

```
In [43]: #import all required libraires
import pandas as pd
import numpy as np
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)
pd.set_option('display.max_columns', 100)
pd.set_option('display.width',1000)
import matplotlib.cm as cm          # Matplotlib and associated plotting modules
import matplotlib.colors as colors
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans # import k-means from clustering stage
from sklearn.metrics import silhouette_score
import folium                         # map rendering library
import json # library to handle JSON files
from pandas.io.json import json_normalize
from geopy.geocoders import Nominatim
import requests # library to handle requests
import webbrowser
import pgeocode
```

```
In [44]: #getting coordinates for Mumbai
address = 'Mumbai'
geolocator = Nominatim(user_agent="ny_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geographical coordinate of Mumbai are {}, {}'.format(latitude, longitude))
```

The geographical coordinate of Mumbai are 19.0759899, 72.8773928.

```
In [45]: #read data from the webpage
url = 'https://en.wikipedia.org/wiki/List_of_neighbourhoods_in_Mumbai'
df1 = pd.read_html(url)
type(df1)
```

Out[45]: list

In [46]: df1

				0		
1	2	3		Area		Loc
0						
ation	Latitude	Longitude				
1						
burbs	19.1293	72.8434		Amboli		Andheri,Western Su
2						
burbs	19.111388	72.860833		Chakala, Andheri		Western Su
3						
burbs	19.124085	72.831373		D.N. Nagar		Andheri,Western Su
4						
burbs	19.124714	72.82721		Four Bungalows		Andheri,Western Su
5						
burbs	19.130815	72.82927		Lokhandwala		Andheri,Western Su
6						
burbs	19.119219	72.882743		Marol		Andheri,Western Su
7						
burbs	19.098889	72.867222		Sahar		Andheri,Western Su
8						
burbs	19.129052	72.817018		Seven Bungalows		Andheri,Western Su
9						
burbs	19.12	72.82		Versova		Andheri,Western Su
10						
burbs	19.284167	72.871111		Mira Road		Mira-Bhayandar,Western Su
11						
burbs	19.29	72.85		Bhayandar		Mira-Bhayandar,Western Su
12						
burbs	19.28	72.785		Uttan		Mira-Bhayandar,Western Su
13						
burbs	19.042718	72.819132		Bandstand Promenade		Bandra,Western Su
14						
burbs	19.0553	72.8314		Kherwadi		Bandra,Western Su
15						
burbs	19.068	72.826		Pali Hill		Bandra,Western Su
16						
burbs	19.247039	72.84983		I.C. Colony		Borivali (West),Western Su
17						
burbs	19.250057	72.782021		Gorai		Borivali (West),Western Su
18						
burbs	19.250069	72.859347		Dahisa		Western Su
19						
burbs	19.148493	72.881756		Aarey Milk Colony		Goregaon,Western Su
20						
burbs	19.167362	72.832252		Bangur Nagar		Goregaon,Western Su
21						
burbs	19.12	72.85		Jogeshwari West		Western Su
22						
burbs	19.1	72.83		Juhu		Western Su
23						
burbs	19.216182	72.830575		Charkop		Kandivali West,Western Su
24						
burbs	19.204511	72.837639		Poisar		Kandivali West,Western Su
25						
burbs	19.211319	72.842737		Mahavir Nagar		Kandivali West,Western Su
26						
burbs	19.210206	72.87298		Thakur village		Kandivali East,Western Su
27						
				Pali Naka		Khar,Western Su

burbs	19.062742	72.829396		
28			Khar Danda	Khar,Western Su
burbs	19.068598	72.840042		
29			Dindoshi	Malad,Western Su
burbs	19.176382	72.864891		
30			Sunder Nagar	Malad,Western Su
burbs	19.175	72.842		
31			Kalina	Sanctacruz,Western Su
burbs	19.081667	72.841389		
32			Naigaon	Vasai,Western Su
burbs	19.351467	72.846343		
33			Nalasopara	Vasai,Western Su
burbs	19.4154	72.8613		
34			Virar	Western Su
burbs	19.47	72.8		
35			Irla	Vile Parle,Western Su
burbs	19.108056	72.838056		
36			Vile Parle	Western Su
burbs	19.1	72.83		
37			Bhandup	Eastern Su
burbs	19.14	72.93		
38			Amrut Nagar	Ghatkopar,Eastern Su
burbs	19.102077	72.912835		
39			Asalfa	Ghatkopar,Eastern Su
burbs	19.091	72.901		
40			Pant Nagar	Ghatkopar,Eastern Su
burbs	19.08	72.91		
41			Kanjurmarg	Eastern Su
burbs	19.13	72.94		
42			Nehru Nagar	Kurla,Eastern Su
burbs	15.451686	74.971977		
43			Nahur	Mulund,Eastern Su
burbs	19.157	72.941		
44			Chandivali	Powai,Eastern Su
burbs	19.11	72.9		
45			Hiranandani Gardens	Powai,Eastern Su
burbs	19.118986	72.911767		
46	Indian Institute of Technology Bombay campus			Powai,Eastern Su
burbs	19.133636	72.915358		
47			Vidyavihar	Eastern Su
burbs	19.08	72.896		
48			Vikhroli	Eastern Su
burbs	19.11	72.94		
49			Chembur	Harbour Su
burbs	19.051	72.894		
50			Deonar	Govandi,Harbour Su
burbs	19.05	72.89		
51			Mankhurd	Harbour Su
burbs	19.05	72.93		
52			Mahul	Trombay,Harbour Su
burbs	19	72.883333		
53			Agripada	South M
umbai	18.9777	72.8273		
54			Altamount Road	South M
umbai	18.9681	72.8095		
55			Bhuleshwar	South M
umbai	18.95	72.83		

56			Breach Candy	South M
umbai	18.967	72.805	Carmichael Road	South M
57			Cavel	South M
umbai	18.9722	72.8113	Churchgate	South M
58			Cotton Green	South M
umbai	18.9474	72.8272	Cuffe Parade	South M
59			Cumbala Hill	South M
umbai	18.93	72.82	Currey Road	South M
60			Dhobitalao	South M
umbai	18.986209	72.844076	Dongri	South M
61			Kala Ghoda	South M
umbai	18.91	72.81	Kemps Corner	South M
62			Lower Parel	South M
umbai	18.965833	72.805833	Mahalaxmi	South M
63			Mahim	South M
umbai	18.994	72.833	Malabar Hill	South M
64			Marine Drive	South M
umbai	18.9433	72.8286	Marine Lines	South M
65			Mumbai Central	South M
umbai	19.283333	72.783333	Nariman Point	South M
66			Prabhadevi	South M
umbai	18.9307	72.8331	Sion	South M
67			Walkeshwar	South M
umbai	18.9629	72.8054	Worli	South M
68			C.G.S. colony	Antop Hill,South M
umbai	18.995278	72.83	Dagdi Chawl	Byculla,South M
69			Navy Nagar	Colaba,South M
umbai	18.983333	72.8	Hindu colony	Dadar,South M
70			Ballard Estate	Fort,South M
umbai	19.035	72.84		
71				
umbai	18.95	72.795		
72				
umbai	18.944	72.823		
73				
umbai	18.9447	72.8244		
74				
umbai	18.9697	72.8194		
75				
umbai	18.926	72.823		
76				
umbai	19.0166	72.8295		
77				
umbai	19.04	72.86		
78				
umbai	18.947596	72.795957		
79				
umbai	19	72.815		
80				
umbai	19.016378	72.856629		
81				
umbai	18.977129	72.829131		
82				
umbai	18.9012	72.8101		
83				
umbai	19.020841	19.020841		
84				

umbai	18.95	72.84		
85			Chira Bazaar	Kalbadevi, South M
umbai	18.94814	72.825462		
86			Fanas Wadi	Kalbadevi, South M
umbai	18.951811	72.825309		
87			Chor Bazaar	Kamathipura, South M
umbai	18.960321	72.827176		
88			Matunga	South M
umbai	19.01798	72.844763		
89			Parel	South M
umbai	18.99	72.84		
90			Gowalia Tank	Tardeo, South M
umbai	18.96245	72.809703		
91			Dava Bazaar	South M
umbai	18.946882	72.831362		
92			Dharavi	M
umbai	19.040208	72.85085		
93			Thane	M
umbai	19.2	72.97]		

In [47]: *#to convert data into dataframe, first need to convert into numpy array, then transpose the list*  
 df2\_T0 = np.array(df1[0][0]).T.tolist()  
 df2\_T1 = np.array(df1[0][1]).T.tolist()  
 df2\_T2 = np.array(df1[0][2]).T.tolist()  
 df2\_T3 = np.array(df1[0][3]).T.tolist()  
*#now combine the list and convert into a dataframe*  
 df3=pd.DataFrame(list(zip(df2\_T0, df2\_T1,df2\_T2,df2\_T3)),  
                  columns=['Area','Location','Latitude','Longitude'])  
 type(df3)

Out[47]: pandas.core.frame.DataFrame

```
In [48]: MumbaiLatLan=df3.drop(df3.index[0])  
MumbaiLatLan
```

Out[48] :

	Area	Location	Latitude	Longitude
1	Amboli	Andheri,Western Suburbs	19.1293	72.8434
2	Chakala, Andheri	Western Suburbs	19.111388	72.860833
3	D.N. Nagar	Andheri,Western Suburbs	19.124085	72.831373
4	Four Bungalows	Andheri,Western Suburbs	19.124714	72.82721
5	Lokhandwala	Andheri,Western Suburbs	19.130815	72.82927
6	Marol	Andheri,Western Suburbs	19.119219	72.882743
7	Sahar	Andheri,Western Suburbs	19.098889	72.867222
8	Seven Bungalows	Andheri,Western Suburbs	19.129052	72.817018
9	Versova	Andheri,Western Suburbs	19.12	72.82
10	Mira Road	Mira-Bhayandar,Western Suburbs	19.284167	72.871111
11	Bhayandar	Mira-Bhayandar,Western Suburbs	19.29	72.85
12	Uttan	Mira-Bhayandar,Western Suburbs	19.28	72.785
13	Bandstand Promenade	Bandra,Western Suburbs	19.042718	72.819132
14	Kherwadi	Bandra,Western Suburbs	19.0553	72.8314
15	Pali Hill	Bandra,Western Suburbs	19.068	72.826
16	I.C. Colony	Borivali (West),Western Suburbs	19.247039	72.84983
17	Gorai	Borivali (West),Western Suburbs	19.250057	72.782021
18	Dahisa	Western Suburbs	19.250069	72.859347
19	Aarey Milk Colony	Goregaon,Western Suburbs	19.148493	72.881756
20	Bangur Nagar	Goregaon,Western Suburbs	19.167362	72.832252
21	Jogeshwari West	Western Suburbs	19.12	72.85
22	Juhu	Western Suburbs	19.1	72.83
23	Charkop	Kandivali West,Western Suburbs	19.216182	72.830575
24	Poisar	Kandivali West,Western Suburbs	19.204511	72.837639
25	Mahavir Nagar	Kandivali West,Western Suburbs	19.211319	72.842737

	<b>Area</b>	<b>Location</b>	<b>Latitude</b>	<b>Longitude</b>
<b>26</b>	Thakur village	Kandivali East,Western Suburbs	19.210206	72.87298
<b>27</b>	Pali Naka	Khar,Western Suburbs	19.062742	72.829396
<b>28</b>	Khar Danda	Khar,Western Suburbs	19.068598	72.840042
<b>29</b>	Dindoshi	Malad,Western Suburbs	19.176382	72.864891
<b>30</b>	Sunder Nagar	Malad,Western Suburbs	19.175	72.842
<b>31</b>	Kalina	Sanctacruz,Western Suburbs	19.081667	72.841389
<b>32</b>	Naigaon	Vasai,Western Suburbs	19.351467	72.846343
<b>33</b>	Nalasopara	Vasai,Western Suburbs	19.4154	72.8613
<b>34</b>	Virar	Western Suburbs	19.47	72.8
<b>35</b>	Irla	Vile Parle,Western Suburbs	19.108056	72.838056
<b>36</b>	Vile Parle	Western Suburbs	19.1	72.83
<b>37</b>	Bhandup	Eastern Suburbs	19.14	72.93
<b>38</b>	Amrut Nagar	Ghatkopar,Eastern Suburbs	19.102077	72.912835
<b>39</b>	Asalfa	Ghatkopar,Eastern Suburbs	19.091	72.901
<b>40</b>	Pant Nagar	Ghatkopar,Eastern Suburbs	19.08	72.91
<b>41</b>	Kanjurmarg	Eastern Suburbs	19.13	72.94
<b>42</b>	Nehru Nagar	Kurla,Eastern Suburbs	15.451686	74.971977
<b>43</b>	Nahur	Mulund,Eastern Suburbs	19.157	72.941
<b>44</b>	Chandivali	Powai,Eastern Suburbs	19.11	72.9
<b>45</b>	Hiranandani Gardens	Powai,Eastern Suburbs	19.118986	72.911767
<b>46</b>	Indian Institute of Technology Bombay campus	Powai,Eastern Suburbs	19.133636	72.915358
<b>47</b>	Vidyavihar	Eastern Suburbs	19.08	72.896
<b>48</b>	Vikhroli	Eastern Suburbs	19.11	72.94
<b>49</b>	Chembur	Harbour Suburbs	19.051	72.894
<b>50</b>	Deonar	Govandi,Harbour Suburbs	19.05	72.89
<b>51</b>	Mankhurd	Harbour Suburbs	19.05	72.93
<b>52</b>	Mahul	Trombay,Harbour Suburbs	19	72.883333
<b>53</b>	Agripada	South Mumbai	18.9777	72.8273
<b>54</b>	Altamount Road	South Mumbai	18.9681	72.8095
<b>55</b>	Bhuleshwar	South Mumbai	18.95	72.83

	<b>Area</b>	<b>Location</b>	<b>Latitude</b>	<b>Longitude</b>
<b>56</b>	Breach Candy	South Mumbai	18.967	72.805
<b>57</b>	Carmichael Road	South Mumbai	18.9722	72.8113
<b>58</b>	Cavel	South Mumbai	18.9474	72.8272
<b>59</b>	Churchgate	South Mumbai	18.93	72.82
<b>60</b>	Cotton Green	South Mumbai	18.986209	72.844076
<b>61</b>	Cuffe Parade	South Mumbai	18.91	72.81
<b>62</b>	Cumbala Hill	South Mumbai	18.965833	72.805833
<b>63</b>	Currey Road	South Mumbai	18.994	72.833
<b>64</b>	Dhobitalao	South Mumbai	18.9433	72.8286
<b>65</b>	Dongri	South Mumbai	19.283333	72.783333
<b>66</b>	Kala Ghoda	South Mumbai	18.9307	72.8331
<b>67</b>	Kemps Corner	South Mumbai	18.9629	72.8054
<b>68</b>	Lower Parel	South Mumbai	18.995278	72.83
<b>69</b>	Mahalaxmi	South Mumbai	18.983333	72.8
<b>70</b>	Mahim	South Mumbai	19.035	72.84
<b>71</b>	Malabar Hill	South Mumbai	18.95	72.795
<b>72</b>	Marine Drive	South Mumbai	18.944	72.823
<b>73</b>	Marine Lines	South Mumbai	18.9447	72.8244
<b>74</b>	Mumbai Central	South Mumbai	18.9697	72.8194
<b>75</b>	Nariman Point	South Mumbai	18.926	72.823
<b>76</b>	Prabhadevi	South Mumbai	19.0166	72.8295
<b>77</b>	Sion	South Mumbai	19.04	72.86
<b>78</b>	Walkeshwar	South Mumbai	18.947596	72.795957
<b>79</b>	Worli	South Mumbai	19	72.815
<b>80</b>	C.G.S. colony	Antop Hill, South Mumbai	19.016378	72.856629
<b>81</b>	Dagdi Chawl	Byculla, South Mumbai	18.977129	72.829131
<b>82</b>	Navy Nagar	Colaba, South Mumbai	18.9012	72.8101
<b>83</b>	Hindu colony	Dadar, South Mumbai	19.020841	19.020841
<b>84</b>	Ballard Estate	Fort, South Mumbai	18.95	72.84
<b>85</b>	Chira Bazaar	Kalbadevi, South Mumbai	18.94814	72.825462
<b>86</b>	Fanas Wadi	Kalbadevi, South Mumbai	18.951811	72.825309
<b>87</b>	Chor Bazaar	Kamathipura, South Mumbai	18.960321	72.827176

	<b>Area</b>	<b>Location</b>	<b>Latitude</b>	<b>Longitude</b>
<b>88</b>	Matunga	South Mumbai	19.01798	72.844763
<b>89</b>	Parel	South Mumbai	18.99	72.84
<b>90</b>	Gowalia Tank	Tardeo, South Mumbai	18.96245	72.809703
<b>91</b>	Dava Bazaar	South Mumbai	18.946882	72.831362
<b>92</b>	Dharavi	Mumbai	19.040208	72.85085
<b>93</b>	Thane	Mumbai	19.2	72.97

```
In [49]: # create map of Mumbai using Latitude and Longitude values
map_Mumbai = folium.Map(location=[latitude, longitude], zoom_start=11)
# add markers to map

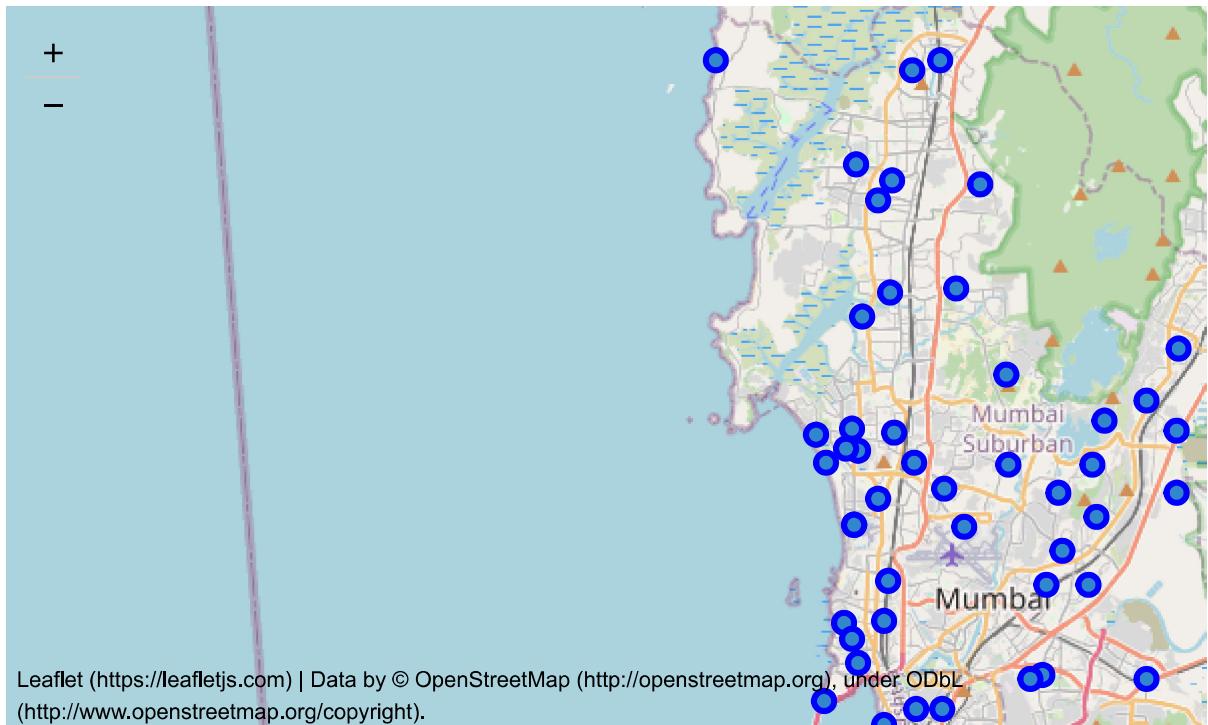
map_Mumbai
```

Out[49]:



```
In [50]: # create map of Mumbai using Latitude and Longitude values
map_mumbai = folium.Map(location=[latitude, longitude], zoom_start=11)
# add markers to map
for lat, lng, label in zip(MumbaiLatLan['Latitude'], MumbaiLatLan['Longitude'],
                           MumbaiLatLan['Area']):
    label = folium.Popup(label, parse_html=False)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=1,
        parse_html=False).add_to(map_mumbai)
map_mumbai
```

Out[50]:

In [51]: *#Define Foursquare Credentials and Version*

```
#@hidden_cell
CLIENT_ID = 'XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX' # your Foursquare ID
CLIENT_SECRET = 'XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX' # your Foursquare Secret
VERSION = '20180605' # Foursquare API version
LIMIT = 100 # A default Foursquare API limit value
```

```
In [52]: #Explore Neighborhoods in Mumbai
def getNearbyVenues(names, latitudes, longitudes, radius=2500):

    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"]的文化["groups"][0]["items"]

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

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

    return(nearby_venues)
```

```
In [53]: #Now write the code to run the above function on each neighborhood and create  
# a new dataframe called Mumbai_venues.  
# type your answer here  
Mumbai_venues = getNearbyVenues(names=MumbaiLatLan['Area'],  
                                 latitudes=MumbaiLatLan['Latitude'],  
                                 longitudes=MumbaiLatLan['Longitude'])  
  
print(Mumbai_venues.shape)  
Mumbai_venues.head(5)
```

Amboli  
Chakala, Andheri  
D.N. Nagar  
Four Bungalows  
Lokhandwala  
Marol  
Sahar  
Seven Bungalows  
Versova  
Mira Road  
Bhayandar  
Uttan  
Bandstand Promenade  
Kherwadi  
Pali Hill  
I.C. Colony  
Gorai  
Dahisa  
Aarey Milk Colony  
Bangur Nagar  
Jogeshwari West  
Juhu  
Charkop  
Poisar  
Mahavir Nagar  
Thakur village  
Pali Naka  
Khar Danda  
Dindoshi  
Sunder Nagar  
Kalina  
Naigaon  
Nalasopara  
Virar  
Irla  
Vile Parle  
Bhandup  
Amrut Nagar  
Asalfa  
Pant Nagar  
Kanjurmarg  
Nehru Nagar  
Nahur  
Chandivali  
Hiranandani Gardens  
Indian Institute of Technology Bombay campus  
Vidyavihar  
Vikhroli  
Chembur  
Deonar  
Mankhurd  
Mahul  
Agripada  
Altamount Road  
Bhuleshwar  
Breach Candy  
Carmichael Road

Cavel  
Churchgate  
Cotton Green  
Cuffe Parade  
Cumbala Hill  
Currey Road  
Dhobitalao  
Dongri  
Kala Ghoda  
Kemps Corner  
Lower Parel  
Mahalaxmi  
Mahim  
Malabar Hill  
Marine Drive  
Marine Lines  
Mumbai Central  
Nariman Point  
Prabhadevi  
Sion  
Walkeshwar  
Worli  
C.G.S. colony  
Dagdi Chawl  
Navy Nagar  
Hindu colony  
Ballard Estate  
Chira Bazaar  
Fanas Wadi  
Chor Bazaar  
Matunga  
Parel  
Gowalia Tank  
Dava Bazaar  
Dharavi  
Thane  
(7371, 7)

Out[53]:

	<b>Neighborhood</b>	<b>Neighborhood Latitude</b>	<b>Neighborhood Longitude</b>	<b>Venue</b>	<b>Venue Latitude</b>	<b>Venue Longitude</b>	<b>Venue Category</b>
<b>0</b>	Amboli	19.1293	72.8434	Merwans Cake shop	19.119300	72.845418	Bakeries
<b>1</b>	Amboli	19.1293	72.8434	Jaffer Bhai's Delhi Darbar	19.137714	72.845909	Mughlai Restaurants
<b>2</b>	Amboli	19.1293	72.8434	Hard Rock Cafe Andheri	19.135995	72.835335	American Restaurants
<b>3</b>	Amboli	19.1293	72.8434	Shawarma Factory	19.124591	72.840398	Falafel Restaurants
<b>4</b>	Amboli	19.1293	72.8434	Joey's Pizza	19.126762	72.830001	Pizza Place



In [54]: *#Let's check how many venues were returned for each neighborhood*  
Mumbai\_venues.groupby('Neighborhood').count()

Out[54] :

	<b>Neighborhood Latitude</b>	<b>Neighborhood Longitude</b>	<b>Venue</b>	<b>Venue Latitude</b>	<b>Venue Longitude</b>	<b>Venue Category</b>
<b>Neighborhood</b>						
<b>Aarey Milk Colony</b>	25	25	25	25	25	25
<b>Agripada</b>	100	100	100	100	100	100
<b>Altamount Road</b>	100	100	100	100	100	100
<b>Amboli</b>	100	100	100	100	100	100
<b>Amrut Nagar</b>	100	100	100	100	100	100
<b>Asalfa</b>	100	100	100	100	100	100
<b>Ballard Estate</b>	100	100	100	100	100	100
<b>Bandstand Promenade</b>	100	100	100	100	100	100
<b>Bangur Nagar</b>	100	100	100	100	100	100
<b>Bhandup</b>	41	41	41	41	41	41
<b>Bhayandar</b>	28	28	28	28	28	28
<b>Bhuleshwar</b>	100	100	100	100	100	100
<b>Breach Candy</b>	100	100	100	100	100	100
<b>C.G.S. colony</b>	92	92	92	92	92	92
<b>Carmichael Road</b>	100	100	100	100	100	100
<b>Cavel</b>	100	100	100	100	100	100
<b>Chakala, Andheri</b>	100	100	100	100	100	100
<b>Chandivali</b>	100	100	100	100	100	100
<b>Charkop</b>	92	92	92	92	92	92
<b>Chembur</b>	82	82	82	82	82	82
<b>Chira Bazaar</b>	100	100	100	100	100	100
<b>Chor Bazaar</b>	56	56	56	56	56	56
<b>Churchgate</b>	100	100	100	100	100	100
<b>Cotton Green</b>	100	100	100	100	100	100
<b>Cuffe Parade</b>	65	65	65	65	65	65
<b>Cumbala Hill</b>	100	100	100	100	100	100
<b>Currey Road</b>	100	100	100	100	100	100
<b>D.N. Nagar</b>	100	100	100	100	100	100
<b>Dagdi Chawl</b>	100	100	100	100	100	100

	<b>Neighborhood Latitude</b>	<b>Neighborhood Longitude</b>	<b>Venue</b>	<b>Venue Latitude</b>	<b>Venue Longitude</b>	<b>Venue Category</b>
<b>Neighborhood</b>						
<b>Dahisa</b>	75	75	75	75	75	75
<b>Dava Bazaar</b>	100	100	100	100	100	100
<b>Deonar</b>	86	86	86	86	86	86
<b>Dharavi</b>	100	100	100	100	100	100
<b>Dhobitalao</b>	100	100	100	100	100	100
<b>Dindoshi</b>	72	72	72	72	72	72
<b>Dongri</b>	9	9	9	9	9	9
<b>Fanas Wadi</b>	100	100	100	100	100	100
<b>Four Bungalows</b>	100	100	100	100	100	100
<b>Gorai</b>	5	5	5	5	5	5
<b>Gowalia Tank</b>	100	100	100	100	100	100
<b>Hiranandani Gardens</b>	100	100	100	100	100	100
<b>I.C. Colony</b>	88	88	88	88	88	88
<b>Indian Institute of Technology Bombay campus</b>	91	91	91	91	91	91
<b>Irla</b>	100	100	100	100	100	100
<b>Jogeshwari West</b>	100	100	100	100	100	100
<b>Juhu</b>	69	69	69	69	69	69
<b>Kala Ghoda</b>	100	100	100	100	100	100
<b>Kalina</b>	100	100	100	100	100	100
<b>Kanjurmarg</b>	28	28	28	28	28	28
<b>Kemps Corner</b>	99	99	99	99	99	99
<b>Khar Danda</b>	100	100	100	100	100	100
<b>Kherwadi</b>	57	57	57	57	57	57
<b>Lokhandwala</b>	100	100	100	100	100	100
<b>Lower Parel</b>	100	100	100	100	100	100
<b>Mahalaxmi</b>	65	65	65	65	65	65
<b>Mahavir Nagar</b>	100	100	100	100	100	100
<b>Mahim</b>	100	100	100	100	100	100
<b>Mahul</b>	4	4	4	4	4	4

	<b>Neighborhood Latitude</b>	<b>Neighborhood Longitude</b>	<b>Venue</b>	<b>Venue Latitude</b>	<b>Venue Longitude</b>	<b>Venue Category</b>
<b>Neighborhood</b>						
<b>Malabar Hill</b>	61	61	61	61	61	61
<b>Mankhurd</b>	13	13	13	13	13	13
<b>Marine Drive</b>	100	100	100	100	100	100
<b>Marine Lines</b>	100	100	100	100	100	100
<b>Marol</b>	100	100	100	100	100	100
<b>Matunga</b>	100	100	100	100	100	100
<b>Mira Road</b>	37	37	37	37	37	37
<b>Mumbai Central</b>	100	100	100	100	100	100
<b>Nahur</b>	71	71	71	71	71	71
<b>Naigaon</b>	4	4	4	4	4	4
<b>Nalasopara</b>	7	7	7	7	7	7
<b>Nariman Point</b>	100	100	100	100	100	100
<b>Navy Nagar</b>	23	23	23	23	23	23
<b>Nehru Nagar</b>	6	6	6	6	6	6
<b>Pali Hill</b>	100	100	100	100	100	100
<b>Pali Naka</b>	65	65	65	65	65	65
<b>Pant Nagar</b>	100	100	100	100	100	100
<b>Parel</b>	100	100	100	100	100	100
<b>Poisar</b>	100	100	100	100	100	100
<b>Prabhadevi</b>	100	100	100	100	100	100
<b>Sahar</b>	100	100	100	100	100	100
<b>Seven Bungalows</b>	100	100	100	100	100	100
<b>Sion</b>	100	100	100	100	100	100
<b>Sunder Nagar</b>	100	100	100	100	100	100
<b>Thakur village</b>	75	75	75	75	75	75
<b>Thane</b>	100	100	100	100	100	100
<b>Uttan</b>	8	8	8	8	8	8
<b>Versova</b>	100	100	100	100	100	100
<b>Vidyavihar</b>	100	100	100	100	100	100
<b>Vikhroli</b>	24	24	24	24	24	24

	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Neighborhood						
<b>Vile Parle</b>	69	69	69	69	69	69
<b>Virar</b>	14	14	14	14	14	14
<b>Walkeshwar</b>	65	65	65	65	65	65
<b>Worli</b>	100	100	100	100	100	100

In [55]: *#Let's find out how many unique categories can be curated from all the returned venues*  
 print('There are {} uniques categories.'.format(len(Mumbai\_venues['Venue Category'].unique())))

There are 210 uniques categories.

```
In [56]: # Now just keeping Shopping malls & Theatre for the analysis
Mumbai_venues_2=Mumbai_venues[(Mumbai_venues['Venue Category']=='Shopping Mall') | (Mumbai_venues['Venue Category']=='Movie Theater') | (Mumbai_venues['Venue Category']=='Theater') | (Mumbai_venues['Venue Category']=='Indie Movie Theater')]

Mumbai_venues_2['Venue Category'] = Mumbai_venues_2['Venue Category'].replace(['Movie Theater','Indie Movie Theater'],'Theater')

Mumbai_venues_2
```

```
C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:5: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead
See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy
"""
```

Out[56] :

	<b>Neighborhood</b>	<b>Neighborhood Latitude</b>	<b>Neighborhood Longitude</b>	<b>Venue</b>	<b>Venue Latitude</b>	<b>Venu Longitude</b>
<b>28</b>	Amboli	19.1293	72.8434	PVR ICON	19.141531	72.830331
<b>229</b>	D.N. Nagar	19.124085	72.831373	Prithvi Theatre	19.106157	72.825810
<b>255</b>	D.N. Nagar	19.124085	72.831373	PVR ICON	19.141531	72.830331
<b>330</b>	Four Bungalows	19.124714	72.82721	Prithvi Theatre	19.106157	72.825810
<b>352</b>	Four Bungalows	19.124714	72.82721	PVR ICON	19.141531	72.830331
<b>423</b>	Lokhandwala	19.130815	72.82927	PVR ICON	19.141531	72.830331
<b>749</b>	Seven Bungalows	19.129052	72.817018	PVR ICON	19.141531	72.830331
<b>812</b>	Versova	19.12	72.82	Prithvi Theatre	19.106157	72.825810
<b>932</b>	Mira Road	19.284167	72.871111	Inox Cinemas - Thakur Mall - Dahisar	19.263130	72.874480
<b>1046</b>	Bandstand Promenade	19.042718	72.819132	Le Rêve (Globus Cinema)	19.056014	72.833951
<b>1257</b>	I.C. Colony	19.247039	72.84983	Sona GOLD	19.234830	72.865032
<b>1290</b>	I.C. Colony	19.247039	72.84983	Prabodhankar Thackeray Natya Mandir	19.233363	72.854462
<b>1336</b>	Dahisa	19.250069	72.859347	Sona GOLD	19.234830	72.865032
<b>1378</b>	Dahisa	19.250069	72.859347	Prabodhankar Thackeray Natya Mandir	19.233363	72.854462
<b>1395</b>	Dahisa	19.250069	72.859347	Inox Cinemas - Thakur Mall - Dahisar	19.263130	72.874480
<b>1427</b>	Bangur Nagar	19.167362	72.832252	Inorbit Mall	19.173065	72.835751
<b>1437</b>	Bangur Nagar	19.167362	72.832252	Infiniti Mall	19.184692	72.834914
<b>1629</b>	Juhu	19.1	72.83	Prithvi Theatre	19.106157	72.825810
<b>1771</b>	Charkop	19.216182	72.830575	INOX Raghuleela	19.213397	72.849115

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude
1803	Poisar	19.204511	72.837639	Infiniti Mall	19.184692	72.834914
1862	Poisar	19.204511	72.837639	Growel's 101	19.202952	72.860453
1930	Mahavir Nagar	19.211319	72.842737	Growel's 101	19.202952	72.860453
1997	Thakur village	19.210206	72.87298	Inox	19.212185	72.871501
2004	Thakur village	19.210206	72.87298	Growel's 101	19.202952	72.860453
2032	Thakur village	19.210206	72.87298	Metro Mall	19.218714	72.866101
2049	Thakur village	19.210206	72.87298	Centrium Mall	19.196567	72.871714
2229	Dindoshi	19.176382	72.864891	Oberoi Mall	19.174061	72.860412
2300	Sunder Nagar	19.175	72.842	Infiniti Mall	19.184692	72.834914
2308	Sunder Nagar	19.175	72.842	Inorbit Mall	19.173065	72.835753
2332	Sunder Nagar	19.175	72.842	Oberoi Mall	19.174061	72.860412
2527	Irla	19.108056	72.838056	Prithvi Theatre	19.106157	72.825810
2627	Vile Parle	19.1	72.83	Prithvi Theatre	19.106157	72.825810
2708	Bhandup	19.14	72.93	Magnet Mall	19.141503	72.931681
2733	Amrut Nagar	19.102077	72.912835	R City Mall	19.099320	72.916714
2826	Amrut Nagar	19.102077	72.912835	Neptune Magnet Mall	19.113237	72.916708
2833	Asalfa	19.091	72.901	PVR Cinemas	19.086643	72.889838
2842	Asalfa	19.091	72.901	Phoenix Marketcity	19.085914	72.888692
2846	Asalfa	19.091	72.901	R City Mall	19.099320	72.916714
2947	Pant Nagar	19.08	72.91	PVR Cinemas	19.086643	72.889838

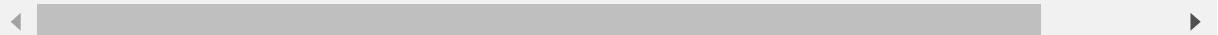
	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude
2951	Pant Nagar	19.08	72.91	R City Mall	19.099320	72.916714
2961	Pant Nagar	19.08	72.91	Phoenix Marketcity	19.085914	72.888692
3049	Kanjurmarg	19.13	72.94	Magnet Mall	19.141503	72.931681
3083	Nahur	19.157	72.941	R mall, Mulund west	19.175375	72.950506
3096	Nahur	19.157	72.941	Mahakavi Kalidas Natya Mandir	19.173408	72.949012
3124	Nahur	19.157	72.941	Magnet Mall	19.141503	72.931681
3162	Chandivali	19.11	72.9	R City Mall	19.099320	72.916714
3278	Hiranandani Gardens	19.118986	72.911767	R City Mall	19.099320	72.916714
3410	Indian Institute of Technology Bombay campus	19.133636	72.915358	Magnet Mall	19.141503	72.931681
3413	Indian Institute of Technology Bombay campus	19.133636	72.915358	Huma Mall	19.134935	72.927979
3428	Vidyavihar	19.08	72.896	PVR Cinemas	19.086643	72.889839
3434	Vidyavihar	19.08	72.896	Phoenix Marketcity	19.085914	72.888692
3514	Vidyavihar	19.08	72.896	Cinemax	19.074561	72.906534
3537	Vikhroli	19.11	72.94	Neptune Magnet Mall	19.113237	72.916708
3595	Chembur	19.051	72.894	Movie Time	19.045790	72.903118
3677	Deonar	19.05	72.89	Movie Time	19.045790	72.903118
3747	Agripada	18.9777	72.8273	High Street Phoenix	18.994967	72.825032
3752	Agripada	18.9777	72.8273	Palladium	18.994317	72.824398
3833	Agripada	18.9777	72.8273	Sophia Bhabha Hall	18.969819	72.807082

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude
3849	Altamont Road	18.9681	72.8095	Sophia Bhabha Hall	18.969819	72.807082
4051	Breach Candy	18.967	72.805	Sophia Bhabha Hall	18.969819	72.807082
4152	Carmichael Road	18.9722	72.8113	Sophia Bhabha Hall	18.969819	72.807082
4232	Carmichael Road	18.9722	72.8113	Nehru Auditorium	18.988726	72.814814
4342	Churchgate	18.93	72.82	Tata Theatre	18.925063	72.819958
4357	Churchgate	18.93	72.82	Jamshed Bhabha Theatre	18.925134	72.819730
4386	Churchgate	18.93	72.82	INOX	18.926465	72.822470
4397	Churchgate	18.93	72.82	Experimental Theatre	18.926086	72.820249
4440	Cotton Green	18.986209	72.844076	High Street Phoenix	18.994967	72.825032
4447	Cotton Green	18.986209	72.844076	Palladium	18.994317	72.824398
4541	Cuffe Parade	18.91	72.81	Tata Theatre	18.925063	72.819958
4554	Cuffe Parade	18.91	72.81	Jamshed Bhabha Theatre	18.925134	72.819730
4571	Cuffe Parade	18.91	72.81	INOX	18.926465	72.822470
4573	Cuffe Parade	18.91	72.81	Experimental Theatre	18.926086	72.820249
4579	Cuffe Parade	18.91	72.81	Maker Arcade	18.916494	72.817852
4620	Cumbala Hill	18.965833	72.805833	Sophia Bhabha Hall	18.969819	72.807082
4701	Currey Road	18.994	72.833	High Street Phoenix	18.994967	72.825032
4709	Currey Road	18.994	72.833	Palladium	18.994317	72.824398
4763	Currey Road	18.994	72.833	Matterden Centre	19.006067	72.830822
4880	Dhobitalao	18.9433	72.8286	Tata Theatre	18.925063	72.819958

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude
4978	Kala Ghoda	18.9307	72.8331	Tata Theatre	18.925063	72.819958
4999	Kala Ghoda	18.9307	72.8331	Jamshed Bhabha Theatre	18.925134	72.819730
5008	Kala Ghoda	18.9307	72.8331	INOX	18.926465	72.822470
5040	Kemps Corner	18.9629	72.8054	Sophia Bhabha Hall	18.969819	72.807082
5109	Lower Parel	18.995278	72.83	High Street Phoenix	18.994967	72.825032
5112	Lower Parel	18.995278	72.83	Palladium	18.994317	72.824398
5172	Lower Parel	18.995278	72.83	Matterden Centre	19.006067	72.830822
5236	Mahalaxmi	18.983333	72.8	Sophia Bhabha Hall	18.969819	72.807082
5316	Mahim	19.035	72.84	Citylight Theatre	19.030302	72.841621
5349	Mahim	19.035	72.84	Shivaji Mandir	19.022554	72.842050
5370	Mahim	19.035	72.84	Le Rêve (Globus Cinema)	19.056014	72.833951
5492	Marine Drive	18.944	72.823	Tata Theatre	18.925063	72.819958
5601	Marine Lines	18.9447	72.8244	Tata Theatre	18.925063	72.819958
5678	Mumbai Central	18.9697	72.8194	Sophia Bhabha Hall	18.969819	72.807082
5739	Nariman Point	18.926	72.823	Tata Theatre	18.925063	72.819958
5749	Nariman Point	18.926	72.823	Jamshed Bhabha Theatre	18.925134	72.819730
5775	Nariman Point	18.926	72.823	INOX	18.926465	72.822470
5810	Nariman Point	18.926	72.823	Experimental Theatre	18.926086	72.820248
5863	Prabhadevi	19.0166	72.8295	Matterden Centre	19.006067	72.830822
5872	Prabhadevi	19.0166	72.8295	High Street Phoenix	18.994967	72.825032
5899	Prabhadevi	19.0166	72.8295	Shivaji Mandir	19.022554	72.842050

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude
5927	Prabhadevi	19.0166	72.8295	Citylight Theatre	19.030302	72.841621
6006	Sion	19.04	72.86	Citylight Theatre	19.030302	72.841621
6030	Sion	19.04	72.86	Aurora Cinema	19.028134	72.857326
6105	Worli	19	72.815	High Street Phoenix	18.994967	72.825032
6107	Worli	19	72.815	Palladium	18.994317	72.824398
6165	Worli	19	72.815	Matterden Centre	19.006067	72.830822
6243	C.G.S. colony	19.016378	72.856629	Shivaji Mandir	19.022554	72.842050
6246	C.G.S. colony	19.016378	72.856629	Big cinemas	19.010945	72.855734
6266	C.G.S. colony	19.016378	72.856629	Citylight Theatre	19.030302	72.841621
6275	C.G.S. colony	19.016378	72.856629	Aurora Cinema	19.028134	72.857326
6284	C.G.S. colony	19.016378	72.856629	Iifa	19.027471	72.853725
6308	Dagdi Chawl	18.977129	72.829131	High Street Phoenix	18.994967	72.825032
6312	Dagdi Chawl	18.977129	72.829131	Palladium	18.994317	72.824398
6390	Dagdi Chawl	18.977129	72.829131	Sophia Bhabha Hall	18.969819	72.807082
6406	Navy Nagar	18.9012	72.8101	Maker Arcade	18.916494	72.817852
6767	Chor Bazaar	18.960321	72.827176	Liberty cinema	18.941652	72.827389
6802	Matunga	19.01798	72.844763	Shivaji Mandir	19.022554	72.842050
6833	Matunga	19.01798	72.844763	Matterden Centre	19.006067	72.830822
6852	Matunga	19.01798	72.844763	Citylight Theatre	19.030302	72.841621
6874	Parel	18.99	72.84	High Street Phoenix	18.994967	72.825032

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude
<b>6881</b>	Parel	18.99	72.84	Palladium	18.994317	72.824398
<b>6935</b>	Parel	18.99	72.84	Matterden Centre	19.006067	72.830822
<b>7008</b>	Gowalia Tank	18.96245	72.809703	Sophia Bhabha Hall	18.969819	72.807082
<b>7228</b>	Dharavi	19.040208	72.85085	Citylight Theatre	19.030302	72.841621
<b>7242</b>	Dharavi	19.040208	72.85085	Shivaji Mandir	19.022554	72.842050
<b>7244</b>	Dharavi	19.040208	72.85085	Le Rêve (Globus Cinema)	19.056014	72.833951
<b>7274</b>	Thane	19.2	72.97	Viviana	19.208302	72.971991
<b>7277</b>	Thane	19.2	72.97	Korum Mall	19.202400	72.965802
<b>7286</b>	Thane	19.2	72.97	Gadkari Rangayatan	19.194063	72.973839
<b>7370</b>	Thane	19.2	72.97	High Street Mall	19.217357	72.980912



In [57]: #3. Analyze Each Neighborhood

```
# one hot encoding
Mumbai_onehot = pd.get_dummies(Mumbai_venues_2[['Venue Category']], prefix="", 
prefix_sep="")
Mumbai_onehot
```

Out[57]:

	<b>Shopping Mall</b>	<b>Theater</b>
<b>28</b>	0	1
<b>229</b>	0	1
<b>255</b>	0	1
<b>330</b>	0	1
<b>352</b>	0	1
<b>423</b>	0	1
<b>749</b>	0	1
<b>812</b>	0	1
<b>932</b>	0	1
<b>1046</b>	0	1
<b>1257</b>	0	1
<b>1290</b>	0	1
<b>1336</b>	0	1
<b>1378</b>	0	1
<b>1395</b>	0	1
<b>1427</b>	1	0
<b>1437</b>	1	0
<b>1629</b>	0	1
<b>1771</b>	0	1
<b>1803</b>	1	0
<b>1862</b>	1	0
<b>1930</b>	1	0
<b>1997</b>	0	1
<b>2004</b>	1	0
<b>2032</b>	1	0
<b>2049</b>	1	0
<b>2229</b>	1	0
<b>2300</b>	1	0
<b>2308</b>	1	0
<b>2332</b>	1	0
<b>2527</b>	0	1
<b>2627</b>	0	1

	<b>Shopping Mall</b>	<b>Theater</b>
<b>2708</b>	1	0
<b>2733</b>	1	0
<b>2826</b>	1	0
<b>2833</b>	0	1
<b>2842</b>	1	0
<b>2846</b>	1	0
<b>2947</b>	0	1
<b>2951</b>	1	0
<b>2961</b>	1	0
<b>3049</b>	1	0
<b>3083</b>	1	0
<b>3096</b>	0	1
<b>3124</b>	1	0
<b>3162</b>	1	0
<b>3278</b>	1	0
<b>3410</b>	1	0
<b>3413</b>	1	0
<b>3428</b>	0	1
<b>3434</b>	1	0
<b>3514</b>	0	1
<b>3537</b>	1	0
<b>3595</b>	0	1
<b>3677</b>	0	1
<b>3747</b>	1	0
<b>3752</b>	1	0
<b>3833</b>	0	1
<b>3849</b>	0	1
<b>4051</b>	0	1
<b>4152</b>	0	1
<b>4232</b>	0	1
<b>4342</b>	0	1
<b>4357</b>	0	1

	<b>Shopping Mall</b>	<b>Theater</b>
<b>4386</b>	0	1
<b>4397</b>	0	1
<b>4440</b>	1	0
<b>4447</b>	1	0
<b>4541</b>	0	1
<b>4554</b>	0	1
<b>4571</b>	0	1
<b>4573</b>	0	1
<b>4579</b>	1	0
<b>4620</b>	0	1
<b>4701</b>	1	0
<b>4709</b>	1	0
<b>4763</b>	0	1
<b>4880</b>	0	1
<b>4978</b>	0	1
<b>4999</b>	0	1
<b>5008</b>	0	1
<b>5040</b>	0	1
<b>5109</b>	1	0
<b>5112</b>	1	0
<b>5172</b>	0	1
<b>5236</b>	0	1
<b>5316</b>	0	1
<b>5349</b>	0	1
<b>5370</b>	0	1
<b>5492</b>	0	1
<b>5601</b>	0	1
<b>5678</b>	0	1
<b>5739</b>	0	1
<b>5749</b>	0	1
<b>5775</b>	0	1
<b>5810</b>	0	1

	<b>Shopping Mall</b>	<b>Theater</b>
<b>5863</b>	0	1
<b>5872</b>	1	0
<b>5899</b>	0	1
<b>5927</b>	0	1
<b>6006</b>	0	1
<b>6030</b>	0	1
<b>6105</b>	1	0
<b>6107</b>	1	0
<b>6165</b>	0	1
<b>6243</b>	0	1
<b>6246</b>	0	1
<b>6266</b>	0	1
<b>6275</b>	0	1
<b>6284</b>	1	0
<b>6308</b>	1	0
<b>6312</b>	1	0
<b>6390</b>	0	1
<b>6406</b>	1	0
<b>6767</b>	0	1
<b>6802</b>	0	1
<b>6833</b>	0	1
<b>6852</b>	0	1
<b>6874</b>	1	0
<b>6881</b>	1	0
<b>6935</b>	0	1
<b>7008</b>	0	1
<b>7228</b>	0	1
<b>7242</b>	0	1
<b>7244</b>	0	1
<b>7274</b>	1	0
<b>7277</b>	1	0
<b>7286</b>	0	1

	<b>Shopping Mall</b>	<b>Theater</b>
<b>7370</b>	1	0

In [58]: *# add neighborhood column back to dataframe*  
Mumbai\_onehot['Neighborhood'] = Mumbai\_venues\_2['Neighborhood']

In [59]: *# move neighborhood column to the first column*  
fixed\_columns = [Mumbai\_onehot.columns[-1]] + list(Mumbai\_onehot.columns[:-1])  
Mumbai\_onehot = Mumbai\_onehot[fixed\_columns]  
Mumbai\_onehot.head()

Out[59]:

	<b>Neighborhood</b>	<b>Shopping Mall</b>	<b>Theater</b>
<b>28</b>	Amboli	0	1
<b>229</b>	D.N. Nagar	0	1
<b>255</b>	D.N. Nagar	0	1
<b>330</b>	Four Bungalows	0	1
<b>352</b>	Four Bungalows	0	1

In [60]: Mumbai\_onehot.shape

Out[60]: (129, 3)

In [61]: *#Next, Let's group rows by neighborhood and by taking the mean of the frequency of occurrence of each category*  
Mumbai\_grouped\_1 = Mumbai\_onehot.groupby('Neighborhood').sum().reset\_index()  
Mumbai\_grouped\_2 = Mumbai\_onehot.groupby('Neighborhood').mean().reset\_index()  
Mumbai\_grouped= Mumbai\_grouped\_1.merge(Mumbai\_grouped\_2,how='inner',left\_on=['Neighborhood'],right\_on=['Neighborhood'])  
Mumbai\_grouped  
Mumbai\_grouped.shape

Out[61]: (64, 5)

In [62]: Mumbai\_grouped.head()

Out[62]:

	<b>Neighborhood</b>	<b>Shopping Mall_x</b>	<b>Theater_x</b>	<b>Shopping Mall_y</b>	<b>Theater_y</b>
<b>0</b>	Agripada	2	1	0.666667	0.333333
<b>1</b>	Altamount Road	0	1	0.000000	1.000000
<b>2</b>	Amboli	0	1	0.000000	1.000000
<b>3</b>	Amrut Nagar	2	0	1.000000	0.000000
<b>4</b>	Asalfa	2	1	0.666667	0.333333

```
In [63]: #4. Cluster Neighborhoods findout best K
Mumbai_grouped_clustering = Mumbai_grouped_2.drop('Neighborhood', 1)

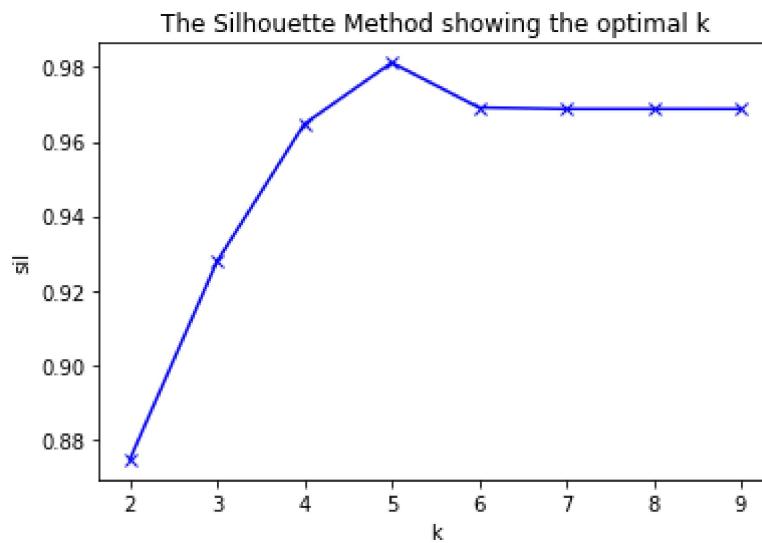
sil = []
kmax = 10

# dissimilarity would not be defined for a single cluster, thus, minimum number of clusters should be 2
for k in range(2, kmax):
    kmeans = KMeans(n_clusters=k, random_state=1).fit(Mumbai_grouped_clustering)
    labels = kmeans.labels_
    sil.append(silhouette_score(Mumbai_grouped_clustering, labels, metric = 'euclidean'))
```

```
In [64]: sil
```

```
Out[64]: [0.8746790609454447,
 0.9278923830070563,
 0.9647569403395169,
 0.9811631761149555,
 0.9691406059845273,
 0.9687499756338532,
 0.9687499756338532,
 0.9687499756338532]
```

```
In [65]: # Plot the elbow
k= range(2,10)
plt.plot(k, sil, 'bx-')
plt.xlabel('k')
plt.ylabel('sil')
plt.title('The Silhouette Method showing the optimal k')
plt.show()
```



```
In [66]: # The best number of clusters with min of cluster value is 6 from above chart
# set number of clusters
kclusters = 5

# run k-means clustering
kmeans = KMeans(n_clusters=kclusters, random_state=1).fit(Mumbai_grouped_clustering)

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

Out[66]: array([2, 0, 0, 1, 2, 0, 1, 1, 0, 3])

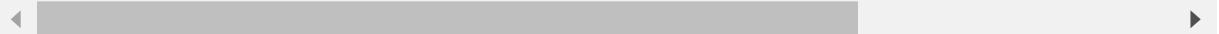
```
In [67]: #Mumbai_grouped_clustering
#Let's create a new dataframe that includes the cluster as well as the top 10
venues for each neighborhood.
# add clustering labels
Mumbai_grouped.insert(0,'Cluster Labels', kmeans.labels_)
Mumbai_merged = MumbaiLatLan

# merge manhattan_grouped with manhattan_data to add Latitude/Longitude for ea
ch neighborhood
Mumbai_merged = Mumbai_merged.merge(Mumbai_grouped,how='inner',left_on=[ 'Area'
],right_on=[ 'Neighborhood'])

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

Out[67]:

	Area	Location	Latitude	Longitude	Cluster Labels	Neighborhood	Shopping Mall _
0	Amboli	Andheri,Western Suburbs	19.1293	72.8434	0	Amboli	0
1	D.N. Nagar	Andheri,Western Suburbs	19.124085	72.831373	0	D.N. Nagar	0
2	Four Bungalows	Andheri,Western Suburbs	19.124714	72.82721	0	Four Bungalows	0
3	Lokhandwala	Andheri,Western Suburbs	19.130815	72.82927	0	Lokhandwala	0
4	Seven Bungalows	Andheri,Western Suburbs	19.129052	72.817018	0	Seven Bungalows	0



```
In [69]: #updaating Labels for each cluster
Mumbai_merged['Labels'] = Mumbai_merged['Cluster Labels'].map({0:'Only Theate
r',1:'Only Shopping Mall'
,2:'66% Shopping Mall/33% Theater',3:'33% Shop
ping Mall/66% Theater'
,4:'75% Shopping Mall/25% Theater'})
Mumbai_merged
```

Out[69] :

	Area	Location	Latitude	Longitude	Cluster Labels	Neighborhood
0	Amboli	Andheri,Western Suburbs	19.1293	72.8434	0	Amboli
1	D.N. Nagar	Andheri,Western Suburbs	19.124085	72.831373	0	D.N. Nagar
2	Four Bungalows	Andheri,Western Suburbs	19.124714	72.82721	0	Four Bungalows
3	Lokhandwala	Andheri,Western Suburbs	19.130815	72.82927	0	Lokhandwala
4	Seven Bungalows	Andheri,Western Suburbs	19.129052	72.817018	0	Seven Bungalows
5	Versova	Andheri,Western Suburbs	19.12	72.82	0	Versova
6	Mira Road	Mira-Bhayandar,Western Suburbs	19.284167	72.871111	0	Mira Road
7	Bandstand Promenade	Bandra,Western Suburbs	19.042718	72.819132	0	Bandstand Promenade
8	I.C. Colony	Borivali (West),Western Suburbs	19.247039	72.84983	0	I.C. Colony
9	Dahisa	Western Suburbs	19.250069	72.859347	0	Dahisa
10	Bangur Nagar	Goregaon,Western Suburbs	19.167362	72.832252	1	Bangur Nagar
11	Juhu	Western Suburbs	19.1	72.83	0	Juhu
12	Charkop	Kandivali West,Western Suburbs	19.216182	72.830575	0	Charkop
13	Poisar	Kandivali West,Western Suburbs	19.204511	72.837639	1	Poisar
14	Mahavir Nagar	Kandivali West,Western Suburbs	19.211319	72.842737	1	Mahavir Nagar

	Area	Location	Latitude	Longitude	Cluster Labels	Neighborhood
15	Thakur village	Kandivali East,Western Suburbs	19.210206	72.87298	4	Thakur village
16	Dindoshi	Malad,Western Suburbs	19.176382	72.864891	1	Dindoshi
17	Sunder Nagar	Malad,Western Suburbs	19.175	72.842	1	Sunder Nagar
18	Irla	Vile Parle,Western Suburbs	19.108056	72.838056	0	Irla
19	Vile Parle	Western Suburbs	19.1	72.83	0	Vile Parle
20	Bhandup	Eastern Suburbs	19.14	72.93	1	Bhandup
21	Amrut Nagar	Ghatkopar,Eastern Suburbs	19.102077	72.912835	1	Amrut Nagar
22	Asalfa	Ghatkopar,Eastern Suburbs	19.091	72.901	2	Asalfa
23	Pant Nagar	Ghatkopar,Eastern Suburbs	19.08	72.91	2	Pant Nagar
24	Kanjurmarg	Eastern Suburbs	19.13	72.94	1	Kanjurmarg
25	Nahur	Mulund,Eastern Suburbs	19.157	72.941	2	Nahur
26	Chandivali	Powai,Eastern Suburbs	19.11	72.9	1	Chandivali

	Area	Location	Latitude	Longitude	Cluster Labels	Neighborhood
27	Hiranandani Gardens	Powai,Eastern Suburbs	19.118986	72.911767	1	Hiranandani Gardens
28	Indian Institute of Technology Bombay campus	Powai,Eastern Suburbs	19.133636	72.915358	1	Indian Institute of Technology Bombay campus
29	Vidyavihar	Eastern Suburbs	19.08	72.896	3	Vidyavihar
30	Vikhroli	Eastern Suburbs	19.11	72.94	1	Vikhroli
31	Chembur	Harbour Suburbs	19.051	72.894	0	Chembur
32	Deonar	Govandi,Harbour Suburbs	19.05	72.89	0	Deonar
33	Agripada	South Mumbai	18.9777	72.8273	2	Agripada
34	Altamount Road	South Mumbai	18.9681	72.8095	0	Altamount Road
35	Breach Candy	South Mumbai	18.967	72.805	0	Breach Candy
36	Carmichael Road	South Mumbai	18.9722	72.8113	0	Carmichael Road
37	Churchgate	South Mumbai	18.93	72.82	0	Churchgate
38	Cotton Green	South Mumbai	18.986209	72.844076	1	Cotton Green
39	Cuffe Parade	South Mumbai	18.91	72.81	3	Cuffe Parade
40	Cumbala Hill	South Mumbai	18.965833	72.805833	0	Cumbala Hill

	Area	Location	Latitude	Longitude	Cluster Labels	Neighborhood	
41	Currey Road	South Mumbai	18.994	72.833	2	Currey Road	2
42	Dhobitalao	South Mumbai	18.9433	72.8286	0	Dhobitalao	0
43	Kala Ghoda	South Mumbai	18.9307	72.8331	0	Kala Ghoda	0
44	Kemps Corner	South Mumbai	18.9629	72.8054	0	Kemps Corner	0
45	Lower Parel	South Mumbai	18.995278	72.83	2	Lower Parel	2
46	Mahalaxmi	South Mumbai	18.983333	72.8	0	Mahalaxmi	0
47	Mahim	South Mumbai	19.035	72.84	0	Mahim	0
48	Marine Drive	South Mumbai	18.944	72.823	0	Marine Drive	0
49	Marine Lines	South Mumbai	18.9447	72.8244	0	Marine Lines	0
50	Mumbai Central	South Mumbai	18.9697	72.8194	0	Mumbai Central	0
51	Nariman Point	South Mumbai	18.926	72.823	0	Nariman Point	0
52	Prabhadevi	South Mumbai	19.0166	72.8295	3	Prabhadevi	3
53	Sion	South Mumbai	19.04	72.86	0	Sion	0
54	Worli	South Mumbai	19	72.815	2	Worli	2

	Area	Location	Latitude	Longitude	Cluster Labels	Neighborhood
55	C.G.S. colony	Antop Hill,South Mumbai	19.016378	72.856629	3	C.G.S. colony
56	Dagdi Chawl	Byculla,South Mumbai	18.977129	72.829131	2	Dagdi Chawl
57	Navy Nagar	Colaba,South Mumbai	18.9012	72.8101	1	Navy Nagar
58	Chor Bazaar	Kamathipura,South Mumbai	18.960321	72.827176	0	Chor Bazaar
59	Matunga	South Mumbai	19.01798	72.844763	0	Matunga
60	Parel	South Mumbai	18.99	72.84	2	Parel
61	Gowalia Tank	Tardeo,South Mumbai	18.96245	72.809703	0	Gowalia Tank
62	Dharavi	Mumbai	19.040208	72.85085	0	Dharavi
63	Thane	Mumbai	19.2	72.97	4	Thane



In [71]: #Finally, let's visualize the resulting clusters

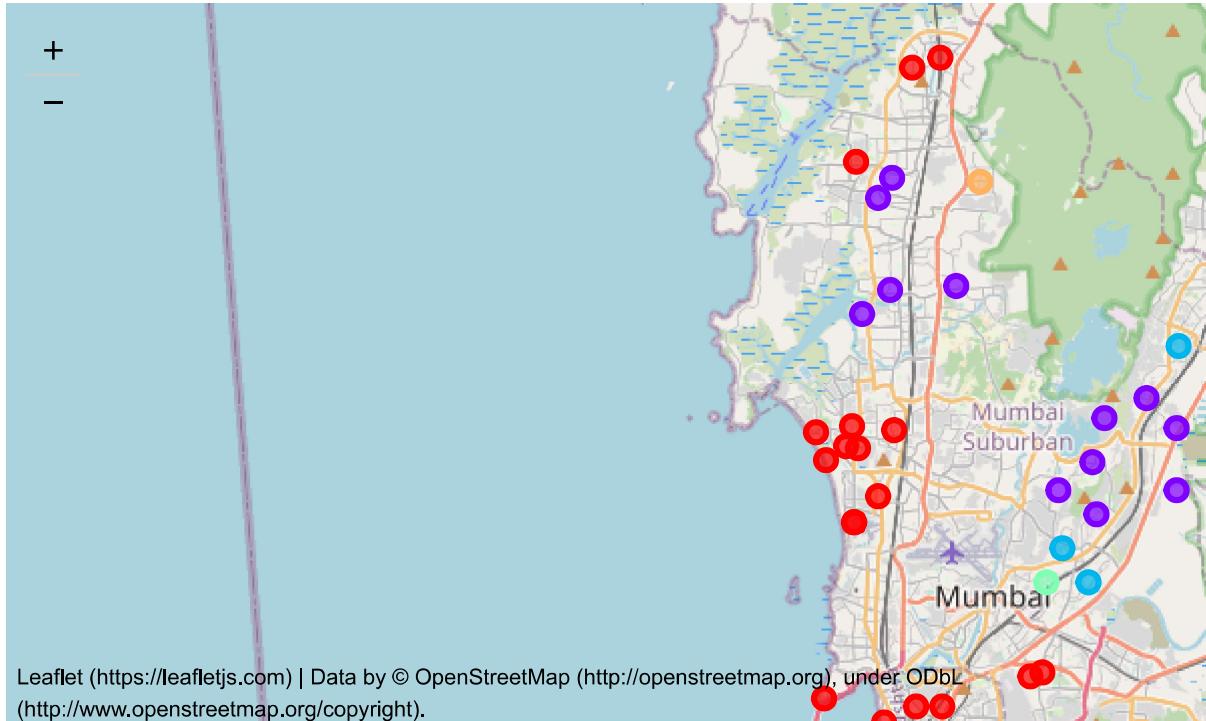
```
# create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

# 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,Labels, X1,X2 in zip(Mumbai_merged['Latitude'], Mumbai_merged['Longitude'], Mumbai_merged['Neighborhood'], Mumbai_merged['Cluster Labels'],Mumbai_merged['Labels'], Mumbai_merged['Shopping Mall_x'], Mumbai_merged['Theater_x']):
    label = folium.Popup(str(poi) + ' Area' + ' has-' + str(Labels)+'; Shopping Mall-' +str(X1)+ ' Theater-' +str(X2), 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[71]:



In [72]: # get mumbai geojson data

```
mumbai_geo = r'https://raw.githubusercontent.com/datameet/PincodeBoundary/master/Mumbai/boundary.geojson' # geojson file
```

```
In [73]: # get Mumbai area wise density information
Mumbai_den = pd.read_csv(r'C:\Users\Puneet\Desktop\Data_Capstone_project\Mumba
i_density.csv')

Mumbai_den.head()
```

Out[73]:

	Pincode	Area	Density_Square_Kilometer
0	400001	MUMBAI GPO	56253.20
1	400002	kalbadevi	56253.20
2	400003	Mandvi	56253.20
3	400004	girgaon	112734.44
4	400005	COLABA POST OFFICE	16867.76

```
In [74]: # generate choropleth map to visualize the population density
map_mumbai = folium.Map(location=[latitude, longitude], zoom_start=11)

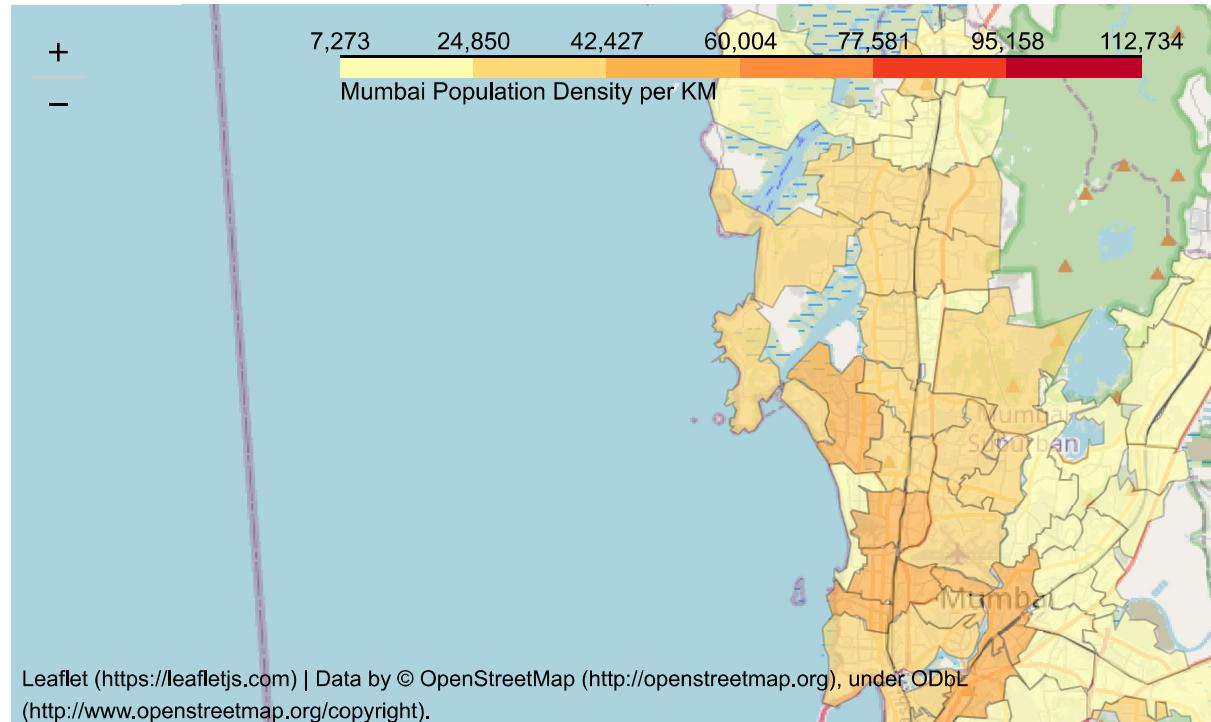
map_mumbai.choropleth(
    geo_data=mumbai_geo,
    data=Mumbai_den,
    columns=['Area', 'Density_Square_Kilometer'],
    key_on='feature.properties.name',
    fill_color='YlOrRd',
    fill_opacity=0.7,
    line_opacity=0.2,
    legend_name='Mumbai Population Density per KM'
)

# display map
map_mumbai
```

C:\ProgramData\Anaconda3\lib\site-packages\folium\folium.py:413: FutureWarning:  
g: The choropleth method has been deprecated. Instead use the new Choropleth  
class, which has the same arguments. See the example notebook 'GeoJSON\_and\_ch  
oropleth' for how to do this.

FutureWarning

Out[74]:



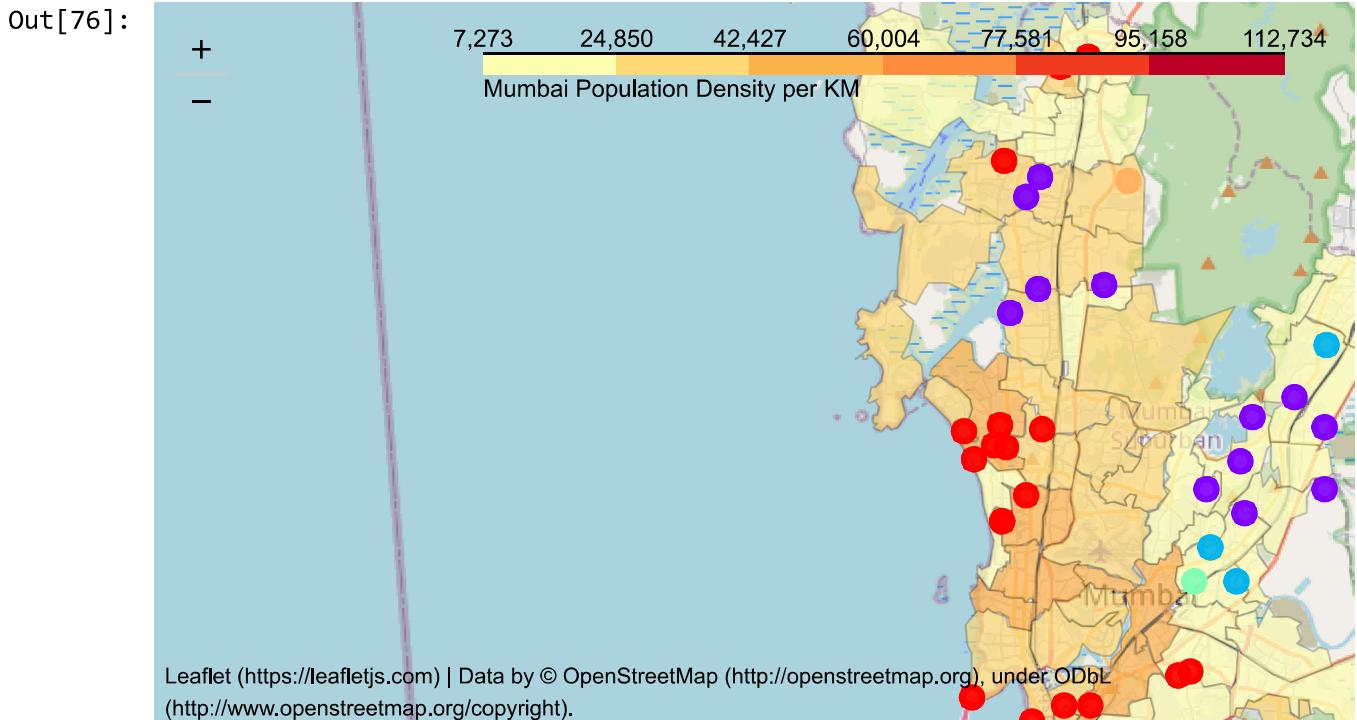
In [76]: #Finally, let's visualize the resulting clusters and Mumbai city population density in a single map

```
# create map
map_clusters = map_mumbai

# 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,Labels, X1,X2 in zip(Mumbai_merged['Latitude'], Mumbai_merged['Longitude'], Mumbai_merged['Neighborhood'], Mumbai_merged['Cluster Labels'],Mumbai_merged['Labels'], Mumbai_merged['Shopping Mall_x'], Mumbai_merged['Theater_x']):
    label = folium.Popup(str(poi) + ' Area' + ' has-' + str(Labels)+'; Shopping Mall-' +str(X1)+ ' Theater-' +str(X2), 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
```



In [ ]: #The End