminary dataset, there are less unique venue names than there are entries in total. This means that there are venues associated with more than one neighborhood, which is the result of queries that overlapped because of radius being set to 1000m in the API request. This will be accepted because the venue is within walking distance of the neighborhood centroid and can influence that neighborhood’s scene.

How many unique venues are there?

```
n_unique_venues = len(prelim_venue_data['Venue Name'].unique())
print(f'There are {n_unique_venues} unique venues in the preliminary dataset')
```

```
There are 5039 unique venues in the preliminary dataset
```

Data Pre-Processing

Data Cleaning

The preliminary dataset was cleaned according to the answers listed in the Exploratory Data Analysis section above. First, venues located in states other than “New York” or “NY” were removed. Entries with “Venue State” equal to “New York” were changed to “NY.”

Remove venues with "Venue State" not equal to "New York" or "NY"

```
ny_venue_data = prelim_venue_data[(prelim_venue_data['Venue State'] == "New York") | (prelim_venue_data['Venue Stat
ny_venue_data['Venue State'].replace(to_replace="New York", value="NY", inplace=True)
delta = prelim_venue_data.shape[0] - ny_venue_data.shape[0]
print(f'{delta} entries were removed from the preliminary dataset based on "Venue State"')
ny_venue_data.head(5)
```

```
20 entries were removed from the preliminary dataset based on "Venue State"
```

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue Name	Venue Category	Venue Latitude	Venue Longitude	Venue City	Venue State
0	Wakefield	40.894705	-73.847201	Major League Music Group	Music Venue	40.891367	-73.850088	N/A	NY
1	Wakefield	40.894705	-73.847201	Dyme Life Radio	Music Venue	40.894541	-73.843266	Bronx	NY
2	Wakefield	40.894705	-73.847201	Par-City	Music Venue	40.890211	-73.847002	Bronx	NY
3	Wakefield	40.894705	-73.847201	The Upper Room	Music Venue	40.892567	-73.846406	N/A	NY
4	Wakefield	40.894705	-73.847201	Tavern	Bar	40.895898	-73.855731	Bronx	NY

Entries returned by Foursquare with no ‘Venue City’ and given the ‘N/A’ treatment were also removed:

Remove entries with "Venue City" equal to "N/A"

```
ny_venue_data_with_city = ny_venue_data[(ny_venue_data['Venue City'] != "N/A")]
delta = ny_venue_data.shape[0] - ny_venue_data_with_city.shape[0]
print(f'{delta} entries were removed based on "Venue City"')
ny_venue_data_with_city.head(5)
```

```
636 entries were removed based on "Venue City"
```

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue Name	Venue Category	Venue Latitude	Venue Longitude	Venue City	Venue State
1	Wakefield	40.894705	-73.847201	Dyme Life Radio	Music Venue	40.894541	-73.843266	Bronx	NY
2	Wakefield	40.894705	-73.847201	Par-City	Music Venue	40.890211	-73.847002	Bronx	NY
4	Wakefield	40.894705	-73.847201	Tavern	Bar	40.895898	-73.855731	Bronx	NY
5	Wakefield	40.894705	-73.847201	M.O.S. Cigars	Smoke Shop	40.890628	-73.848478	Bronx	NY
6	Wakefield	40.894705	-73.847201	Inn At the Border	Other Nightlife	40.898248	-73.838641	Mount Vernon	NY

A list of music-related venue categories was created based on the unique venue categories included in the preliminary dataset. This list was used to filter out the non-music-related entries that snuck into our request.

Remove entries that are not associated with music-related categories

```
music_related_categories = ['Music Venue', 'Lounge', 'Nightclub', 'Jazz Club', 'Recording Studtio', 'Piano Bar',
                            'Record Shop', 'Concert Hall', 'Karaoke Bar', 'Music Store', 'Rock Club', 'Amphitheater
                            'Music Festival', 'Opera House', 'Music School']
ny_music_venues = ny_venue_data_with_city[ny_venue_data_with_city['Venue Category'].isin(music_related_categories)]
delta = ny_venue_data_with_city.shape[0] - ny_music_venues.shape[0]
print(f'{delta} entries were removed based on "Venue Category" not being related to music')
print(ny_music_venues['Venue Category'].unique())
ny_music_venues.head(5)
```

```
6477 entries were removed based on "Venue Category" not being related to music
['Music Venue' 'Lounge' 'Nightclub' 'Jazz Club' 'Piano Bar' 'Record Shop'
 'Concert Hall' 'Karaoke Bar' 'Music Store' 'Rock Club' 'Amphitheater'
 'Music Festival' 'Opera House' 'Music School']
```

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue Name	Venue Category	Venue Latitude	Venue Longitude	Venue City	Venue State
1	Wakefield	40.894705	-73.847201	Dyme Life Radio	Music Venue	40.894541	-73.843266	Bronx	NY
2	Wakefield	40.894705	-73.847201	Par-City	Music Venue	40.890211	-73.847002	Bronx	NY
12	Wakefield	40.894705	-73.847201	Emma C. Brisbane Youth Leadership Center	Lounge	40.887923	-73.853688	Bronx	NY
13	Wakefield	40.894705	-73.847201	Karma Lounge	Nightclub	40.901605	-73.850720	Bronx	NY
14	Wakefield	40.894705	-73.847201	Wenbley Lounge	Lounge	40.897526	-73.859468	Bronx	NY

The image below shows the total number of entries and number of unique entries in the ny_music_venues dataframe. As previously mentioned, some venues are assigned to multiple neighborhoods because the venue is within 1,000 meters of the neighborhood's centroid location.

How many music venue entries are left?

```
n_entries = ny_music_venues.shape[0]
print(f'There are {n_entries} entries in the ny_music_venues dataframe')
```

```
There are 2309 entries in the ny_music_venues dataframe
```

How many unique music venues are left?

```
n_unique_entries = len(ny_music_venues['Venue Name'].unique())
print(f'There are {n_unique_entries} unique entries in the ny_music_venues dataframe')
```

```
There are 1282 unique entries in the ny_music_venues dataframe
```

One-Hot-Encoding Venue Categories

In order to use Foursquare's category values to find similar neighborhoods based on music venues, a one-hot-encoding representation of each entry was created using Pandas' 'get_dummies' function. The result was a dataframe of New York City music-related venues where entry venue category is represented by a value of 1 in the column of matching venue category, as shown below:

One-Hot-Encode Venue Categories

```
ny_venue_category_onehot = pd.get_dummies(ny_music_venues[['Venue Category']], prefix="", prefix_sep="")

ny_venue_category_onehot['Neighborhood'] = ny_music_venues['Neighborhood']

fixed_columns = [ny_venue_category_onehot.columns[-1]] + list(ny_venue_category_onehot.columns[:-1])
ny_venue_category_onehot = ny_venue_category_onehot[fixed_columns]

print(ny_venue_category_onehot.shape)
ny_venue_category_onehot.head(10)
```

```
(2385, 16)
```

	Neighborhood	Amphitheater	Concert Hall	Jazz Club	Karaoke Bar	Lounge	Music Festival	Music School	Music Store	Music Venue	Nightclub	Opera House	Piano Bar	Record Shop	Recording Studio	Rock Club
1	Wakefield	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2	Wakefield	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
12	Wakefield	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
13	Wakefield	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
14	Wakefield	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
18	Wakefield	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
21	Wakefield	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
23	Wakefield	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
24	Co-op City	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
29	Co-op City	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Data Visualization

Venue counts were determined for each venue category and neighborhood in New York City using the one hot encoded dataframe:

Determine the total amount of venues of each category in each neighborhood

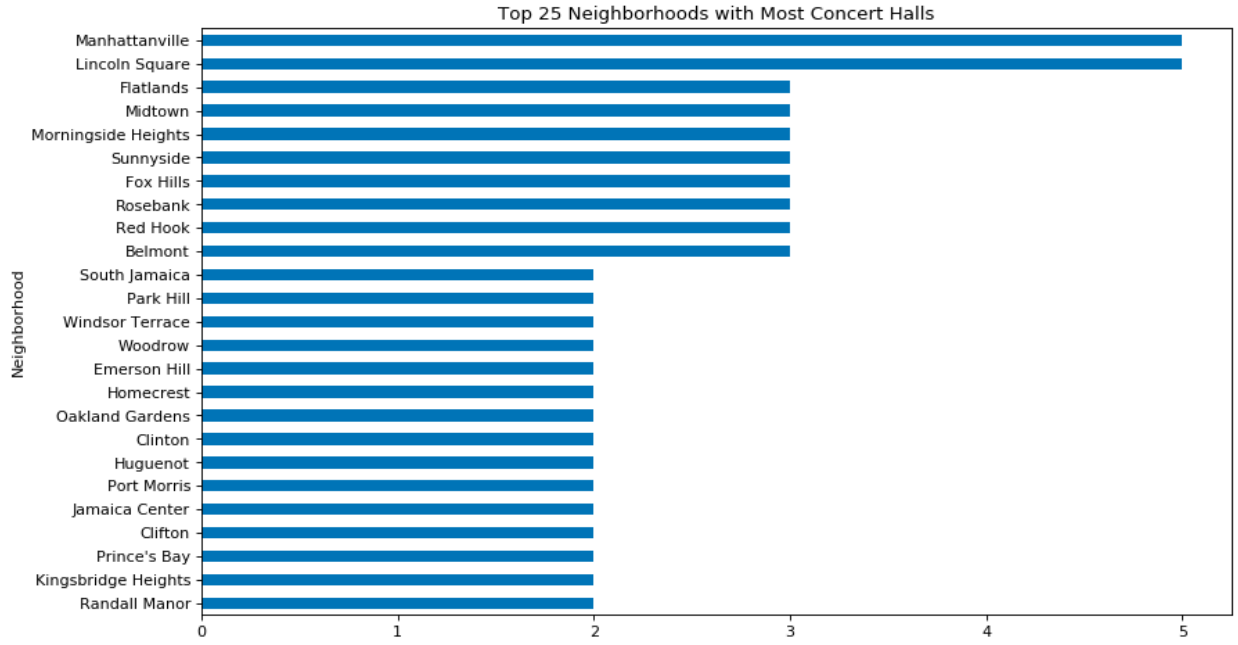
```
venue_counts = ny_venue_category_onehot.groupby('Neighborhood').sum()
venue_counts.head(10)
```

Neighborhood	Amphitheater	Concert Hall	Jazz Club	Karaoke Bar	Lounge	Music Festival	Music School	Music Store	Music Venue	Nightclub	Opera House	Piano Bar	Record Shop	Recording Studio	Rock Club
Allerton	0	0	0	0	3	0	0	0	2	3	0	0	0	0	0
Arden Heights	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
Arrochar	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Astoria	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Astoria Heights	0	0	0	1	3	0	0	0	1	2	0	0	0	0	0
Auburndale	0	0	0	3	2	0	0	0	2	1	0	0	0	0	1
Bath Beach	0	0	0	1	9	0	0	1	1	1	0	0	0	0	1
Bay Ridge	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0
Bay Terrace	0	0	0	0	3	0	0	1	2	1	0	0	0	0	0
Baychester	0	1	0	1	1	0	0	0	1	2	0	0	0	0	0

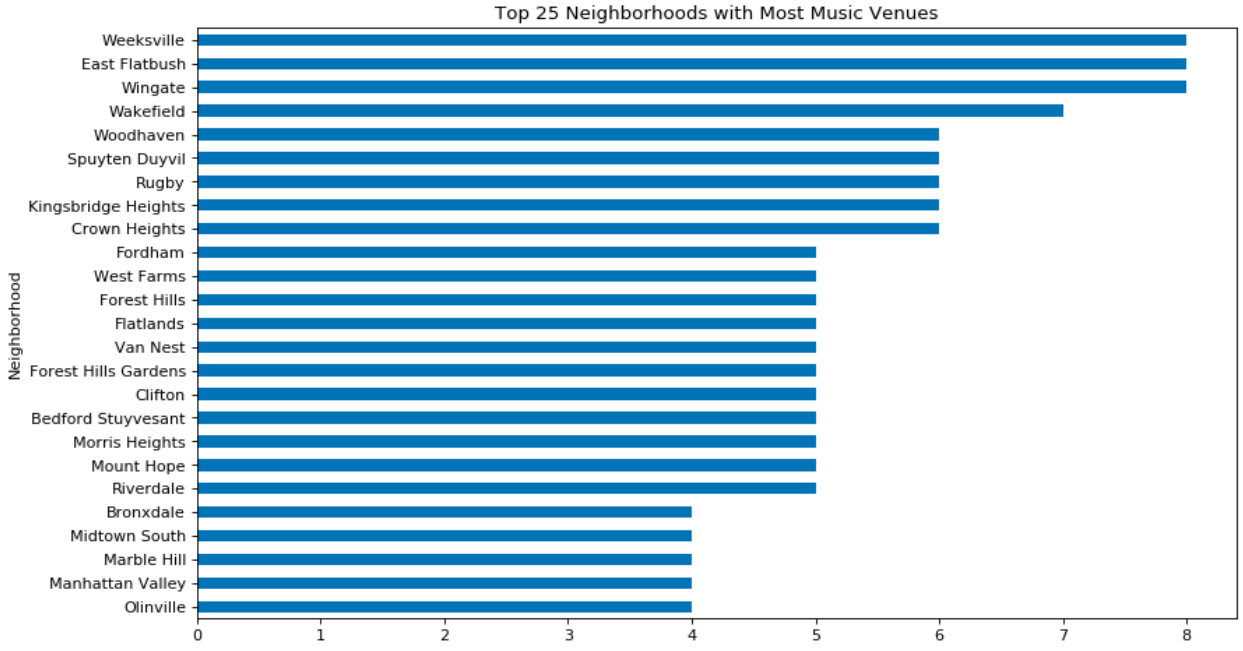
Using the dataframe of venue counts shown above, horizontal bar plots were created for select venue categories to help visualize the top 25 neighborhoods with the most of each particular venu. Using the following loop and matplotlib:

```
plot_categories = ['Concert Hall', 'Music Venue', 'Nightclub', 'Jazz Club', 'Piano Bar']
n = 25
for category in plot_categories:
    plt.figure(num=None, figsize=(12, 7), dpi=80, facecolor='w', edgecolor='k')
    plt.title(f'Top {n} Neighborhoods with Most {category}s')
    top_category_neighborhoods = venue_counts[category].sort_values(ascending=False)[0:n]
    top_category_neighborhoods = top_category_neighborhoods.sort_values(ascending=True)
    top_category_neighborhoods.plot.barh(y=category, rot=0)
```

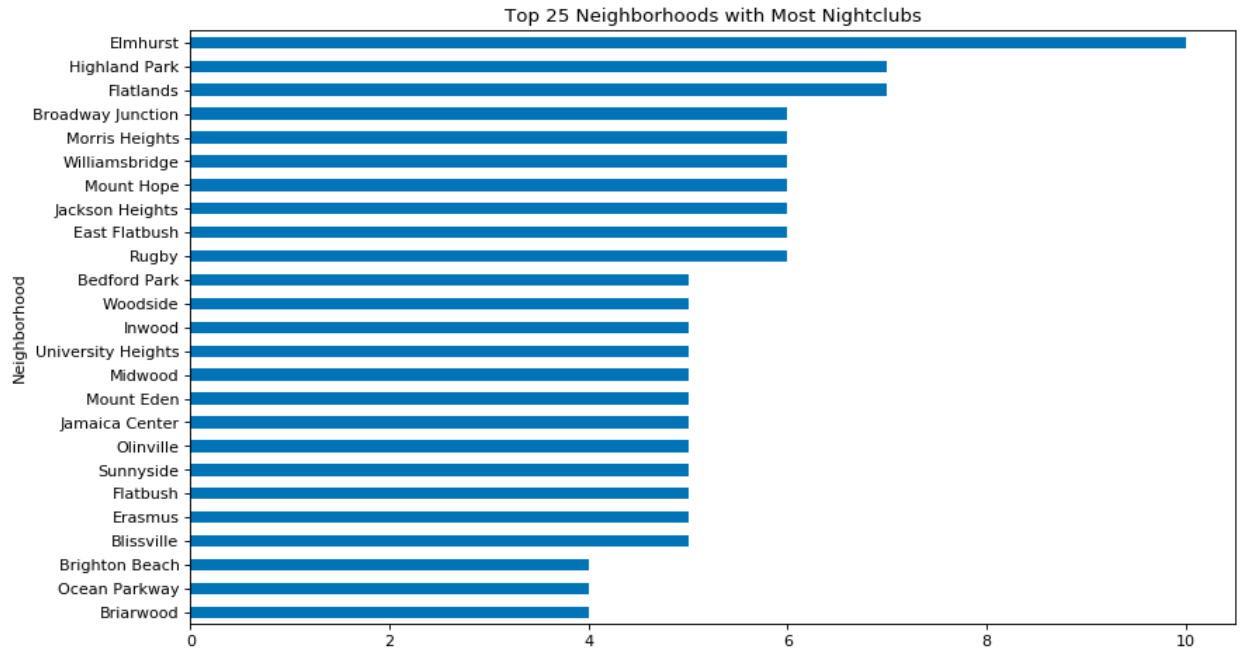
Neighborhoods With Most ‘Concert Halls’



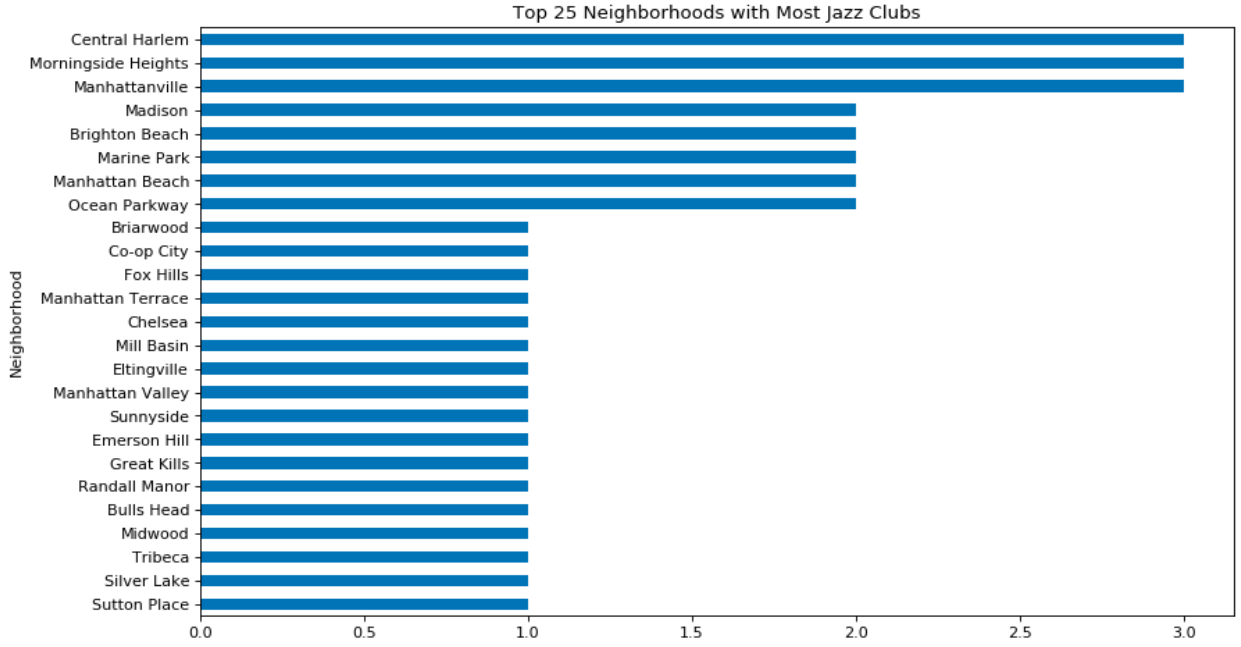
Neighborhoods With Most ‘Music Venues’



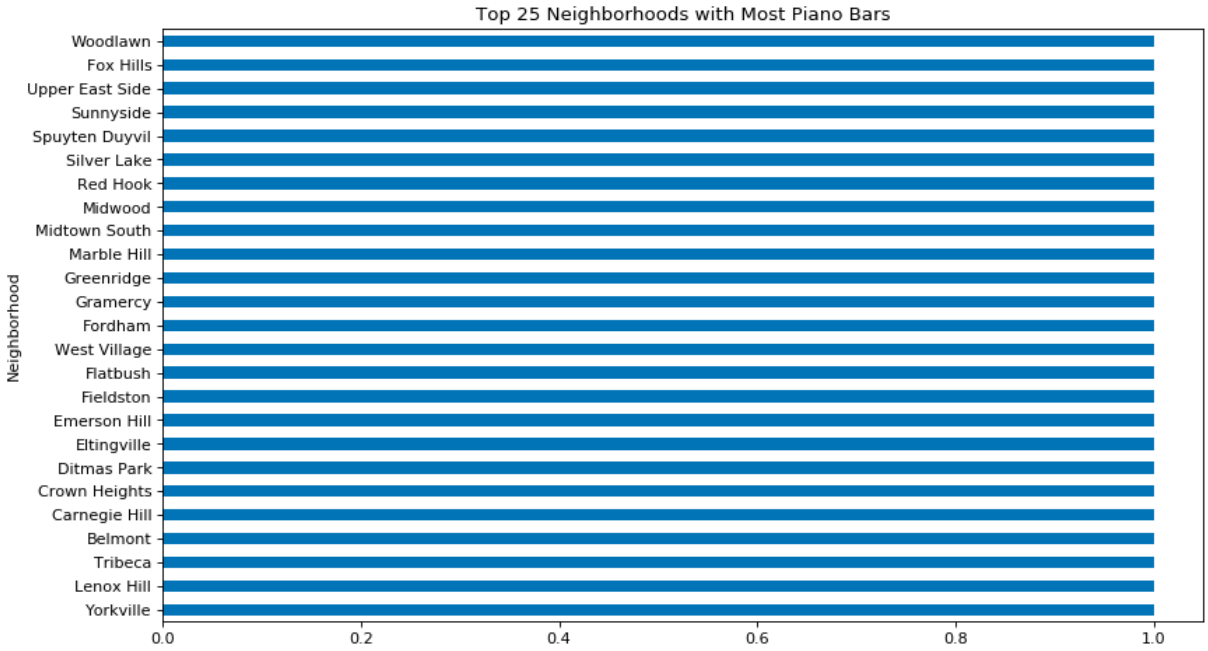
Neighborhoods With Most ‘Nightclubs’



Neighborhoods With Most ‘Jazz Clubs’



Neighborhoods With Most ‘Piano Bars’



Feature Generation

The encoded dataset of music-related venues in New York City was then used to quantify a music profile for each neighborhood. For each venue category, the percent distribution of venues across each neighborhood was calculated. This information would then be used to fit a K-Means clustering algorithm to the data in an effort to determine neighborhoods of similar music venue profile.

First, the total number of venues for each category was determined:

Determine the total amount of venues of each category

```
venue_totals = {}
for category in music_related_categories:
    venue_totals[category] = venue_counts[category].sum()

venue_totals
```

```
{'Music Venue': 431,
 'Lounge': 816,
 'Nightclub': 425,
 'Jazz Club': 47,
 'Recording Studio': 76,
 'Piano Bar': 23,
 'Record Shop': 100,
 'Concert Hall': 115,
 'Karaoke Bar': 138,
 'Music Store': 100,
 'Rock Club': 104,
 'Amphitheater': 3,
 'Music Festival': 1,
 'Opera House': 1,
 'Music School': 5}
```

Finally, the percentage of venues in each neighborhood was calculated with respect to the total amount of venues in the dataset, by venue category. So it's clear, the value shown in the "Lounge" column for Astoria represents the percentage of lounges in the dataset that are located in Astoria.

For each venue category, determine the percentage of entities in each neighborhood

```
for category, total in venue_totals.items():
    venue_mean[category] = venue_counts[category].apply(lambda x: x / total)
venue_mean = venue_mean.reindex(sorted(venue_mean.columns), axis=1)
venue_mean.head(5)
```

Neighborhood	Amphitheater	Concert Hall	Jazz Club	Karaoke Bar	Lounge	Music Festival	Music School	Music Store	Music Venue	Nightclub	Opera House	Piano Bar	Record Shop	Recording Studio	Rock Club
Allerton	0.0	0.000000	0.0	0.000000	0.003676	0.0	0.0	0.0	0.00464	0.007059	0.0	0.0	0.00	0.0	0.0
Arden Heights	0.0	0.008696	0.0	0.000000	0.001225	0.0	0.0	0.0	0.00000	0.000000	0.0	0.0	0.00	0.0	0.0
Arrochar	0.0	0.000000	0.0	0.000000	0.000000	0.0	0.0	0.0	0.00000	0.002353	0.0	0.0	0.01	0.0	0.0
Astoria	0.0	0.000000	0.0	0.007246	0.001225	0.0	0.0	0.0	0.00000	0.000000	0.0	0.0	0.00	0.0	0.0
Astoria Heights	0.0	0.000000	0.0	0.007246	0.003676	0.0	0.0	0.0	0.00232	0.004706	0.0	0.0	0.00	0.0	0.0

With the above, a dataframe showing the top five music venue categories for each neighborhood was created:

Creating a dataframe that shows the top 5 venue categories each neighborhood is known for

```
def return_top_venue_categories(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('{}{} Top Venue Category'.format(ind+1, indicators[ind]))
    except:
        columns.append('{}th Top Venue Category'.format(ind+1))

neighborhoods_top_venue_categories = pd.DataFrame(columns=columns)
neighborhoods_top_venue_categories['Neighborhood'] = venue_mean['Neighborhood']

for ind in np.arange(venue_mean.shape[0]):
    neighborhoods_top_venue_categories.iloc[ind, 1:] = return_top_venue_categories(venue_mean.iloc[ind, :], num_top

neighborhoods_top_venue_categories.head(5)
```

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
0	Allerton	Nightclub	Music Venue	Lounge	Rock Club	Recording Studio
1	Arden Heights	Concert Hall	Lounge	Rock Club	Recording Studio	Record Shop
2	Arrochar	Record Shop	Nightclub	Rock Club	Recording Studio	Piano Bar
3	Astoria	Karaoke Bar	Lounge	Rock Club	Recording Studio	Record Shop
4	Astoria Heights	Karaoke Bar	Nightclub	Lounge	Music Venue	Rock Club

Results

Cluster Modeling

Scikit-learn's K-Means clustering was used to determine similar neighborhoods based on music venue percentage. The image below shows the data being scaled and the K-Means model being created:

Create a KMeans Model To Cluster Neighborhoods

```
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler

kclusters = 15

venue_grouped_clustering = venue_mean.drop('Neighborhood', 1)
kmeans = KMeans(n_clusters=kclusters, random_state=0).fit(venue_grouped_clustering)

kmeans.labels_
```

```
array([ 7,  7,  7,  7,  7,  7,  7,  4,  7,  4,  7,  7,  7,  7,  4,  4,  4,
        7,  4,  0, 13, 11,  7,  4,  7, 10,  9, 11,  4,  7,  7,  4,  9,  7,
        7,  7,  4,  0,  7,  7,  7, 12,  7,  9, 13,  7, 10,  7,  7,  7,  4,
        7,  7,  9,  7,  7,  7,  4,  4,  1, 11,  9,  0,  4,  0,  7,  7,  7,
       11,  4,  7,  4, 10,  4,  7, 13,  7, 11,  7,  7,  7,  7, 10,  4, 14,
       14,  4,  7,  0,  7,  0,  7,  4, 13,  8,  0,  7,  4,  7,  4, 14,  4,
        7,  7,  7,  7,  7,  7,  0,  7,  7,  7, 10,  9,  7,  0,  9, 13,  4,
        7, 10,  4,  4,  7,  7,  7, 10,  7,  7,  7,  5,  7,  7,  4,  4,  7,
        9, 10,  4,  9,  7,  7,  7, 11,  0,  7,  2,  7, 13,  7,  5,  4, 13,
        6,  4,  9,  6,  9, 12,  7,  0,  6,  7,  7,  4,  7,  7,  7,  0, 14,
        9,  7, 12,  4, 11,  4,  7,  4,  4,  8,  7,  4,  4,  7,  4, 10, 13,
        7,  7,  7,  7,  7,  7, 11,  6,  4, 10,  7,  7,  7, 10,  4,  7,  7,
        7,  4,  7,  7,  7,  7,  3, 10,  7,  7,  5,  9,  7,  0, 11,  4,  7,
        7,  7,  7,  7,  7,  7,  7,  7,  4,  7,  7,  4,  7, 13,  7,  7,  4,
       14, 13,  7,  7,  4,  7,  7,  7,  0,  7,  4, 11,  7,  7,  7, 14,  7,
        3,  9,  7, 11,  7, 14,  7,  9,  4,  4,  0,  9,  7, 10,  3,  7,  4,
        4,  9,  7, 14,  4, 10,  4,  4,  7,  7, 11, 10, 10,  0,  7,  7,  0],
      dtype=int32)
```

A new dataframe was created by merging neighborhood location data with cluster labels and top venue categories.

Creating a new dataframe merging neighborhood location data, top venue category by neighborhood, and cluster labels

```
neighborhoods_top_venue_categories.insert(1,'Cluster Labels', kmeans.labels_)

ny_neighborhood_music_profile = nyc_neighborhoods.drop(columns=['Borough'])

ny_neighborhood_music_profile = ny_neighborhood_music_profile.join(neighborhoods_top_venue_categories.set_index('Ne

ny_neighborhood_music_profile.head()
```

	Neighborhood	Latitude	Longitude	Cluster Labels	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
0	Wakefield	40.894705	-73.847201	7.0	Music Venue	Nightclub	Lounge	Rock Club	Recording Studio
1	Co-op City	40.874294	-73.829939	9.0	Jazz Club	Recording Studio	Nightclub	Music Venue	Rock Club
2	Eastchester	40.887556	-73.827806	11.0	Recording Studio	Jazz Club	Nightclub	Music Venue	Rock Club
3	Fieldston	40.895437	-73.905643	0.0	Piano Bar	Music Venue	Record Shop	Lounge	Nightclub
4	Riverdale	40.890834	-73.912585	7.0	Music Venue	Nightclub	Lounge	Rock Club	Recording Studio

Cluster Visualization

The following code uses folium to visualize neighborhoods of similar music profile by coloring each neighborhood point based on cluster label:

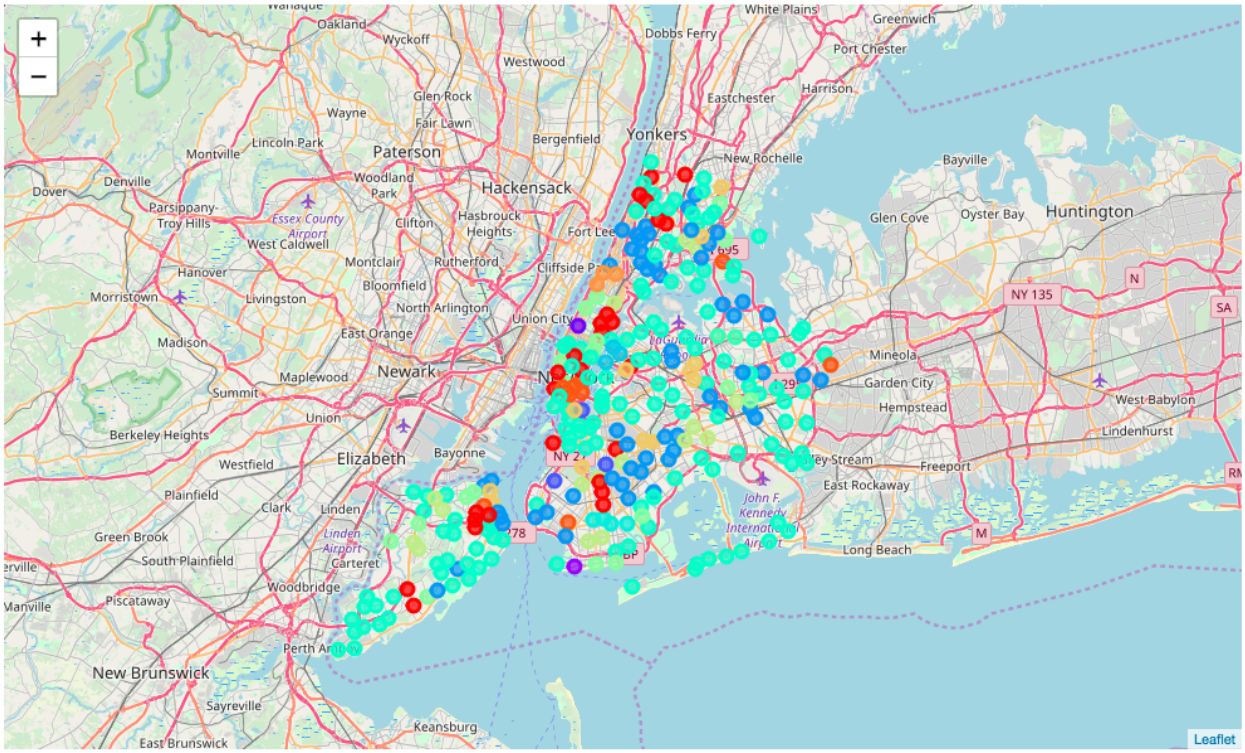
Creating A Visualization of The Clusters

```
# create map
import matplotlib.cm as cm
import matplotlib.colors as colors
latitude = 40.730610
longitude = -73.935242
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=10)

# 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(ny_neighborhood_music_profile['Latitude'], ny_neighborhood_music_profile['Longitu
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[int(cluster)-1],
        fill=True,
        fill_color=rainbow[int(cluster)-1],
        fill_opacity=0.7).add_to(map_clusters)

map_clusters
```



Cluster Evaluation

The following code iterates through and prints the results of each cluster:

Examining Clusters

```
for cluster in range(0, kclusters):
    print(f'Cluster {cluster}:')
    print(ny_neighborhood_music_profile.loc[ny_neighborhood_music_profile['Cluster Labels'] == cluster, ny_neighbo
```

The resulting clusters can be seen in the Clusters section of this document's Appendix. Each cluster shows a list of neighborhoods with their respective top venue categories. We can compare the resulting clusters to the bar plots in the Data Visualization section and get a sense that the clusters are properly grouping neighborhoods based on music-related venue counts.

It is interesting to see that some clusters are very small, sometimes only holding a single neighborhood, and appear to have identified a niche music profile. Examples of this are:

Cluster 1 - Coney Island - Music Festival (Coney Island Music Festival)
Cluster 2 - Lincoln Square - Opera House (Metropolitan Opera House)

Other clusters, such as Cluster 4 and Cluster 7, are very large and appear to be grouping neighborhoods with assortments of live music type venues such as Music Venue, Nightclub, Rock Club, Lounge, etc.

The inter-cluster 1st Top Venue Category of Clusters 9, 11, 12, 13, & 14 are all the same; Jazz Club, Recording Studio, Rock Club, Jazz Club, and Piano Club respectively. It's interested to see that Cluster 9 and 12 are both mainly interested in Jazz but were clustered differently because their other top venue categories were different, meaning a different music profile.

Conclusion

Machine learning and clustering algorithms can be applied to multi-dimensional datasets to find similarities and patterns in the data. Clusters of neighborhoods of similar music profile, or any profile, can be generated using high-quality venue location data. There is a preface on high-quality because analysis models are only as good as the input into them (garbage in, garbage out). Luckily, Foursquare offers a robust ‘Places API’ service that, although (as we have seen) not perfect (nothing is), can be leverages in similar studies and model-making.

This project could be expanded on in a number of different ways. Foursquare’s API could be further interrogated to retrieve and consider more music-related venues in New York City. New datasets of music-related venues can be acquired and potentially merged with what was retrieved from Foursquare. The DBSCAN clustering algorithm, better at maintaining dense clusters and ignoring outliers, could be implemented and compared to KMeans. The clustering model could become the basis for a recommendation system aimed to provide neighborhoods of similar music profile to users.

References

[0] - 2014 New York City Neighborhood Names - NYU Spatial Data Repository

[1] - 'Places API' Documentation - Foursquare

Appendix

Clusters

Cluster 0:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
3	Fieldston	Piano Bar	Music Venue	Record Shop	Lounge	Nightclub
6	Marble Hill	Piano Bar	Music Venue	Concert Hall	Nightclub	Lounge
7	Woodlawn	Piano Bar	Music Venue	Lounge	Nightclub	Rock Club
16	Fordham	Piano Bar	Music Venue	Lounge	Music Store	Concert Hall
34	Belmont	Piano Bar	Concert Hall	Music Store	Nightclub	Music Venue
35	Spuyten Duyvil	Piano Bar	Music Venue	Concert Hall	Nightclub	Lounge
54	Flatbush	Piano Bar	Lounge	Nightclub	Music Store	Concert Hall
55	Crown Heights	Piano Bar	Recording Studio	Music Venue	Lounge	Record Shop
67	Red Hook	Piano Bar	Concert Hall	Music Store	Record Shop	Nightclub
107	Upper East Side	Piano Bar	Rock Club	Recording Studio	Record Shop	Opera House
108	Yorkville	Piano Bar	Rock Club	Recording Studio	Record Shop	Opera House
109	Lenox Hill	Piano Bar	Rock Club	Recording Studio	Record Shop	Opera House
126	Gramercy	Piano Bar	Music Venue	Lounge	Nightclub	Rock Club
221	Ditmas Park	Piano Bar	Music Store	Lounge	Nightclub	Karaoke Bar
242	Greenridge	Piano Bar	Rock Club	Lounge	Recording Studio	Record Shop
247	Carnegie Hill	Piano Bar	Lounge	Rock Club	Recording Studio	Record Shop
250	Midtown South	Piano Bar	Music Venue	Lounge	Nightclub	Rock Club

Cluster 1:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
78	Coney Island	Music Festival	Karaoke Bar	Rock Club	Music Venue	Concert Hall

Cluster 2:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
112	Lincoln Square	Opera House	Concert Hall	Jazz Club	Music Venue	Lounge

Cluster 3:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
48	Sunset Park	Amphitheater	Recording Studio	Karaoke Bar	Record Shop	Music Venue
88	Prospect Lefferts Gardens	Amphitheater	Jazz Club	Record Shop	Lounge	Rock Club
280	Vinegar Hill	Amphitheater	Recording Studio	Rock Club	Music Venue	Concert Hall

Cluster 4:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
9	Williamsbridge	Nightclub	Recording Studio	Record Shop	Karaoke Bar	Lounge
14	University Heights	Nightclub	Lounge	Music Store	Music Venue	Concert Hall
15	Morris Heights	Nightclub	Karaoke Bar	Music Venue	Music Store	Record Shop
19	High Bridge	Rock Club	Lounge	Music Store	Music Venue	Record Shop
20	Melrose	Music Store	Concert Hall	Nightclub	Karaoke Bar	Lounge
23	Longwood	Recording Studio	Music Store	Nightclub	Record Shop	Concert Hall
25	Morrisania	Music Store	Record Shop	Concert Hall	Nightclub	Karaoke Bar
31	Westchester Square	Recording Studio	Music Store	Rock Club	Nightclub	Lounge
37	Pelham Bay	Recording Studio	Music Store	Karaoke Bar	Music Venue	Lounge
41	Olinville	Recording Studio	Nightclub	Music Venue	Karaoke Bar	Lounge
43	Concourse	Rock Club	Lounge	Nightclub	Music Venue	Record Shop
44	Unionport	Music Store	Recording Studio	Record Shop	Lounge	Nightclub
56	East Flatbush	Music Venue	Nightclub	Lounge	Music Store	Concert Hall
60	Brownsville	Recording Studio	Rock Club	Record Shop	Concert Hall	Lounge
63	Bedford Stuyvesant	Recording Studio	Music Venue	Lounge	Rock Club	Record Shop
71	Cypress Hills	Music Store	Rock Club	Nightclub	Record Shop	Lounge
72	East New York	Music Store	Nightclub	Music Venue	Lounge	Rock Club
74	Canarsie	Music Store	Rock Club	Music Venue	Lounge	Nightclub
75	Flatlands	Concert Hall	Karaoke Bar	Nightclub	Music Venue	Lounge
79	Bath Beach	Lounge	Music Store	Rock Club	Karaoke Bar	Nightclub
80	Borough Park	Music Store	Rock Club	Nightclub	Concert Hall	Lounge
81	Dyker Heights	Music Store	Rock Club	Concert Hall	Nightclub	Music Venue
99	Fort Hamilton	Music Store	Nightclub	Karaoke Bar	Lounge	Music Venue
101	Washington Heights	Music Store	Rock Club	Music Venue	Lounge	Karaoke Bar
103	Hamilton Heights	Recording Studio	Rock Club	Music Venue	Record Shop	Concert Hall
131	Jackson Heights	Nightclub	Music Store	Lounge	Rock Club	Recording Studio
132	Elmhurst	Nightclub	Music Store	Lounge	Music Venue	Rock Club
136	Kew Gardens	Music Store	Lounge	Music Venue	Karaoke Bar	Nightclub
150	Whitestone	Rock Club	Recording Studio	Music Store	Music Venue	Karaoke Bar
156	Bellerose	Music Store	Rock Club	Recording Studio	Record Shop	Piano Bar
158	Fresh Meadows	Music Store	Concert Hall	Lounge	Rock Club	Recording Studio
160	Jamaica Center	Music Store	Concert Hall	Nightclub	Record Shop	Music Venue
164	South Jamaica	Music Store	Concert Hall	Rock Club	Music Venue	Nightclub
174	Beechhurst	Recording Studio	Music Store	Rock Club	Music Venue	Nightclub
175	Bay Terrace	Music Store	Music Venue	Lounge	Nightclub	Rock Club
194	Bellaire	Music Store	Rock Club	Music Venue	Nightclub	Recording Studio
196	Forest Hills Gardens	Music Venue	Music Store	Lounge	Rock Club	Recording Studio
197	St. George	Recording Studio	Music Store	Rock Club	Lounge	Nightclub
198	New Brighton	Recording Studio	Music Store	Rock Club	Lounge	Music Venue
200	Rosebank	Concert Hall	Music Store	Music Venue	Lounge	Rock Club
211	New Dorp	Music Store	Record Shop	Nightclub	Karaoke Bar	Music Venue
223	Rugby	Music Store	Lounge	Nightclub	Music Venue	Record Shop
235	Bay Terrace	Music Store	Music Venue	Lounge	Nightclub	Rock Club

252	Shore Acres	Concert Hall	Music Store	Music Venue	Lounge	Rock Club
253	Clifton	Concert Hall	Music Venue	Music Store	Nightclub	Lounge
259	Remsen Village	Music Store	Lounge	Concert Hall	Nightclub	Music Venue
260	New Lots	Karaoke Bar	Music Store	Concert Hall	Music Venue	Lounge
265	Pomonok	Karaoke Bar	Music Store	Concert Hall	Nightclub	Lounge
268	Concourse Village	Karaoke Bar	Lounge	Rock Club	Nightclub	Music Venue
269	Mount Eden	Nightclub	Music Store	Record Shop	Lounge	Concert Hall
270	Mount Hope	Nightclub	Music Venue	Music Store	Lounge	Concert Hall
281	Weeksville	Music Venue	Music Store	Concert Hall	Lounge	Nightclub
294	Malba	Rock Club	Karaoke Bar	Recording Studio	Music Store	Nightclub
295	Highland Park	Nightclub	Recording Studio	Karaoke Bar	Lounge	Music Venue
297	Bronxdale	Music Store	Music Venue	Concert Hall	Karaoke Bar	Lounge
300	Erasmus	Lounge	Nightclub	Music Store	Music Venue	Record Shop

Cluster 5:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
139	Long Island City	Music School	Recording Studio	Nightclub	Record Shop	Music Venue
272	Hunters Point	Music School	Recording Studio	Record Shop	Music Venue	Nightclub
304	Queensbridge	Music School	Recording Studio	Rock Club	Record Shop	Music Venue

Cluster 6:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
53	Manhattan Terrace	Record Shop	Jazz Club	Music Store	Karaoke Bar	Recording Studio
83	Marine Park	Jazz Club	Record Shop	Music Store	Lounge	Music Venue
98	Ocean Parkway	Record Shop	Jazz Club	Karaoke Bar	Music Store	Recording Studio
296	Madison	Record Shop	Jazz Club	Karaoke Bar	Recording Studio	Music Store

Cluster 7:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
0	Wakefield	Music Venue	Nightclub	Lounge	Rock Club	Recording Studio
4	Riverdale	Music Venue	Nightclub	Lounge	Rock Club	Recording Studio
5	Kingsbridge	Music Venue	Lounge	Nightclub	Rock Club	Recording Studio
8	Norwood	Record Shop	Lounge	Music Venue	Nightclub	Rock Club
10	Baychester	Concert Hall	Karaoke Bar	Nightclub	Music Venue	Lounge
11	Pelham Parkway	Recording Studio	Music Venue	Karaoke Bar	Lounge	Rock Club
12	City Island	Music Venue	Rock Club	Recording Studio	Record Shop	Piano Bar
13	Bedford Park	Nightclub	Record Shop	Concert Hall	Lounge	Music Venue
17	East Tremont	Lounge	Music Venue	Karaoke Bar	Nightclub	Rock Club
18	West Farms	Music Venue	Karaoke Bar	Lounge	Nightclub	Rock Club
21	Mott Haven	Concert Hall	Nightclub	Lounge	Music Venue	Rock Club
22	Port Morris	Concert Hall	Music Venue	Lounge	Nightclub	Rock Club
24	Hunts Point	Recording Studio	Nightclub	Music Venue	Lounge	Rock Club
26	Soundview	Recording Studio	Lounge	Music Venue	Rock Club	Record Shop
27	Clason Point	Rock Club	Lounge	Recording Studio	Record Shop	Piano Bar
28	Throgs Neck	Lounge	Rock Club	Recording Studio	Record Shop	Piano Bar
36	North Riverdale	Lounge	Music Venue	Nightclub	Rock Club	Recording Studio
39	Edgewater Park	Lounge	Music Venue	Rock Club	Recording Studio	Record Shop
40	Castle Hill	Recording Studio	Lounge	Nightclub	Rock Club	Record Shop
42	Pelham Gardens	Recording Studio	Concert Hall	Music Venue	Karaoke Bar	Nightclub
45	Edenwald	Music Venue	Lounge	Nightclub	Rock Club	Recording Studio
46	Bay Ridge	Karaoke Bar	Music Store	Music Venue	Lounge	Rock Club
49	Greenpoint	Karaoke Bar	Nightclub	Music Venue	Rock Club	Recording Studio
52	Sheepshead Bay	Karaoke Bar	Lounge	Nightclub	Rock Club	Recording Studio
59	Prospect Heights	Nightclub	Music Venue	Rock Club	Recording Studio	Record Shop
61	Williamsburg	Rock Club	Nightclub	Music Venue	Recording Studio	Record Shop
62	Bushwick	Music Venue	Nightclub	Rock Club	Recording Studio	Record Shop
64	Brooklyn Heights	Recording Studio	Rock Club	Concert Hall	Lounge	Record Shop
65	Cobble Hill	Lounge	Rock Club	Recording Studio	Record Shop	Piano Bar
66	Carroll Gardens	Rock Club	Lounge	Recording Studio	Record Shop	Piano Bar
68	Gowanus	Rock Club	Nightclub	Lounge	Recording Studio	Record Shop
69	Fort Greene	Nightclub	Rock Club	Recording Studio	Record Shop	Piano Bar
70	Park Slope	Nightclub	Music Venue	Rock Club	Recording Studio	Record Shop
73	Starrett City	Music Venue	Rock Club	Recording Studio	Record Shop	Piano Bar
76	Mill Island	Music Store	Rock Club	Recording Studio	Record Shop	Piano Bar
82	Gerritsen Beach	Nightclub	Rock Club	Recording Studio	Record Shop	Piano Bar
84	Clinton Hill	Recording Studio	Record Shop	Concert Hall	Lounge	Music Venue
85	Sea Gate	Music Venue	Rock Club	Recording Studio	Record Shop	Piano Bar
86	Downtown	Nightclub	Rock Club	Recording Studio	Record Shop	Piano Bar
87	Boerum Hill	Nightclub	Rock Club	Recording Studio	Record Shop	Piano Bar
94	Georgetown	Karaoke Bar	Concert Hall	Lounge	Nightclub	Rock Club
95	East Williamsburg	Music Venue	Rock Club	Recording Studio	Record Shop	Piano Bar
96	North Side	Record Shop	Nightclub	Music Venue	Rock Club	Recording Studio

97	South Side	Nightclub	Music Venue	Rock Club	Recording Studio	Record Shop
102	Inwood	Lounge	Nightclub	Concert Hall	Music Venue	Rock Club
110	Roosevelt Island	Lounge	Rock Club	Recording Studio	Record Shop	Piano Bar
113	Clinton	Concert Hall	Music Venue	Lounge	Nightclub	Rock Club
114	Midtown	Concert Hall	Music Venue	Lounge	Nightclub	Rock Club
128	Financial District	Music Venue	Rock Club	Recording Studio	Record Shop	Piano Bar
129	Astoria	Karaoke Bar	Lounge	Rock Club	Recording Studio	Record Shop
130	Woodside	Nightclub	Lounge	Rock Club	Recording Studio	Record Shop
133	Howard Beach	Rock Club	Concert Hall	Music Venue	Lounge	Recording Studio
135	Forest Hills	Music Venue	Lounge	Karaoke Bar	Rock Club	Recording Studio
137	Richmond Hill	Lounge	Nightclub	Music Venue	Rock Club	Recording Studio
141	East Elmhurst	Karaoke Bar	Nightclub	Lounge	Rock Club	Recording Studio
142	Maspeth	Recording Studio	Rock Club	Nightclub	Lounge	Record Shop
143	Ridgewood	Recording Studio	Rock Club	Record Shop	Concert Hall	Lounge
144	Glendale	Karaoke Bar	Music Venue	Lounge	Rock Club	Recording Studio
148	South Ozone Park	Lounge	Rock Club	Recording Studio	Record Shop	Piano Bar
149	College Point	Karaoke Bar	Nightclub	Music Venue	Lounge	Rock Club
151	Bayside	Karaoke Bar	Lounge	Music Venue	Rock Club	Recording Studio
152	Auburndale	Karaoke Bar	Rock Club	Music Venue	Lounge	Nightclub
153	Little Neck	Music Store	Lounge	Rock Club	Recording Studio	Record Shop
154	Douglaston	Music Store	Lounge	Rock Club	Recording Studio	Record Shop
155	Glen Oaks	Concert Hall	Nightclub	Rock Club	Recording Studio	Record Shop
161	Oakland Gardens	Concert Hall	Karaoke Bar	Rock Club	Recording Studio	Record Shop
162	Queens Village	Rock Club	Music Venue	Karaoke Bar	Lounge	Recording Studio
163	Hollis	Recording Studio	Rock Club	Lounge	Nightclub	Music Venue
165	St. Albans	Lounge	Nightclub	Rock Club	Recording Studio	Record Shop
166	Rochdale	Recording Studio	Record Shop	Lounge	Rock Club	Piano Bar
167	Springfield Gardens	Recording Studio	Record Shop	Music Venue	Lounge	Rock Club
168	Cambria Heights	Record Shop	Lounge	Nightclub	Music Venue	Rock Club
169	Rosedale	Music Venue	Lounge	Rock Club	Recording Studio	Record Shop
170	Far Rockaway	Karaoke Bar	Record Shop	Music Venue	Rock Club	Recording Studio
172	Breezy Point	Lounge	Rock Club	Recording Studio	Record Shop	Piano Bar
173	Steinway	Recording Studio	Record Shop	Music Venue	Nightclub	Lounge
176	Edgemere	Music Venue	Rock Club	Recording Studio	Record Shop	Piano Bar
178	Rockaway Beach	Rock Club	Nightclub	Recording Studio	Record Shop	Piano Bar
179	Neponsit	Lounge	Rock Club	Recording Studio	Record Shop	Piano Bar
182	Holliswood	Recording Studio	Concert Hall	Music Venue	Lounge	Nightclub
183	Jamaica Estates	Lounge	Nightclub	Music Venue	Rock Club	Recording Studio
184	Queensboro Hill	Karaoke Bar	Concert Hall	Nightclub	Lounge	Rock Club
185	Hillcrest	Lounge	Nightclub	Karaoke Bar	Rock Club	Recording Studio
186	Ravenswood	Karaoke Bar	Music Venue	Lounge	Rock Club	Recording Studio
187	Lindenwood	Concert Hall	Lounge	Music Venue	Rock Club	Recording Studio
188	Laurelton	Concert Hall	Lounge	Music Venue	Rock Club	Recording Studio
190	Belle Harbor	Concert Hall	Lounge	Rock Club	Recording Studio	Record Shop
191	Rockaway Park	Concert Hall	Music Venue	Rock Club	Recording Studio	Record Shop

193	Brookville	Lounge	Music Venue	Rock Club	Recording Studio	Record Shop
195	North Corona	Concert Hall	Lounge	Karaoke Bar	Nightclub	Rock Club
204	South Beach	Karaoke Bar	Nightclub	Rock Club	Recording Studio	Record Shop
205	Port Richmond	Rock Club	Record Shop	Nightclub	Music Venue	Lounge
206	Mariner's Harbor	Record Shop	Nightclub	Lounge	Rock Club	Recording Studio
208	Castleton Corners	Concert Hall	Music Venue	Lounge	Rock Club	Recording Studio
212	Oakwood	Record Shop	Nightclub	Rock Club	Recording Studio	Piano Bar
216	Woodrow	Concert Hall	Rock Club	Nightclub	Music Venue	Lounge
217	Tottenville	Rock Club	Nightclub	Lounge	Recording Studio	Record Shop
224	Park Hill	Concert Hall	Lounge	Nightclub	Rock Club	Recording Studio
226	Graniteville	Nightclub	Rock Club	Recording Studio	Record Shop	Piano Bar
227	Arlington	Lounge	Rock Club	Recording Studio	Record Shop	Piano Bar
228	Arrochar	Record Shop	Nightclub	Rock Club	Recording Studio	Piano Bar
229	Grasmere	Nightclub	Lounge	Rock Club	Recording Studio	Record Shop
231	Dongan Hills	Karaoke Bar	Rock Club	Recording Studio	Record Shop	Piano Bar
232	Midland Beach	Karaoke Bar	Nightclub	Lounge	Rock Club	Recording Studio
233	Grant City	Karaoke Bar	Music Store	Nightclub	Lounge	Rock Club
234	New Dorp Beach	Record Shop	Karaoke Bar	Nightclub	Music Venue	Rock Club
236	Huguenot	Concert Hall	Music Venue	Lounge	Rock Club	Recording Studio
237	Pleasant Plains	Karaoke Bar	Lounge	Rock Club	Recording Studio	Record Shop
238	Butler Manor	Lounge	Nightclub	Rock Club	Recording Studio	Record Shop
239	Charleston	Karaoke Bar	Nightclub	Music Venue	Lounge	Rock Club
240	Rossville	Rock Club	Nightclub	Music Venue	Lounge	Recording Studio
241	Arden Heights	Concert Hall	Lounge	Rock Club	Recording Studio	Record Shop
249	Civic Center	Karaoke Bar	Nightclub	Music Venue	Rock Club	Recording Studio
251	Richmond Town	Karaoke Bar	Music Venue	Rock Club	Recording Studio	Record Shop
254	Concord	Concert Hall	Lounge	Nightclub	Rock Club	Recording Studio
261	Paerdegat Basin	Rock Club	Lounge	Nightclub	Music Venue	Recording Studio
264	Utopia	Music Store	Nightclub	Lounge	Rock Club	Recording Studio
266	Astoria Heights	Karaoke Bar	Nightclub	Lounge	Music Venue	Rock Club
267	Claremont Village	Record Shop	Concert Hall	Lounge	Karaoke Bar	Nightclub
274	Tudor City	Karaoke Bar	Music Venue	Lounge	Rock Club	Recording Studio
275	Stuyvesant Town	Karaoke Bar	Music Venue	Rock Club	Recording Studio	Record Shop
276	Flatiron	Music Venue	Lounge	Nightclub	Rock Club	Recording Studio
277	Sunnyside Gardens	Music Store	Nightclub	Lounge	Rock Club	Recording Studio
279	Fulton Ferry	Recording Studio	Record Shop	Music Venue	Lounge	Rock Club
284	Manor Heights	Concert Hall	Music Venue	Rock Club	Recording Studio	Record Shop
285	Willowbrook	Concert Hall	Music Venue	Lounge	Rock Club	Recording Studio
286	Sandy Ground	Rock Club	Nightclub	Recording Studio	Record Shop	Piano Bar
287	Egbertville	Nightclub	Music Venue	Rock Club	Recording Studio	Record Shop
290	Middle Village	Karaoke Bar	Lounge	Rock Club	Recording Studio	Record Shop
291	Prince's Bay	Concert Hall	Nightclub	Rock Club	Recording Studio	Record Shop
292	Lighthouse Hill	Karaoke Bar	Music Venue	Rock Club	Recording Studio	Record Shop

293	Richmond Valley	Nightclub	Lounge	Rock Club	Recording Studio	Record Shop
298	Allerton	Nightclub	Music Venue	Lounge	Rock Club	Recording Studio
299	Kingsbridge Heights	Concert Hall	Music Venue	Lounge	Nightclub	Rock Club
301	Hudson Yards	Music Venue	Nightclub	Lounge	Rock Club	Recording Studio
302	Hammels	Nightclub	Rock Club	Recording Studio	Record Shop	Piano Bar
303	Bayswater	Music Venue	Rock Club	Recording Studio	Record Shop	Piano Bar

Cluster 8:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
115	Murray Hill	Music School	Karaoke Bar	Lounge	Concert Hall	Rock Club
138	Flushing	Music School	Karaoke Bar	Music Store	Lounge	Nightclub
180	Murray Hill	Music School	Karaoke Bar	Lounge	Concert Hall	Rock Club

Cluster 9:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
1	Co-op City	Jazz Club	Recording Studio	Nightclub	Music Venue	Rock Club
29	Country Club	Jazz Club	Rock Club	Music Store	Lounge	Music Venue
51	Brighton Beach	Jazz Club	Music Store	Nightclub	Karaoke Bar	Lounge
77	Manhattan Beach	Jazz Club	Concert Hall	Karaoke Bar	Nightclub	Lounge
111	Upper West Side	Jazz Club	Concert Hall	Karaoke Bar	Music Venue	Lounge
116	Chelsea	Jazz Club	Nightclub	Lounge	Rock Club	Recording Studio
117	Greenwich Village	Jazz Club	Rock Club	Lounge	Recording Studio	Record Shop
124	Manhattan Valley	Jazz Club	Music Venue	Record Shop	Karaoke Bar	Lounge
157	Kew Gardens Hills	Jazz Club	Record Shop	Concert Hall	Karaoke Bar	Lounge
201	West Brighton	Jazz Club	Music Store	Concert Hall	Music Venue	Lounge
213	Great Kills	Jazz Club	Music Store	Nightclub	Lounge	Music Venue
244	Chelsea	Jazz Club	Nightclub	Lounge	Rock Club	Recording Studio
246	Bulls Head	Jazz Club	Music Store	Record Shop	Music Venue	Rock Club
256	Randall Manor	Jazz Club	Music Store	Concert Hall	Music Venue	Karaoke Bar
262	Mill Basin	Jazz Club	Karaoke Bar	Record Shop	Concert Hall	Lounge
263	Jamaica Hills	Jazz Club	Music Store	Concert Hall	Nightclub	Record Shop
271	Sutton Place	Jazz Club	Karaoke Bar	Nightclub	Rock Club	Recording Studio
273	Turtle Bay	Jazz Club	Karaoke Bar	Music Venue	Rock Club	Recording Studio

Cluster 10:

99	Fort Hamilton	Music Store	Nightclub	Karaoke Bar	Lounge	Music Venue
101	Washington Heights	Music Store	Rock Club	Music Venue	Lounge	Karaoke Bar
103	Hamilton Heights	Recording Studio	Rock Club	Music Venue	Record Shop	Concert Hall
131	Jackson Heights	Nightclub	Music Store	Lounge	Rock Club	Recording Studio
132	Elmhurst	Nightclub	Music Store	Lounge	Music Venue	Rock Club
136	Kew Gardens	Music Store	Lounge	Music Venue	Karaoke Bar	Nightclub
150	Whitestone	Rock Club	Recording Studio	Music Store	Music Venue	Karaoke Bar
156	Bellerose	Music Store	Rock Club	Recording Studio	Record Shop	Piano Bar
158	Fresh Meadows	Music Store	Concert Hall	Lounge	Rock Club	Recording Studio
160	Jamaica Center	Music Store	Concert Hall	Nightclub	Record Shop	Music Venue
164	South Jamaica	Music Store	Concert Hall	Rock Club	Music Venue	Nightclub
174	Beechhurst	Recording Studio	Music Store	Rock Club	Music Venue	Nightclub
175	Bay Terrace	Music Store	Music Venue	Lounge	Nightclub	Rock Club
194	Bellaire	Music Store	Rock Club	Music Venue	Nightclub	Recording Studio
196	Forest Hills Gardens	Music Venue	Music Store	Lounge	Rock Club	Recording Studio
197	St. George	Recording Studio	Music Store	Rock Club	Lounge	Nightclub
198	New Brighton	Recording Studio	Music Store	Rock Club	Lounge	Music Venue
200	Rosebank	Concert Hall	Music Store	Music Venue	Lounge	Rock Club
211	New Dorp	Music Store	Record Shop	Nightclub	Karaoke Bar	Music Venue
223	Rugby	Music Store	Lounge	Nightclub	Music Venue	Record Shop
235	Bay Terrace	Music Store	Music Venue	Lounge	Nightclub	Rock Club

Cluster 11:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
2	Eastchester	Recording Studio	Jazz Club	Nightclub	Music Venue	Rock Club
33	Morris Park	Recording Studio	Music Store	Rock Club	Concert Hall	Nightclub
58	Windsor Terrace	Recording Studio	Rock Club	Concert Hall	Music Store	Music Venue
89	Ocean Hill	Recording Studio	Rock Club	Lounge	Concert Hall	Nightclub
134	Corona	Recording Studio	Nightclub	Lounge	Music Venue	Rock Club
145	Rego Park	Recording Studio	Concert Hall	Karaoke Bar	Music Venue	Lounge
189	Lefrak City	Recording Studio	Nightclub	Concert Hall	Lounge	Music Venue
199	Stapleton	Recording Studio	Rock Club	Music Venue	Karaoke Bar	Nightclub
218	Tompkinsville	Recording Studio	Rock Club	Music Store	Karaoke Bar	Lounge
278	Blissville	Recording Studio	Nightclub	Concert Hall	Music Venue	Lounge
282	Broadway Junction	Recording Studio	Nightclub	Lounge	Rock Club	Music Venue
283	Dumbo	Recording Studio	Rock Club	Record Shop	Concert Hall	Music Venue

Cluster 12:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
104	Manhattanville	Jazz Club	Concert Hall	Music Store	Record Shop	Lounge
105	Central Harlem	Jazz Club	Record Shop	Music Store	Lounge	Nightclub
125	Morningside Heights	Jazz Club	Concert Hall	Music Store	Music Venue	Lounge

Cluster 13:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
38	Schuylerville	Rock Club	Music Store	Lounge	Nightclub	Music Venue
47	Bensonhurst	Rock Club	Jazz Club	Music Store	Record Shop	Lounge
100	Chinatown	Rock Club	Karaoke Bar	Lounge	Recording Studio	Record Shop
118	East Village	Rock Club	Music Venue	Nightclub	Lounge	Recording Studio
119	Lower East Side	Rock Club	Lounge	Recording Studio	Record Shop	Piano Bar
121	Little Italy	Rock Club	Music Venue	Lounge	Recording Studio	Record Shop
122	Soho	Rock Club	Lounge	Recording Studio	Record Shop	Piano Bar
181	Floral Park	Rock Club	Concert Hall	Lounge	Recording Studio	Record Shop
202	Grymes Hill	Rock Club	Jazz Club	Concert Hall	Recording Studio	Karaoke Bar
248	Noho	Rock Club	Music Venue	Lounge	Recording Studio	Record Shop

Cluster 14:

	Neighborhood	1st Top Venue Category	2nd Top Venue Category	3rd Top Venue Category	4th Top Venue Category	5th Top Venue Category
92	Midwood	Piano Bar	Jazz Club	Recording Studio	Karaoke Bar	Nightclub
120	Tribeca	Piano Bar	Jazz Club	Karaoke Bar	Nightclub	Rock Club
123	West Village	Piano Bar	Jazz Club	Rock Club	Nightclub	Recording Studio
140	Sunnyside	Piano Bar	Recording Studio	Concert Hall	Jazz Club	Rock Club
214	Eltingville	Piano Bar	Jazz Club	Rock Club	Lounge	Recording Studio
219	Silver Lake	Piano Bar	Jazz Club	Rock Club	Concert Hall	Record Shop
220	Sunnyside	Piano Bar	Recording Studio	Concert Hall	Jazz Club	Rock Club
255	Emerson Hill	Piano Bar	Jazz Club	Rock Club	Concert Hall	Karaoke Bar
305	Fox Hills	Piano Bar	Concert Hall	Jazz Club	Rock Club	Nightclub