Exploration and Grouping of best places in Chennai city

March 12, 2021

0.0.1 For this final data science project conducted by IBM. I have planned to analyse the geography my hometown city 'chennai', one of the materopolitan city present in India. This project uses as many informations that can be retrived from a FourSquare API based on their 'venue explore options' and identifies best geographical location which could be regarded as a starting point of visit for any tourist coming to chennai.

Import all necessary python modules to process web-data and to represent them graphically

[528]:
```
import numpy as np # library to handle data in a vectorized manner
! pip install geopy
! pip install folium
! pip install termcolor

from termcolor import colored
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
%config InlineBackend.figure_format = 'retina'
plt.style.use('ggplot')

import pandas as pd
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)

import json
import math
from math import sin, cos, sqrt, atan2, radians # to convert geo coordinates to␣
 ↪distance in km
from geopy.geocoders import Nominatim # convert an address into latitude and␣
 ↪longitude values

import requests
from bs4 import BeautifulSoup
# Matplotlib and associated plotting modules
import matplotlib.cm as cm
import matplotlib.colors as colors
```

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

#!conda install -c conda-forge folium=0.5.0 --yes # uncomment this line if you␣
 ↪haven't completed the Foursquare API lab
import folium # map rendering library

print('Libraries imported.')
```

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: geopy in
/home/santhosh/.local/lib/python3.8/site-packages (2.1.0)
Requirement already satisfied: geographiclib<2,>=1.49 in
/home/santhosh/.local/lib/python3.8/site-packages (from geopy) (1.50)
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: folium in
/home/santhosh/.local/lib/python3.8/site-packages (0.5.0)
Requirement already satisfied: jinja2 in
/home/santhosh/.local/lib/python3.8/site-packages (from folium) (2.11.3)
Requirement already satisfied: requests in /usr/lib/python3/dist-packages (from
folium) (2.22.0)
Requirement already satisfied: six in /home/santhosh/.local/lib/python3.8/site-
packages (from folium) (1.15.0)
Requirement already satisfied: branca in
/home/santhosh/.local/lib/python3.8/site-packages (from folium) (0.4.2)
Requirement already satisfied: MarkupSafe>=0.23 in
/home/santhosh/.local/lib/python3.8/site-packages (from jinja2->folium) (1.1.1)
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: termcolor in
/home/santhosh/.local/lib/python3.8/site-packages (1.1.0)
Libraries imported.
```

The url(https://chennaiiq.com/chennai/latitude_longitude_areas.asp) contains the latitudes and longitudinal coordinates of different major areas/regions present in chennai city . Hence i have fetched this url link and processed the desired table using the python module beautifulsoup

[529]:
```
url = 'https://chennaiiq.com/chennai/latitude_longitude_areas.asp'
r = requests.get(url)
html_data = r.text
soup = BeautifulSoup(html_data, "html.parser")
soup.head.title # get the title of a web-page just to make sure it is working␣
 ↪correctly
```

[529]:
```
<title>Chennai Latitude Longitude, Chennai Latitude, Chennai Logitude</title>
```

[530]:
```
tables = soup.find("table", attrs={"class": "TBox"})
```

It should be noted that the latitudes and longitudes obtained from the url are not represented in

the decimal form. Hence it is better to convert them into decimal before going for the next step. The python function 'convert' takes the coordinates of latitude and longitues in Deg/Min/Sec unit and convert them in to decimal degrees. The final processed entries are stored as a dataframe 'chennai_data'.

[531]:
```
def convert(coords):
    multiplier = 1 if coords[-1] in ['N', 'E'] else -1
    coords = coords[:-1].strip()
    coords = coords.replace(u'°',u' ').replace("'"," ").replace('"',' ').
 ↪replace(u'\xa0', u' ').strip()
    FormattedCoordinates = multiplier * sum(float(x) / 60 ** n for n, x in␣
 ↪enumerate(coords.split(' ')))
    return (FormattedCoordinates)
```

[532]:
```
table_data = []
index = ['S.No.', 'Location', 'Latitude', 'Longitude']
chennai_data = pd.DataFrame(columns=['S.No.', 'Location', 'Latitude',␣
 ↪'Longitude'])
for tr in table.find_all("tr", attrs={"class": "tab"}):
    col = tr.find_all("td")
    try:
        s_no = col[0].text.strip()
        location = col[1].text.strip()
        Latitude = convert(col[2].text)
        longitude = convert(col[3].text)
        chennai_data = chennai_data.append({"S.No.":s_no, "Location":location,␣
 ↪"Latitude":Latitude, "Longitude":longitude}, ignore_index=True)
    except:
        pass
        break
```

[533]:
```
chennai_data.head()
```

[533]:

	S.No.	Location	Latitude	Longitude
0	1	Adyar Bus Debot.	12.997222	80.256944
1	2	Adyar Signal	13.006389	80.257500
2	3	Alandur	13.007778	80.209722
3	4	Ambattur	13.110000	80.170000
4	5	Anna Arch	13.074444	80.218333

1) Lets create and visualize the location map of all area in chennai city using Folium. Two different maps of chennai are displayed, first on the left is generated using the default folium tiles (OpenStreetMap). The second one on the right is made using "Stamen Watercolor" tiles to empahsises the city is located near costal region.

[550]:
```
latitude = 12.997222 # location of Adyar Bus Debot
longitude = 80.256944
# i chose this coord, because it is the center of all locations
```

```
# create map of Chennai city using latitude and longitude values
map_chennai_basic = folium.Map(location=[latitude,␣
↪longitude],tiles='OpenStreetMap',zoom_start=11)
# add markers to ma
for lat, lng, label in zip(chennai_data['Latitude'], chennai_data['Longitude'],␣
↪chennai_data['Location']):
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='cyan',
        fill=True,
        fill_color='#ab1d64',
        fill_opacity=0.8,
        parse_html=False).add_to(map_chennai_basic)

map_chennai_watercolor = folium.Map(location=[latitude,␣
↪longitude],tiles="Stamen Watercolor",zoom_start=11)
# add markers to ma
for lat, lng, label in zip(chennai_data['Latitude'], chennai_data['Longitude'],␣
↪chennai_data['Location']):
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='cyan',
        fill=True,
        fill_color='#ab1d64',
        fill_opacity=0.8,
        parse_html=False).add_to(map_chennai_watercolor)

map_chennai_basic,map_chennai_watercolor
from IPython.display import display, HTML

htmlmap = HTML('<iframe srcdoc="{}" style="float:left; width: {}px; height:␣
↪{}px; display:inline-block; width: 50%; margin: 0 auto; border: 2px solid␣
↪black"></iframe>'
           '<iframe srcdoc="{}" style="float:right; width: {}px; height: {}px;␣
↪display:inline-block; width: 50%; margin: 0 auto; border: 2px solid black"></
↪iframe>'
           .format(map_chennai_basic.get_root().render().replace('"', '&quot;
↪'),500,500,
                   map_chennai_watercolor.get_root().render().replace('"',␣
↪'&quot;'),500,500))
```

```
display(htmlmap)
```

```
<IPython.core.display.HTML object>
```

2) Now we are going to use Foursquare API to get the information of various places that are present around each areas. Before starting the Foursquare API, we will set up all necessary credentials such as CLIENT_ID, CLIENT_SECRET, ACCESS_TOKEN, VERSION to seamlessly integrate with the API.

[535]:
```
CLIENT_ID = 'M34ZNX3WLFJGWKDH5YL5O4BCN1W1GKQQXH2YUKAJX4FQ1BY3' # your␣
↪Foursquare ID
CLIENT_SECRET = 'NNVAOTDYMEFXTYYAMRGRZWDA5T2RG4JZPYZ442XZDEF2GLWJ' # your␣
↪Foursquare Secret
ACCESS_TOKEN = 'ZS31YLOV3FWOHMJPAYQT3DCQIN2VNBRYRJH4RF4J4OASANZL' # your␣
↪FourSquare Access Token
VERSION = '20180604'
print('Your credentails:')
print('CLIENT_ID: ' + CLIENT_ID)
print('CLIENT_SECRET:' + CLIENT_SECRET)
```

```
Your credentails:
CLIENT_ID: M34ZNX3WLFJGWKDH5YL5O4BCN1W1GKQQXH2YUKAJX4FQ1BY3
CLIENT_SECRET:NNVAOTDYMEFXTYYAMRGRZWDA5T2RG4JZPYZ442XZDEF2GLWJ
```

3) Here, we are going to use FrontSquare as a medium to explore all places that are present with in 10 kilometer radius from the latitudes and longitudes.The json formatted output of Frontsquare results are processed carefully to choose only those columns that are going to be very helpful for the analysis.

For example, by default, FourSquare groups venues based on their purposes which we are going to fetch it from results variable and store them in 'category_name'.

The output of all processed entries are stored as a dataframe 'venues_list'.

[536]:
```
LIMIT = 20
radius = 10000 # fetch all places thar are withn 10 kilometer radius
def ExploreNearbyPlaces(names, latitudes, longitudes, radius=10000):
    venues_list = []
    #names, latitudes, longitudes = ['Adyar Bus Debot'], [latitude], [longitude]
    #names, latitudes, longitudes = names[:3], latitudes[:3], longitudes[:3]
    for name, lat, lng in zip(names, latitudes, longitudes):
        url = 'https://api.foursquare.com/v2/venues/explore?
↪client_id={}&client_secret={}&ll={},{}&oauth_token={}&v={}&radius={}&limit={}'.
↪format(CLIENT_ID, CLIENT_SECRET, lat, lng,ACCESS_TOKEN, VERSION, radius,␣
↪LIMIT)
        results = requests.get(url).json()
        for i in range(len(results['response']['groups'][0]['items'])):
            try:
```

```
                category_name =␣
↪results['response']['groups'][0]['items'][i]['venue']['categories'][0]['name']
                #venue_address =␣
↪results['response']['groups'][0]['items'][i]['venue']['location']['address']
                venue_name =␣
↪results['response']['groups'][0]['items'][i]['venue']['name']
                venue_lat =␣
↪results['response']['groups'][0]['items'][i]['venue']['location']['lat']
                venue_lng =␣
↪results['response']['groups'][0]['items'][i]['venue']['location']['lng']
                venue_distance =␣
↪results['response']['groups'][0]['items'][i]['venue']['location']['distance']
                venues_list.append([name, lat, lng,category_name, venue_name,␣
↪venue_lat, venue_lng, venue_distance])
            except:
                pass
    venues_list = pd.DataFrame(venues_list)
    venues_list.columns = ['AreaName', 'AreaLatitude', 'AreaLongitude',
                  'CategoryName', 'VenueName', 'VenueLatitide',␣
↪'VenueLongitude',
                  'VenueDistance']
    return venues_list

venues_list = ExploreNearbyPlaces(names=chennai_data['Location'],
                                  latitudes=chennai_data['Latitude'],
                                  longitudes=chennai_data['Longitude']
                                 )
venues_list = venues_list.drop_duplicates(subset='VenueName', keep='first')
```

The following cell does some basic operations on venues_list such as seeing how datas are stored, what is the types of each coulmn, name of columns and so on.

[537]:
```
print (venues_list.head())
print('\n')
print (venues_list['CategoryName'].unique())
print('\n')
venues_list[venues_list['CategoryName'] == 'Multiplex']
```

```
           AreaName  AreaLatitude  AreaLongitude               CategoryName  \
0  Adyar Bus Debot.     12.997222      80.256944                 Juice Bar
1  Adyar Bus Debot.     12.997222      80.256944                      Beach
2  Adyar Bus Debot.     12.997222      80.256944  North Indian Restaurant
3  Adyar Bus Debot.     12.997222      80.256944  Middle Eastern Restaurant
4  Adyar Bus Debot.     12.997222      80.256944                      Beach

                                VenueName  VenueLatitide  VenueLongitude  \
0                 Fruit Shop On Greams Road      13.001280       80.267439
```

```
1  Besant Nagar Beach (Edward Elliot's Beach)      13.000506       80.270840
2                             Bombay Brassiere      13.006961       80.256419
3                          Zaitoon Restaurant      12.996861       80.256178
4                       4th Seaward Road Beach      12.979286       80.264673

   VenueDistance
0           1224
1           1550
2           1085
3             92
4           2165


['Juice Bar' 'Beach' 'North Indian Restaurant' 'Middle Eastern Restaurant'
 'Hotel' 'Ice Cream Shop' 'Asian Restaurant'
 'Vegetarian / Vegan Restaurant' 'Bistro' 'Italian Restaurant' 'Café'
 "Women's Store" 'Clothing Store' 'Spa' 'Fast Food Restaurant' 'Bakery'
 'Indian Restaurant' 'Restaurant' 'Multiplex' 'Shopping Mall'
 'Coffee Shop' 'Rajasthani Restaurant' 'Lounge'
 'Molecular Gastronomy Restaurant' 'Park' 'Sandwich Place' 'Snack Place'
 'Gym' 'South Indian Restaurant' 'Theater' 'BBQ Joint' 'Pub'
 'Chocolate Shop' "Men's Store" 'Modern European Restaurant'
 'Chinese Restaurant' 'Indian Sweet Shop' 'Dessert Shop' 'Cricket Ground'
 'Movie Theater' 'Bar' 'Gaming Cafe' 'Donut Shop' 'Pizza Place'
 'Food Court' 'Jewelry Store' 'Kebab Restaurant' 'Hyderabadi Restaurant'
 'Multicuisine Indian Restaurant' 'African Restaurant' 'Concert Hall'
 'Furniture / Home Store' 'Pool' 'Breakfast Spot' 'Seafood Restaurant'
 'Lighthouse' 'Department Store' 'Food' 'Burger Joint' 'Accessories Store'
 'Sporting Goods Shop' 'Theme Park' 'Andhra Restaurant' 'Museum'
 'Video Store' 'Nightclub' 'Farmers Market']
```

[537]:

	AreaName	AreaLatitude	AreaLongitude	CategoryName	\
46	Alandur	13.007778	80.209722	Multiplex	
76	Ambattur	13.110000	80.170000	Multiplex	
141	Anna Statue	13.068056	80.271944	Multiplex	
147	Anna Statue	13.068056	80.271944	Multiplex	
279	Chennai Airport	12.992222	80.169444	Multiplex	
1457	Poonamallee	13.042500	80.100833	Multiplex	
1847	Tiruvottiyur	13.160000	80.289722	Multiplex	

	VenueName	VenueLatitide	VenueLongitude	\
46	Luxe Cinemas	12.991041	80.216962	
76	Palazzo	13.050383	80.209541	
141	Escape Cinemas	13.058746	80.264170	
147	Serene Sathyam	13.055665	80.258041	

```
279                                  IMAX®      12.990639       80.216310
1457  PVR Cinemas Grand Galada Center Mall      12.978902       80.161557
1847                            S2 Cinemas      13.112313       80.236524

      VenueDistance
46             2021
76             7900
141            1335
147            2043
279            5086
1457           9669
1847           7838
```

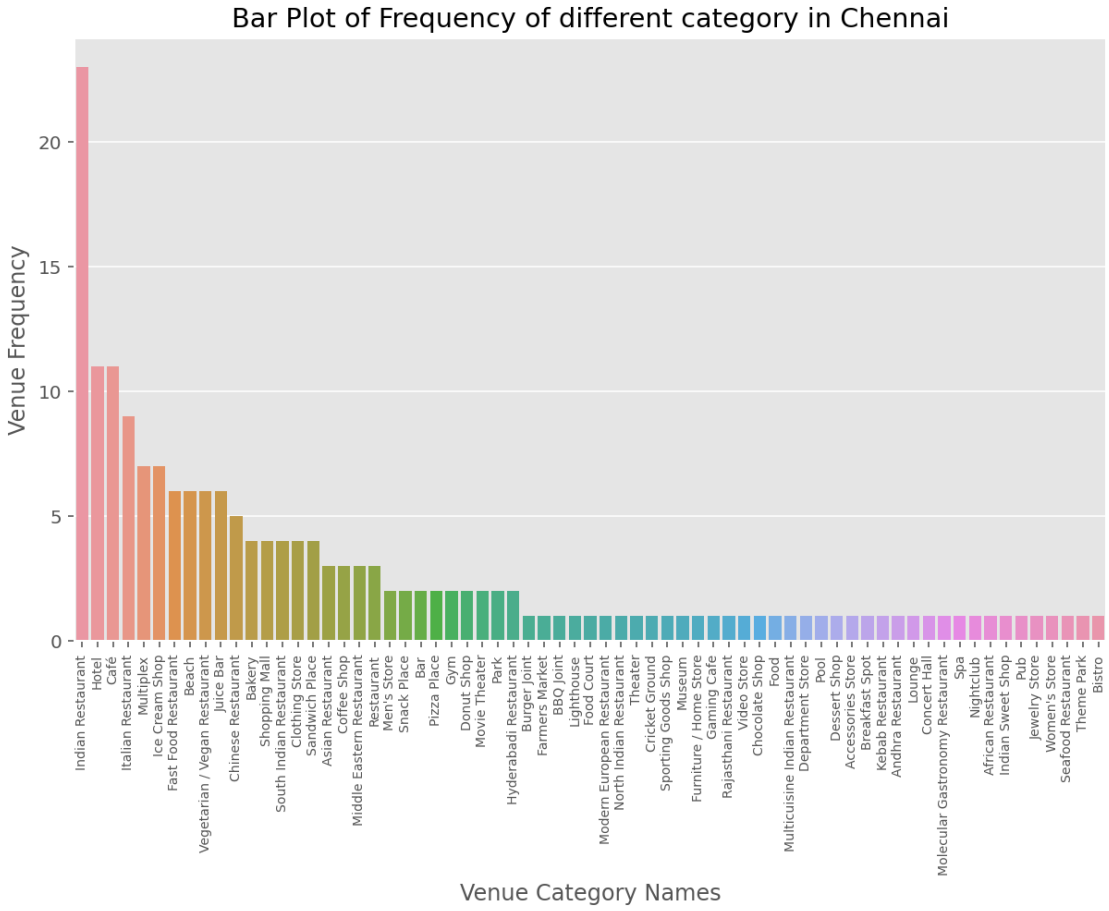
Analysis 1) In this analysis, we are going to analyse the frequence of occurence of each venue categories ('CategoryName') for a whole chennai city and also report their frequencies in individual areas.

From the below figure, it is evident that venue category 'Indian Restaurant','Hotel', 'cafe' has more number of venues than other category in chennai.

[538]:
```
venues_category_total = venues_list['CategoryName'].value_counts()
#print(venues_category_total.values)

fig_dims = (10, 6)
fig, ax = plt.subplots(figsize=fig_dims)
plt.bar(venues_category_total.index, venues_category_total.values)
plt.xticks(rotation=90,fontsize=7)
plt.xlabel("Venue Category Names")
plt.ylabel("Venue Frequency")
plt.title("Bar Plot of Frequency of different category in Chennai")
sns.color_palette("cubehelix", as_cmap=True)
sns.barplot(x=venues_category_total.index, y=venues_category_total.values)
```

[538]:
```
<AxesSubplot:title={'center':'Bar Plot of Frequency of different category in
Chennai'}, xlabel='Venue Category Names', ylabel='Venue Frequency'>
```



[539]:
```
a = venues_list.groupby('AreaName')#.value_counts()#.to_frame('CategoryName')
print('Fequency of a Category Name:')
print(venues_list['CategoryName'].value_counts().head()) # value_count of each␣
 ↪category. Normalize to create weigths
Category_counts_total = venues_list['CategoryName'].value_counts()
#print(Category_counts_total.loc['Hotel'])
Category_names = Category_counts_total.index.values
```

```
Fequency of a Category Name:
Indian Restaurant     23
Hotel                 11
Café                  11
Italian Restaurant     9
Multiplex              7
Name: CategoryName, dtype: int64
```

OBSERVATION: If you observe from the data. Some categories are more common than other, this could be either due to their popularity or it is easy to establish that venue than other. For example restuarant is more frequently seen than museum or theater. To address this, i am going to try

normalizing their values by dividing the value_count of each category in a area with total category count.

[540]:
```
venues_CategoryName = venues_list.groupby(['AreaName', 'CategoryName']).size().
 ↪unstack(fill_value=0) # groupby based on area
AreaNames = venues_CategoryName.index.values
array_total = []
for area in AreaNames:
    array = []
    for category in Category_names:
        array.append(venues_CategoryName.loc[area, category] /␣
 ↪Category_counts_total.loc[category])
    array_total.append(array)
CategoriesNormalized = pd.DataFrame(array_total)
CategoriesNormalized.set_index(AreaNames, inplace=True)
CategoriesNormalized.columns = Category_names
CategoriesNormalized.head() # this normalized data table can help us to get␣
 ↪many new interesting informations.
```

[540]:

	Indian Restaurant	Hotel	Café	Italian Restaurant	\
AVM Studio	0.043478	0.000000	0.000000	0.000000	
Adyar Bus Debot.	0.000000	0.181818	0.181818	0.222222	
Adyar Signal	0.000000	0.000000	0.000000	0.111111	
Alandur	0.086957	0.363636	0.000000	0.000000	
Ambattur	0.173913	0.000000	0.181818	0.111111	

	Multiplex	Ice Cream Shop	Fast Food Restaurant	Beach	\
AVM Studio	0.000000	0.000000	0.166667	0.000000	
Adyar Bus Debot.	0.000000	0.142857	0.000000	0.666667	
Adyar Signal	0.000000	0.000000	0.166667	0.000000	
Alandur	0.142857	0.142857	0.000000	0.000000	
Ambattur	0.142857	0.285714	0.166667	0.000000	

	Vegetarian / Vegan Restaurant	Juice Bar	\
AVM Studio	0.166667	0.000000	
Adyar Bus Debot.	0.166667	0.333333	
Adyar Signal	0.000000	0.000000	
Alandur	0.166667	0.000000	
Ambattur	0.166667	0.000000	

	Chinese Restaurant	Bakery	Shopping Mall	\
AVM Studio	0.2	0.00	0.25	
Adyar Bus Debot.	0.0	0.00	0.00	
Adyar Signal	0.0	0.25	0.00	
Alandur	0.0	0.00	0.25	

```
Ambattur                        0.0    0.00          0.25

                South Indian Restaurant  Clothing Store  Sandwich Place  \
AVM Studio                         0.00            0.25            0.00
Adyar Bus Debot.                   0.00            0.25            0.00
Adyar Signal                       0.00            0.00            0.00
Alandur                            0.00            0.00            0.00
Ambattur                           0.25            0.00            0.25

                Asian Restaurant  Coffee Shop  Middle Eastern Restaurant  \
AVM Studio              0.000000     0.000000                   0.000000
Adyar Bus Debot.        0.333333     0.000000                   0.333333
Adyar Signal            0.000000     0.000000                   0.000000
Alandur                 0.666667     0.333333                   0.000000
Ambattur                0.000000     0.000000                   0.000000

                Restaurant  Men's Store  Snack Place  Bar  Pizza Place  Gym  \
AVM Studio        0.000000          0.0          0.0  0.0          0.0  0.0
Adyar Bus Debot.  0.000000          0.0          0.0  0.0          0.0  0.0
Adyar Signal      0.000000          0.0          0.0  0.0          0.0  0.0
Alandur           0.666667          0.0          0.0  0.0          0.0  0.0
Ambattur          0.000000          0.0          0.5  0.0          0.0  0.5

                Donut Shop  Movie Theater  Park  Hyderabadi Restaurant  \
AVM Studio             0.0            0.0   0.0                    0.0
Adyar Bus Debot.       0.0            0.0   0.0                    0.0
Adyar Signal           0.0            0.0   0.0                    0.0
Alandur                0.0            0.0   0.0                    0.0
Ambattur               0.0            0.0   1.0                    0.0

                Burger Joint  Farmers Market  BBQ Joint  Lighthouse  \
AVM Studio               0.0             0.0        0.0         0.0
Adyar Bus Debot.         0.0             0.0        0.0         0.0
Adyar Signal             0.0             0.0        0.0         0.0
Alandur                  0.0             0.0        0.0         0.0
Ambattur                 0.0             0.0        0.0         0.0

                Food Court  Modern European Restaurant  \
AVM Studio             0.0                         0.0
Adyar Bus Debot.       0.0                         0.0
Adyar Signal           0.0                         0.0
Alandur                0.0                         0.0
Ambattur               0.0                         0.0

                North Indian Restaurant  Theater  Cricket Ground  \
AVM Studio                          0.0      0.0             0.0
Adyar Bus Debot.                    1.0      0.0             0.0
```

Adyar Signal	0.0	0.0	0.0
Alandur	0.0	0.0	0.0
Ambattur	0.0	0.0	0.0

	Sporting Goods Shop	Museum	Furniture / Home Store	\
AVM Studio	0.0	0.0	0.0	
Adyar Bus Debot.	0.0	0.0	0.0	
Adyar Signal	0.0	0.0	0.0	
Alandur	0.0	0.0	0.0	
Ambattur	0.0	0.0	0.0	

	Gaming Cafe	Rajasthani Restaurant	Video Store	\
AVM Studio	0.0	0.0	0.0	
Adyar Bus Debot.	0.0	0.0	0.0	
Adyar Signal	0.0	0.0	0.0	
Alandur	0.0	1.0	0.0	
Ambattur	0.0	0.0	0.0	

	Chocolate Shop	Food	Multicuisine Indian Restaurant	\
AVM Studio	0.0	0.0	0.0	
Adyar Bus Debot.	0.0	0.0	0.0	
Adyar Signal	0.0	0.0	0.0	
Alandur	0.0	0.0	0.0	
Ambattur	0.0	0.0	0.0	

	Department Store	Pool	Dessert Shop	Accessories Store	\
AVM Studio	0.0	0.0	0.0	0.0	
Adyar Bus Debot.	0.0	0.0	0.0	0.0	
Adyar Signal	0.0	0.0	0.0	0.0	
Alandur	0.0	0.0	0.0	0.0	
Ambattur	0.0	0.0	0.0	0.0	

	Breakfast Spot	Kebab Restaurant	Andhra Restaurant	Lounge	\
AVM Studio	0.0	0.0	0.0	0.0	
Adyar Bus Debot.	0.0	0.0	0.0	0.0	
Adyar Signal	0.0	0.0	0.0	0.0	
Alandur	0.0	0.0	0.0	1.0	
Ambattur	0.0	0.0	0.0	0.0	

	Concert Hall	Molecular Gastronomy Restaurant	Spa	\
AVM Studio	0.0	0.0	0.0	
Adyar Bus Debot.	0.0	0.0	0.0	
Adyar Signal	0.0	0.0	1.0	
Alandur	0.0	1.0	0.0	
Ambattur	0.0	0.0	0.0	

	Nightclub	African Restaurant	Indian Sweet Shop	Pub	\

```
AVM Studio              0.0                 0.0                 0.0  0.0
Adyar Bus Debot.        0.0                 0.0                 0.0  0.0
Adyar Signal            0.0                 0.0                 0.0  0.0
Alandur                 0.0                 0.0                 0.0  0.0
Ambattur                0.0                 0.0                 0.0  0.0

                  Jewelry Store  Women's Store  Seafood Restaurant  \
AVM Studio                  1.0            0.0                 0.0
Adyar Bus Debot.            0.0            1.0                 0.0
Adyar Signal                0.0            0.0                 0.0
Alandur                     0.0            0.0                 0.0
Ambattur                    0.0            0.0                 0.0

                  Theme Park  Bistro
AVM Studio               0.0     0.0
Adyar Bus Debot.         0.0     1.0
Adyar Signal             0.0     0.0
Alandur                  0.0     0.0
Ambattur                 0.0     0.0
```

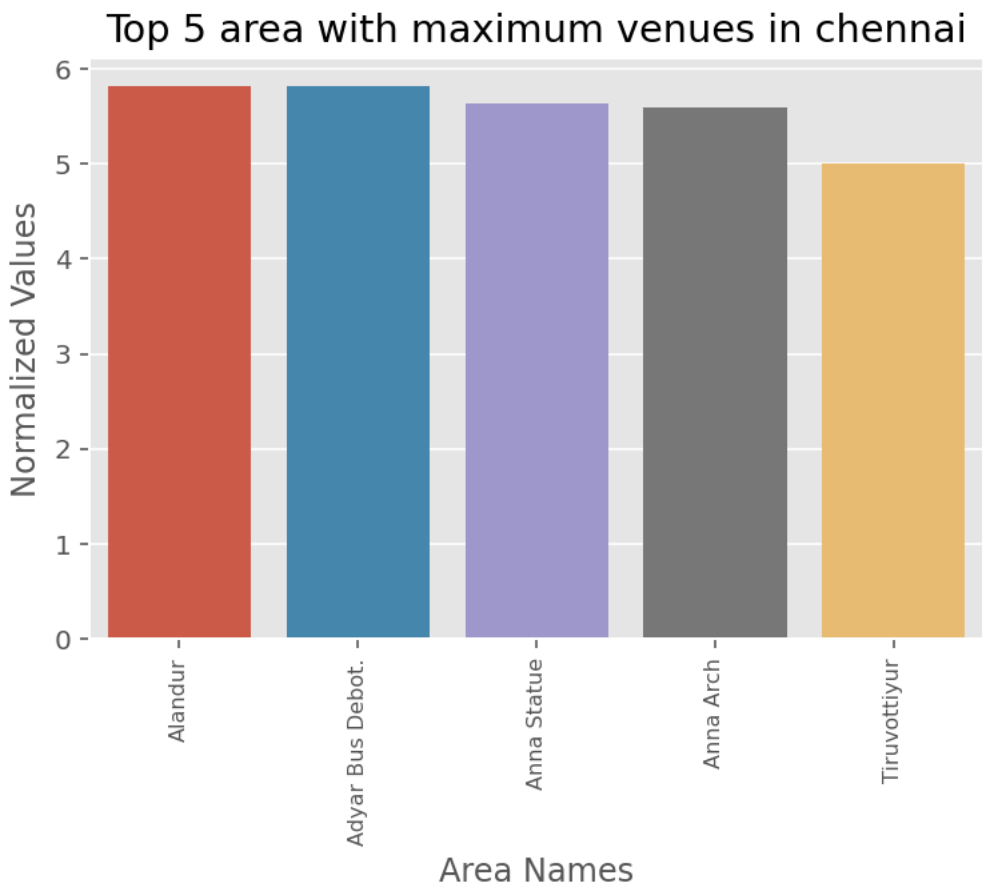
Now,that we have dataframe containing normalized entries across columns and rows. we could now ask following questions like 1) Which area contain maximum cafe 2) List top 5 areas that have maximum best venues etc

[541]:
```
print('\n')
print(colored('The Area: {} contain many cafe venues than other areas in␣
 ↪Chennai City.'.format(CategoriesNormalized.sort_values('Café',).index[0]),␣
 ↪'red'))
print('\n')
print(colored('Top 5 areas that contain maximum venues in chennai:','green'))
print(CategoriesNormalized.sum(axis=1).sort_values(ascending=False).head(5))
print('\n\n')
plt.xticks(rotation=90,fontsize=8)
plt.title('Top 5 area with maximum venues in chennai')
plt.xlabel('Area Names')
plt.ylabel('Normalized Values')
sns.color_palette("hls", 8)
sns.barplot(x=CategoriesNormalized.sum(axis=1).sort_values(ascending=False).
 ↪head(5).index, y=CategoriesNormalized.sum(axis=1).
 ↪sort_values(ascending=False).head(5).values)
```

```
The Area: AVM Studio contain many cafe venues than other areas in Chennai
City.
```

```
Top 5 areas that contain maximum venues in chennai:
Alandur              5.819641
Adyar Bus Debot.     5.812049
Anna Statue          5.634215
Anna Arch            5.586957
Tiruvottiyur         4.999467
dtype: float64
```

[541]:
```
<AxesSubplot:title={'center':'Top 5 area with maximum venues in chennai'},
xlabel='Area Names', ylabel='Normalized Values'>
```



Lets map the top 10 area of maximum venue in folium

[542]:
```
top_10_areas = CategoriesNormalized.sum(axis=1).sort_values(ascending=False).
↪head(10).index
print(top_10_areas)
```

```
latitude = 12.997222 # location of Adyar Bus Debot
longitude = 80.256944
# i chose this coord, because it is the center of all locations
# create map of Chennai city using latitude and longitude values
map_chennai_basic = folium.Map(location=[latitude,␣
 ↪longitude],tiles='OpenStreetMap',zoom_start=12)
# add markers to ma
for lat, lng, label in zip(chennai_data['Latitude'], chennai_data['Longitude'],␣
 ↪chennai_data['Location']):
    if label in top_10_areas:
        label = folium.Popup(label, parse_html=True)
        folium.CircleMarker(
            [lat, lng],
            radius=7,
            popup=label,
            color='#04d604',
            fill=True,
            fill_color='#fc1500',
            fill_opacity=0.8,
            parse_html=False).add_to(map_chennai_basic)
    else:
        label = folium.Popup(label, parse_html=True)
        folium.CircleMarker(
            [lat, lng],
            radius=5,
            popup=label,
            color='cyan',
            fill=True,
            fill_color='#ab1d64',
            fill_opacity=0.5,
            parse_html=False).add_to(map_chennai_basic)

map_chennai_basic
```

```
Index(['Alandur', 'Adyar Bus Debot.', 'Anna Statue', 'Anna Arch',
       'Tiruvottiyur', 'Poonamallee', 'Chola', 'Ambattur', 'Avadi', 'MRTS'],
      dtype='object')
```

[542]:
```
<folium.folium.Map at 0x7f37d8b3c370>
```

TASK: Finding the closest area to the corrdinates specified by the user. This could be either coordinates taken from a GPS system or user can specify it.

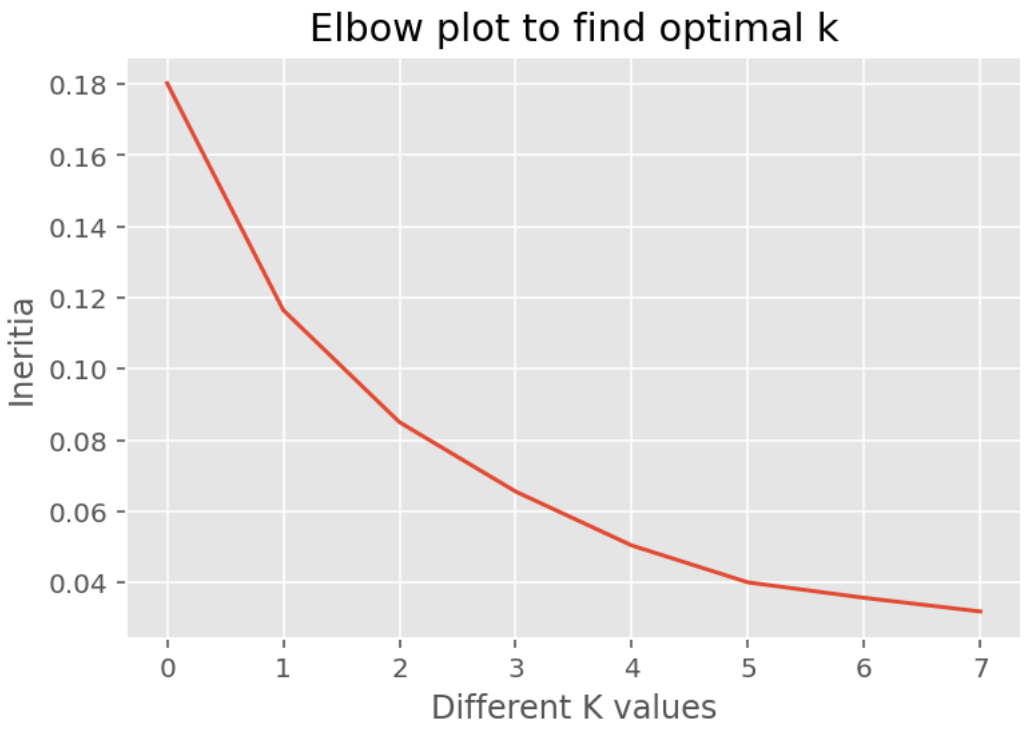
[543]:
```
user_lat, user_lng = 13.067439, 80.237617 # latitudes and longitudes given by␣
 ↪the user in decimal degrees
NearestChennaiArea = []
R = 6373.0
```

```
for loc,lat,lng in␣
 ↪zip(chennai_data['Location'],chennai_data['Latitude'],chennai_data['Longitude']):
 ↪
    lat1 = radians(user_lat)
    lon1 = radians(user_lng)
    lat2 = radians(lat)
    lon2 = radians(lng)
    dlon = lon2 - lon1
    dlat = lat2 - lat1
    a = (sin(dlat/2))**2 + cos(lat1) * cos(lat2) * (sin(dlon/2))**2
    c = 2 * atan2(sqrt(a), sqrt(1-a))
    distance = R * c
    NearestChennaiArea.append([loc,distance])
NearestChennaiArea = sorted(NearestChennaiArea, key = lambda x:float(x[1]))
print(colored(NearestChennaiArea[0][0],'red'),'is the nearest area in chennai␣
 ↪located {} km from your specified latitude and longitude'.
 ↪format(NearestChennaiArea[0][1]))
```

```
Loyolo College is the nearest area in chennai located
0.5288299700189477 km from your specified latitude and longitude
```

Clustering Analysis: Here, we are going to cluster all area names by using their latitudes and longitudes using K-Means clustering algorithm. The value of 'k' in k-means was increated to one count using range function. Optimal 'k' was obtained using elbow plot.

[544]:
```
coord = np.asarray(chennai_data[['Latitude','Longitude']].values,␣
 ↪dtype='float') # latitude and longitude in np array form
k_means_inertia = []
for i in range(2,10):
    #print(i)
    kmeans = KMeans(n_clusters=i).fit(coord)
    k_means_inertia.append(kmeans.inertia_)
plt.plot(range(len(k_means_inertia)), k_means_inertia)
plt.xlabel('Different K values')
plt.ylabel('Ineritia')
plt.title('Elbow plot to find optimal k')
plt.show()
```



The optimal k value is somewhere between 4 and 5. Here i am taking 5 as the number of clusters for the k-mean algorithm

[552]:
```
kmeans = KMeans(n_clusters=5).fit(coord)

color_codes = {0:['#800442','#f2057c'], 1:['#55056b','#ae0bdb'],2:
 ↪['#042469','#0447d6'],3:['#046e42','#08d17e'],
               4:['#425205','#add907'],5:['#854103','#f27707']}
area_color = {}
for i in range(len(chennai_data['Location'])):
    area_color[chennai_data['Location'][i]] = color_codes[kmeans.labels_[i]]

latitude = 12.997222
longitude = 80.256944
map_chennai_cluster = folium.Map(location=[latitude,␣
 ↪longitude],tiles='OpenStreetMap',zoom_start=12)

for lat, lng, labels in zip(chennai_data['Latitude'],␣
 ↪chennai_data['Longitude'], chennai_data['Location']):
    label = folium.Popup(labels, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=7,
```

```
        popup=label,
        color=area_color[labels][0],
        fill=True,
        fill_color=area_color[labels][1],
        fill_opacity=0.8,
        parse_html=False).add_to(map_chennai_cluster)

map_chennai_cluster
```

[552]: <folium.folium.Map at 0x7f37d7f08520>

Summary Statistics for each cluster

[553]:
```
area_group = {}
for i in range(len(chennai_data['Location'])):
    area_group[chennai_data['Location'][i]] = kmeans.labels_[i]

#print(CategoriesNormalized.columns)
for k_cluster in range(5):
    venue_dictionary_per_cluster = {}
    for area,j in area_group.items():
        if k_cluster == j:
            if area in CategoriesNormalized.index:
                for ven in CategoriesNormalized.columns:
                    if ven not in venue_dictionary_per_cluster:
                        venue_dictionary_per_cluster[ven] = 0.0
                    if ven in venue_dictionary_per_cluster:
                        val = venue_dictionary_per_cluster[ven]
                        #print(area,ven)
                        #print(CategoriesNormalized.loc[area,ven])
                        val += CategoriesNormalized.loc[area,ven]
                        venue_dictionary_per_cluster[ven] = val

    top_5_venue = sorted([[k,p] for k, p in venue_dictionary_per_cluster.
 ↪items() ], key = lambda x:float(x[1]), reverse=True )[:5]   # for each key␣
 ↪(k), pair (p)
    print('\n')
    print('Top 5 Venues of the cluster : '+str(k_cluster+1)+' is -')
    for k in top_5_venue:
        print(k[0])
    print('\n')
    #break
#CategoriesNormalized.head()
#area_group
```

```
Top 5 Venues of the cluster : 1 is -
```

```
Snack Place
Pizza Place
Park
BBQ Joint
Food Court
```

```
Top 5 Venues of the cluster : 2 is -
Bar
Lighthouse
Cricket Ground
Furniture / Home Store
Gaming Cafe
```

```
Top 5 Venues of the cluster : 3 is -
Farmers Market
Museum
Video Store
Food
Kebab Restaurant
```

```
Top 5 Venues of the cluster : 4 is -
Burger Joint
North Indian Restaurant
Department Store
Accessories Store
Spa
```

```
Top 5 Venues of the cluster : 5 is -
Sporting Goods Shop
Rajasthani Restaurant
Andhra Restaurant
Lounge
Molecular Gastronomy Restaurant
```

Final Summary: For this final data science project we performed following task. 1: Used BeautifulSoup to parse the web-content of chennai areas. 2: Converted the latitutes and longitudes from Deg/Min/Sec to decimal degress. 3: Mapping the geo corrdinates into Folium and represented them via two different tiles 'OpenStreetMap' and 'Stamen Watercolor'. 4: FourSquare API is used to get the different venues for all the areas. 5: Categorised different venues based on their category types and normalized them. 6: Reported top 10 area having maximum venues in chennai. 7: Finding the closest areas in chennai based on user supplied geo coordinates. 8: Clustering of all areas corrdinates into 5 clusters using k-mean clustering and mapping their location in folium. 9: Finally reported top 5 venues for each cluster.

[ ]: