Applied Data Science Capstone

Introduction

History of Hyderabad

Hyderabad is the capital of the Indian state of Telangana. It is a historic city noted for its many monuments, temples, mosques and bazaars. A multitude of influences has shaped the character of the city in the last 400 years.

The city is forming its role and outlook as part of the booming service industry revolution, and is trying to preserve and popularize its history.

The History of this city, has deeply affected the culture, language, and cuisine of the people living here, and the areas once part of Hyderabad state.

Hyderabad is the capital of southern India's Telangana state. A major center for the technology industry, it's home to many upscale restaurants and shops. Its historic sites include Golconda Fort, a former diamond-trading center that was once the Qutb Shahi dynastic capital. The Charminar, a 16th-century mosque whose 4 arches support towering minarets, is an old city landmark near the long-standing Laad Bazaar.

Importing Libraries

In [2]:
```
from bs4 import BeautifulSoup
import requests
import numpy as np

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

import json # library to handle JSON files

import urllib
!conda install -c conda-forge geocoder --yes
import geocoder

!conda install -c conda-forge geopy --yes
from geopy.geocoders import Nominatim # convert an address into latitude and longit
ude values
import requests # library to handle requests
from pandas.io.json import json_normalize # tranform JSON file into a pandas datafr
am

# 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
import folium # map rendering library

print('Libraries imported.')
```

```
Solving environment: done

## Package Plan ##

  environment location: /home/jupyterlab/conda

  added / updated specs:
    - geocoder


The following packages will be downloaded:

    package                    |            build
    ---------------------------|-----------------
    orderedset-2.0             |          py36_0         231 KB  conda-forge
    geocoder-1.38.1            |            py_0          52 KB  conda-forge
    ratelim-0.1.6              |          py36_0           5 KB  conda-forge
    ------------------------------------------------------------
                                           Total:         288 KB

The following NEW packages will be INSTALLED:

    geocoder:   1.38.1-py_0  conda-forge
    orderedset: 2.0-py36_0   conda-forge
    ratelim:    0.1.6-py36_0 conda-forge


Downloading and Extracting Packages
orderedset-2.0       | 231 KB    | ##################################### | 100%
geocoder-1.38.1      | 52 KB     | ##################################### | 100%
ratelim-0.1.6        | 5 KB      | ##################################### | 100%
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
Solving environment: done

# All requested packages already installed.

Solving environment: done

# All requested packages already installed.

Libraries imported.
```

Data Section

In [3]:
```
url = "hyddata.csv"
df = pd.read_csv(url)
df.head()
```

Out[3]:

	officename	pincode	officeType	Deliverystatus	divisionname	regionname	circlename	Taluk	
0	A.Gs Office S.O	500004	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Khairatabad	
1	A.Gs. Staff Quarters S.O	500045	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Khairatabad	
2	Anandnagar S.O (Hyderabad)	500004	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Khairatabad	
3	AP Police Academy PO	500091	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Rajendra Nagar	
4	Appa Himayathsagar B.O	500008	B.O	Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Rajendranagar	K.

Focus is only on Hyderbad City

In [4]:
```
hyd_data = df.rename(columns={'divisionname' : 'Borough', 'officename' : 'Neighbourhood'})
hyd_data.head()
```

Out[4]:

	Neighbourhood	pincode	officeType	Deliverystatus	Borough	regionname	circlename	Taluk	D
0	A.Gs Office S.O	500004	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Khairatabad	
1	A.Gs. Staff Quarters S.O	500045	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Khairatabad	
2	Anandnagar S.O (Hyderabad)	500004	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Khairatabad	
3	AP Police Academy PO	500091	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Rajendra Nagar	
4	Appa Himayathsagar B.O	500008	B.O	Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Rajendranagar	K.V.

Focus is only on Hyderbad City

In [5]:
```
hyd_data = hyd_data[hyd_data.Borough == "Hyderabad City"]
hyd_data.tail()
```

Out[5]:

	Neighbourhood	pincode	officeType	Deliverystatus	Borough	regionname	circlename	Taluk	Dis
72	Vidhan Sabha S.O (Hyderabad)	500004	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Nampally	
73	Vijay Nagar Colony S.O (Hyderabad)	500057	S.O	Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Asifnagar	
74	Vivekananda Nagar Colony S.O	500018	S.O	Non-Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Balanagar	
75	Wattinagulapalli B.O	500075	B.O	Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Rajendra Nagar	K.V.R
76	Yousufguda S.O	500045	S.O	Delivery	Hyderabad City	Hyderabad City	Andhra Pradesh	Khairatabad	

Join all by Pincode

In [6]:
```
def neighbourhood_list(grouped):
    return ', '.join(sorted(grouped['Neighbourhood'].tolist()))

grp = hyd_data.groupby(['pincode', 'Borough'])
hydcity_hyd_city = grp.apply(neighbourhood_list).reset_index(name = 'Neighbourhood
')
```

Displaying hyderabadcity data

In [ ]:
```
hydcity_hyd_city.head()
```

Out[ ]:

	pincode	Borough	Neighbourhood
0	500001	Hyderabad City	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...
1	500004	Hyderabad City	A.Gs Office S.O, Anandnagar S.O (Hyderabad), B...
2	500006	Hyderabad City	Karwan Sahu S.O, Kulsumpura S.O, Mangalhat S.O
3	500008	Hyderabad City	Appa Himayathsagar B.O, Dargah Hussain Shahwal...
4	500018	Hyderabad City	Bharat Nagar Colony S.O, Erragadda S.O, Fathen...

Getting Coordinates as per pincode

In [8]:
```
def get_latlng(postal_code):
    # initialize your variable to None
    lat_lng_coords = None
    # loop until you get the coordinates
    while(lat_lng_coords is None):
        g = geocoder.arcgis('{}, Hyderabad, TELANGANA'.format(postal_code))
        lat_lng_coords = g.latlng
    return lat_lng_coords

print('done')
```

```
done
```

In [9]:
```
get_latlng('500001')
```

Out[9]:
```
[17.390585000000044, 78.47038817100008]
```

Now appling this functions for all pincode of areas of South Mumbai

In [10]:
```
latitude = []
longitude = []

for row in hydcity_hyd_city['pincode']:
    coordinate = get_latlng(row)
    latitude.append(coordinate[0])
    longitude.append(coordinate[1])

hydcity_hyd_city['latitude'] = latitude
hydcity_hyd_city['longitude'] = longitude
hydcity_hyd_city.head()
```

Out[10]:

	pincode	Borough	Neighbourhood	latitude	longitude
0	500001	Hyderabad City	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	17.390585	78.470388
1	500004	Hyderabad City	A.Gs Office S.O, Anandnagar S.O (Hyderabad), B...	17.403781	78.462525
2	500006	Hyderabad City	Karwan Sahu S.O, Kulsumpura S.O, Mangalhat S.O	17.371224	78.454180
3	500008	Hyderabad City	Appa Himayathsagar B.O, Dargah Hussain Shahwal...	17.396335	78.406792
4	500018	Hyderabad City	Bharat Nagar Colony S.O, Erragadda S.O, Fathen...	17.457435	78.445780

Next, we are going to start utilizing the Foursquare API to explore the South Mumbabi for data collection

In [11]:
```
CLIENT_ID = 'Q5U3IIIC5I51HWBVM3D1S5IG0GNAIPRLPE4R2CKMJGS2NBMD' # your Foursquare ID
CLIENT_SECRET = 'AONPJJBL5CACYQBOHBA3JKVMSSYFEA41VBSXAZHMKPXRX5ST' # your Foursquar
e Secret
VERSION = '20180605' # Foursquare API version

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

```
Your credentails:
CLIENT_ID: Q5U3IIIC5I51HWBVM3D1S5IG0GNAIPRLPE4R2CKMJGS2NBMD
CLIENT_SECRET:AONPJJBL5CACYQBOHBA3JKVMSSYFEA41VBSXAZHMKPXRX5ST
```

In [12]:
```
first_lat = hydcity_hyd_city['latitude'][0]
first_long = hydcity_hyd_city['longitude'][0]
radius = 500
LIMIT = 100

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

Out[12]:
```
'https://api.foursquare.com/v2/venues/explore?&client_id=Q5U3IIIC5I51HWBVM3D1S5I
G0GNAIPRLPE4R2CKMJGS2NBMD&client_secret=AONPJJBL5CACYQBOHBA3JKVMSSYFEA41VBSXAZHM
KPXRX5ST&v=20180605&ll=17.390585000000044,78.47038817100008&radius=500&limit=100
'
```

Getting the results

In [13]:
```
results = requests.get(url).json()
```

In [14]:
```
# function that extracts the category of the venue
def get_category_type(row):
    try:
        categories_list = row['categories']
    except:
        categories_list = row['venue.categories']

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

We are ready to clean the json and structure it into *pandas* data frame

In [15]:
```
venues = results['response']['groups'][0]['items']

nearby_venues = json_normalize(venues) # flatten JSON

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

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

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

nearby_venues.head()
```

Out[15]:

	name	categories	lat	lng
0	Jagdish Market	Mobile Phone Shop	17.391815	78.474880
1	Al-Yousufain Fast Food Center	Fried Chicken Joint	17.391338	78.470147
2	Hotel Royalton	Hotel	17.393211	78.473504
3	Hyderabad Deccan Railway Station	Platform	17.392863	78.467555
4	Hollywood Foot Wear	Shoe Store	17.391627	78.474748

In [16]:
```
print('{} venues were returned by Foursquare.'.format(nearby_venues.shape[0]))
```

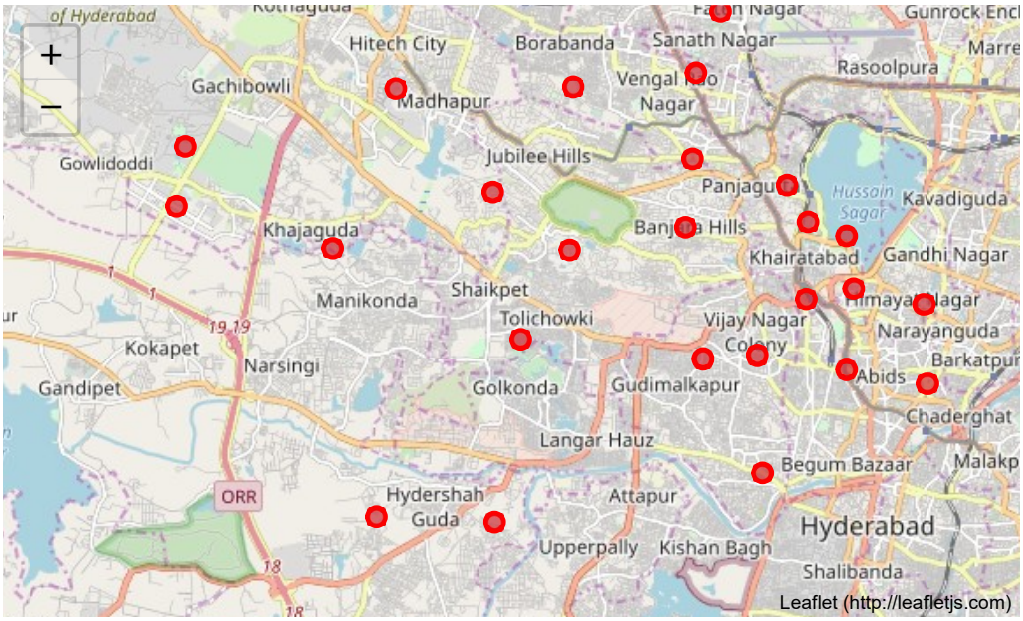
```
7 venues were returned by Foursquare.
```

Methodlogy Selection

Creating a Map

In [17]:
```
address = 'Hyderabad, TELANGANA'

geolocator = Nominatim(user_agent="userid")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude

# create map of South Mumbai using latitude and longitude values
map_hydcity_hyd_city = folium.Map(location=[latitude, longitude], zoom_start=11.5)

# add markers to map
for lat, lng, borough, neighborhood in zip(hydcity_hyd_city['latitude'],hydcity_hyd
_city['longitude'],
hydcity_hyd_city['Borough'], hydcity_hyd_city['Neighbourhood']):
    label = '{}, {}'.format(neighborhood, borough)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='red',
        fill = True,
        fill_color='#cc3139',
        fill_opacity=0.7,
        parse_html=False).add_to(map_hydcity_hyd_city)


map_hydcity_hyd_city
```

Out[17]:



Explore Hyderabad City

In [18]:
```
def getNearbyVenues(names, latitudes, longitudes, radius=500):

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

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

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

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

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

    return(nearby_venues)
```

In [19]:
```
hydcity_venues = getNearbyVenues(names=hydcity_hyd_city['Neighbourhood'],
                                 latitudes=hydcity_hyd_city['latitude'],
                                 longitudes=hydcity_hyd_city['longitude']
                                )
```

```
Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O, Seetharampet S.O, State Bank Of
Hyderabad S.O
A.Gs Office S.O, Anandnagar S.O (Hyderabad), Bazarghat S.O (Hyderabad), Khairata
bad H.O, Parishram Bhawan S.O, Vidhan Sabha S.O (Hyderabad)
Karwan Sahu S.O, Kulsumpura S.O, Mangalhat S.O
Appa Himayathsagar B.O, Dargah Hussain Shahwali B.O, Golconda S.O, Hyder Shah Ko
te B.O, Kakatiya Nagar S.O, Lunger House S.O, Nanakramguda B.O, Sakkubai Nagar
S.O, Toli Chowki S.O
Bharat Nagar Colony S.O, Erragadda S.O, Fathenagar Colony S.O, Moosapet B.O, San
ath Nagar Colony S.O, Sanathnagar I E S.O, Swarajyanagar S.O, Vivekananda Nagar
Colony S.O
Lingampalli S.O
Central Secretariat S.O
Humayunnagar S.O, Murad Nagar S.O (Hyderabad), Shantinagar S.O (Hyderabad)
Gagan Mahal S.O, Himayathnagar S.O, Narayanguda S.O, Ramakrishna Mutt S.O
Ibrahim Bagh Lines S.O
Gachibowli S.O, Manuu S.O
Dr.B R Ambedkar O.U  S.O, Jubilee Hills S.O
Banjara Hills S.O
Sanjeev Reddy Nagar S.O, Vengal Rao Nagar S.O
Raj Bhawan S.O (Hyderabad)
A.Gs. Staff Quarters S.O, Yousufguda S.O
CUC S.O
Vijay Nagar Colony S.O (Hyderabad)
LIC Division S.O, New Mla Quarters S.O
Srinagar Colony S.O
Aziz Nagar B.O, Bhaskar Nagar S.O, C.B.I.T S.O, Gandipet B.O, Himayathnagar B.O,
Janwada B.O, Kokapet B.O, Mancherevula B.O, Narsingi B.O, Wattinagulapalli B.O
Cyberabad S.O, Madhapur B.O
I.M.Colony S.O, Somajiguda S.O
Kondapur B.O, Kothaguda S.O (K.V.Rangareddy)
Manikonda S.O
AP Police Academy PO, Hydershahkote S.O
Putlibowli S.O, State Bank Of India S.O
Film Nagar S.O
```

'Top 5 regions of Hyderabad City with Highest Number of Restaurants'

In [21]:
```
print(hydcity_venues.shape)
hydcity_venues.head()
```

```
(243, 7)
```

Out[21]:

	Neighbourhood	Neighbourhood Latitude	Neighboruhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	17.390585	78.470388	Jagdish Market	17.391815	78.474880	Mobile Phone Shop
1	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	17.390585	78.470388	Al-Yousufain Fast Food Center	17.391338	78.470147	Fried Chicken Joint
2	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	17.390585	78.470388	Hotel Royalton	17.393211	78.473504	Hotel
3	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	17.390585	78.470388	Hyderabad Deccan Railway Station	17.392863	78.467555	Platform
4	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	17.390585	78.470388	Hollywood Foot Wear	17.391627	78.474748	Shoe Store

In [22]:
```
hydcity_venues.groupby('Neighbourhood').count()
```

Out[22]:

Neighbourhood	Neighbourhood Latitude	Neighboruhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
A.Gs Office S.O, Anandnagar S.O (Hyderabad), Bazarghat S.O (Hyderabad), Khairatabad H.O, Parishram Bhawan S.O, Vidhan Sabha S.O (Hyderabad)	15	15	15	15	15	15
A.Gs. Staff Quarters S.O, Yousufguda S.O	2	2	2	2	2	2
Appa Himayathsagar B.O, Dargah Hussain Shahwali B.O, Golconda S.O, Hyder Shah Kote B.O, Kakatiya Nagar S.O, Lunger House S.O, Nanakramguda B.O, Sakkubai Nagar S.O, Toli Chowki S.O	6	6	6	6	6	6
Aziz Nagar B.O, Bhaskar Nagar S.O, C.B.I.T S.O, Gandipet B.O, Himayathnagar B.O, Janwada B.O, Kokapet B.O, Mancherevula B.O, Narsingi B.O, Wattinagulapalli B.O	16	16	16	16	16	16
Banjara Hills S.O	9	9	9	9	9	9
Bharat Nagar Colony S.O, Erragadda S.O, Fathenagar Colony S.O, Moosapet B.O, Sanath Nagar Colony S.O, Sanathnagar I E S.O, Swarajyanagar S.O, Vivekananda Nagar Colony S.O	4	4	4	4	4	4
CUC S.O	2	2	2	2	2	2
Central Secretariat S.O	2	2	2	2	2	2
Cyberabad S.O, Madhapur B.O	36	36	36	36	36	36
Dr.B R Ambedkar O.U S.O, Jubilee Hills S.O	4	4	4	4	4	4
Film Nagar S.O	9	9	9	9	9	9
Gachibowli S.O, Manuu S.O	8	8	8	8	8	8
Gagan Mahal S.O, Himayathnagar S.O, Narayanguda S.O, Ramakrishna Mutt S.O	22	22	22	22	22	22
Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O, Seetharampet S.O, State Bank Of Hyderabad S.O	7	7	7	7	7	7
Humayunnagar S.O, Murad Nagar S.O (Hyderabad), Shantinagar S.O (Hyderabad)	13	13	13	13	13	13
I.M.Colony S.O, Somajiguda S.O	16	16	16	16	16	16
Karwan Sahu S.O, Kulsumpura S.O, Mangalhat S.O	2	2	2	2	2	2
Kondapur B.O, Kothaguda S.O (K.V.Rangareddy)	20	20	20	20	20	20
LIC Division S.O, New Mla Quarters S.O	12	12	12	12	12	12
Lingampalli S.O	4	4	4	4	4	4
Manikonda S.O	3	3	3	3	3	3
Putlibowli S.O, State Bank Of India S.O	6	6	6	6	6	6
Raj Bhawan S.O (Hyderabad)	8	8	8	8	8	8

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

In [23]:
```
print('There are {} uniques categories.'.format(len(hydcity_venues['Venue Category
'].unique())))
```

```
There are 83 uniques categories.
```

Analyze Each Neighborhood

In [24]:
```
# one hot encoding
hydcity_onehot = pd.get_dummies(hydcity_venues[['Venue Category']], prefix="", pref
ix_sep="")

# add neighborhood column back to dataframe
hydcity_onehot['Neighbourhood'] = hydcity_venues['Neighbourhood']

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

hydcity_onehot.head()
```

Out[24]:

	Neighbourhood	ATM	Andhra Restaurant	Arts & Crafts Store	Asian Restaurant	Athletics & Sports	Bakery	Beer Garden	Boutique	Breakfast Spot	Burg Joi
0	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	0	0	0	0	0	0	0	0	0	
1	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	0	0	0	0	0	0	0	0	0	
2	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	0	0	0	0	0	0	0	0	0	
3	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	0	0	0	0	0	0	0	0	0	
4	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	0	0	0	0	0	0	0	0	0	

And let's examine the new dataframe size.

In [25]:
```
hydcity_onehot.shape
```

Out[25]:
```
(243, 84)
```

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

In [26]:
```
hydcity_grouped = hydcity_onehot.groupby('Neighbourhood').mean().reset_index()
hydcity_grouped
```

Out[26]:

	Neighbourhood	ATM	Andhra Restaurant	Arts & Crafts Store	Asian Restaurant	Athletics & Sports	Bakery	Beer Garden	Boutique	Breakfas Spo
0	A.Gs Office S.O, Anandnagar S.O (Hyderabad), B...	0.0	0.000000	0.000000	0.000000	0.000000	0.066667	0.000000	0.000000	0.0
1	A.Gs. Staff Quarters S.O, Yousufguda S.O	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
2	Appa Himayathsagar B.O, Dargah Hussain Shahwal...	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
3	Aziz Nagar B.O, Bhaskar Nagar S.O, C.B.I.T S.O...	0.0	0.000000	0.000000	0.062500	0.000000	0.000000	0.000000	0.000000	0.0
4	Banjara Hills S.O	0.0	0.000000	0.000000	0.000000	0.000000	0.111111	0.000000	0.000000	0.0
5	Bharat Nagar Colony S.O, Erragadda S.O, Fathen...	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
6	CUC S.O	0.5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
7	Central Secretariat S.O	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
8	Cyberabad S.O, Madhapur B.O	0.0	0.027778	0.000000	0.027778	0.000000	0.055556	0.000000	0.000000	0.0
9	Dr.B R Ambedkar O.U S.O, Jubilee Hills S.O	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
10	Film Nagar S.O	0.0	0.000000	0.000000	0.111111	0.111111	0.000000	0.111111	0.000000	0.0
11	Gachibowli S.O, Manuu S.O	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
12	Gagan Mahal S.O, Himayathnagar S.O, Narayangud...	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.045455	0.0
13	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
14	Humayunnagar S.O, Murad Nagar S.O (Hyderabad),...	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
15	I.M.Colony S.O, Somajiguda S.O	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
16	Karwan Sahu S.O, Kulsumpura S.O, Mangalhat S.O	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
17	Kondapur B.O, Kothaguda S.O (K.V.Rangareddy)	0.0	0.050000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0
18	LIC Division S.O, New Mla Quarters S.O	0.0	0.000000	0.083333	0.000000	0.000000	0.000000	0.000000	0.000000	0.0

Let's confirm the new size

In [28]:
```
hydcity_grouped.shape
```

Out[28]: (26, 84)

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

In [29]:
```
num_top_venues = 5

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

----A.Gs Office S.O, Anandnagar S.O (Hyderabad), Bazarghat S.O (Hyderabad), Khairatabad H.O, Parishram Bhawan S.O, Vidhan Sabha S.O (Hyderabad)----

	venue	freq
0	Indian Restaurant	0.13
1	Hotel	0.13
2	Hyderabadi Restaurant	0.13
3	Performing Arts Venue	0.07
4	Paper / Office Supplies Store	0.07

----A.Gs. Staff Quarters S.O, Yousufguda S.O----

	venue	freq
0	Fast Food Restaurant	0.5
1	Sandwich Place	0.5
2	ATM	0.0
3	Middle Eastern Restaurant	0.0
4	Performing Arts Venue	0.0

----Appa Himayathsagar B.O, Dargah Hussain Shahwali B.O, Golconda S.O, Hyder Shah Kote B.O, Kakatiya Nagar S.O, Lunger House S.O, Nanakramguda B.O, Sakkubai Nagar S.O, Toli Chowki S.O----

	venue	freq
0	Women's Store	0.17
1	Café	0.17
2	Historic Site	0.17
3	Golf Course	0.17
4	Indian Restaurant	0.17

----Aziz Nagar B.O, Bhaskar Nagar S.O, C.B.I.T S.O, Gandipet B.O, Himayathnagar B.O, Janwada B.O, Kokapet B.O, Mancherevula B.O, Narsingi B.O, Wattinagulapalli B.O----

	venue	freq
0	Hotel	0.19
1	Coffee Shop	0.12
2	Hotel Pool	0.06
3	Cafeteria	0.06
4	Hotel Bar	0.06

----Banjara Hills S.O----

	venue	freq
0	Coffee Shop	0.44
1	Café	0.11
2	Sandwich Place	0.11
3	Bakery	0.11
4	Deli / Bodega	0.11

----Bharat Nagar Colony S.O, Erragadda S.O, Fathenagar Colony S.O, Moosapet B.O, Sanath Nagar Colony S.O, Sanathnagar I E S.O, Swarajyanagar S.O, Vivekananda Nagar Colony S.O----

	venue	freq
0	Train Station	0.50
1	Department Store	0.25
2	Bus Station	0.25
3	ATM	0.00
4	Middle Eastern Restaurant	0.00

----CUC S.O----

	venue	freq
0	ATM	0.5

Let's put that into a pandas dataframe

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

In [30]:
```
def return_most_common_venues(row, num_top_venues):
    row_categories = row.iloc[1:]
    row_categories_sorted = row_categories.sort_values(ascending=False)

    return row_categories_sorted.index.values[0:num_top_venues]
```

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

In [31]:
```
num_top_venues = 10

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

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

# create a new dataframe
neighbourhoods_venues_sorted = pd.DataFrame(columns=columns)
neighbourhoods_venues_sorted['Neighbourhood'] = hydcity_grouped['Neighbourhood']

for ind in np.arange(hydcity_grouped.shape[0]):
    neighbourhoods_venues_sorted.iloc[ind, 1:] = return_most_common_venues(hydcity_
grouped.iloc[ind, :], num_top_venues)

neighbourhoods_venues_sorted
```

Out[31]:

	Neighbourhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue
0	A.Gs Office S.O, Anandnagar S.O (Hyderabad), B...	Hyderabadi Restaurant	Hotel	Indian Restaurant	Ice Cream Shop	Café	Paper / Office Supplies Store	Middle Eastern Restaurant
1	A.Gs. Staff Quarters S.O, Yousufguda S.O	Fast Food Restaurant	Sandwich Place	Women's Store	Furniture / Home Store	Donut Shop	Electronics Store	Farmers Market
2	Appa Himayathsagar B.O, Dargah Hussain Shahwal...	Women's Store	Café	Hyderabadi Restaurant	Indian Restaurant	Historic Site	Golf Course	Electronics Store
3	Aziz Nagar B.O, Bhaskar Nagar S.O, C.B.I.T S.O...	Hotel	Coffee Shop	Hotel Pool	Indian Restaurant	Restaurant	Sandwich Place	Cafeteria
4	Banjara Hills S.O	Coffee Shop	Deli / Bodega	Café	Hookah Bar	Bakery	Sandwich Place	Electronics Store
5	Bharat Nagar Colony S.O, Erragadda S.O, Fathen...	Train Station	Bus Station	Department Store	Women's Store	Donut Shop	Electronics Store	Farmers Market
6	CUC S.O	ATM	Pizza Place	Hot Dog Joint	Fried Chicken Joint	Dessert Shop	Donut Shop	Electronics Store
7	Central Secretariat S.O	Garden	Chinese Restaurant	Furniture / Home Store	Donut Shop	Electronics Store	Farmers Market	Fast Food Restaurant
8	Cyberabad S.O, Madhapur B.O	Café	Coffee Shop	Indian Restaurant	Hotel	Bakery	Mediterranean Restaurant	Jewelry Store
9	Dr.B R Ambedkar O.U S.O, Jubilee Hills S.O	Women's Store	Food Court	Park	Lake	Gym	Historic Site	Donut Shop
10	Film Nagar S.O	Italian Restaurant	Asian Restaurant	Athletics & Sports	Beer Garden	Coffee Shop	Irish Pub	Mediterranean Restaurant
11	Gachibowli S.O, Manuu S.O	Coffee Shop	Sandwich Place	Cafeteria	College Rec Center	Gym	Café	Women's Store
12	Gagan Mahal S.O, Himayathnagar S.O, Narayangud...	Indian Restaurant	Fast Food Restaurant	Vegetarian / Vegan Restaurant	Café	Restaurant	Hookah Bar	Department Store
13	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	Hotel	Shoe Store	Train Station	Electronics Store	Platform	Mobile Phone Shop	Fried Chicken Joint
14	Humayunnagar S.O, Murad Nagar S.O (Hyderabad),...	Fast Food Restaurant	Indian Restaurant	Hookah Bar	Juice Bar	Pizza Place	Farmers Market	Restaurant
15	I.M.Colony S.O, Somajiguda S.O	Sandwich Place	Hotel	Pizza Place	Coffee Shop	Indian Restaurant	Convenience Store	Donut Shop
16	Karwan Sahu S.O, Kulsumpura S.O, Mangalhat S.O	Women's Store	South Indian Restaurant	Garden	Donut Shop	Electronics Store	Farmers Market	Fast Food Restaurant
	Kondapur B.O,	Indian	Grocery	Department	Ice Cream			Breakfast

Cluster Neighborhoods

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

In [35]:
```
# set number of clusters
kclusters = 5

hydcity_grouped_clustering = hydcity_grouped.drop('Neighbourhood', 1)

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

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

Out[35]:
```
array([3, 0, 3, 3, 1, 3, 3, 4, 3, 3], dtype=int32)
```

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

In [37]:
```
hydcity_merged = hydcity_hyd_city

# add clustering labels
hydcity_merged['Cluster Labels'] = kmeans.labels_[1]

hydcity_merged = hydcity_merged.join(neighbourhoods_venues_sorted.set_index('Neighb
ourhood'), on='Neighbourhood')

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

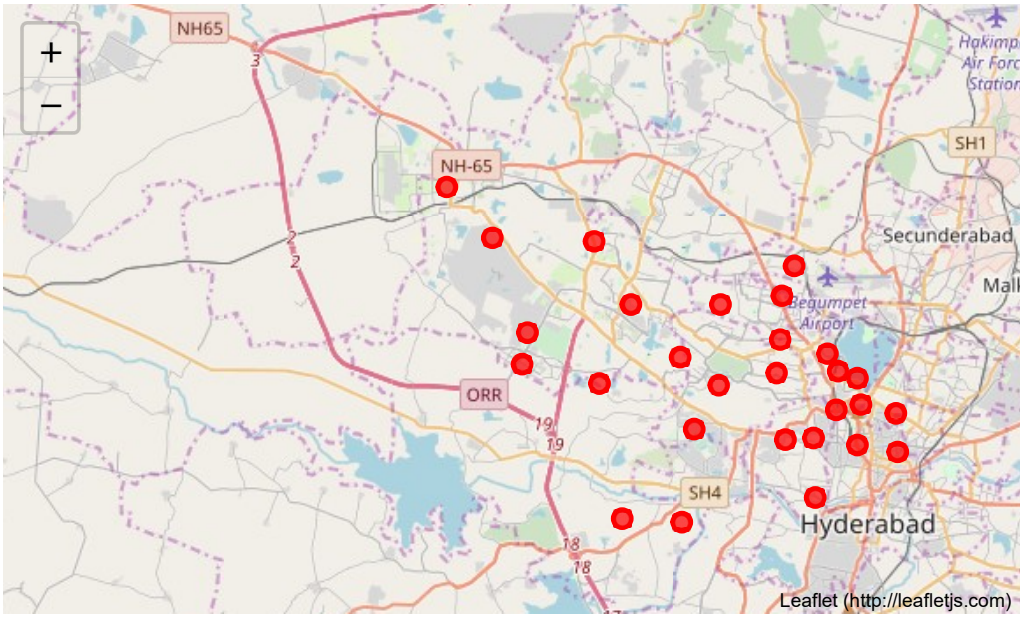
Out[37]:

	pincode	Borough	Neighbourhood	latitude	longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4tl Co
0	500001	Hyderabad City	Gandhi Bhawan S.O (Hyderabad), Moazzampura S.O...	17.390585	78.470388	0	Hotel	Shoe Store	Train Station	Elec
1	500004	Hyderabad City	A.Gs Office S.O, Anandnagar S.O (Hyderabad), B...	17.403781	78.462525	0	Hyderabadi Restaurant	Hotel	Indian Restaurant	Ice
2	500006	Hyderabad City	Karwan Sahu S.O, Kulsumpura S.O, Mangalhat S.O	17.371224	78.454180	0	Women's Store	South Indian Restaurant	Garden	
3	500008	Hyderabad City	Appa Himayathsagar B.O, Dargah Hussain Shahwal...	17.396335	78.406792	0	Women's Store	Café	Hyderabadi Restaurant	Res
4	500018	Hyderabad City	Bharat Nagar Colony S.O, Erragadda S.O, Fathen...	17.457435	78.445780	0	Train Station	Bus Station	Department Store	W

Finally, let's visualize the resulting clusters

In [38]:
```
# create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

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

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

map_clusters
```

Out[38]:



Examine Clusters

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

Cluster 1

In [43]:
```
hydcity_merged.loc[hydcity_merged['Cluster Labels'] == 0, hydcity_merged.columns
[[1] + list(range(5, hydcity_merged.shape[1]))]].head( )
```

Out[43]:

	Borough	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th M Comm Ve
0	Hyderabad City	0	Hotel	Shoe Store	Train Station	Electronics Store	Platform	Mobile Phone Shop	Fried Chicken Joint	D S
1	Hyderabad City	0	Hyderabadi Restaurant	Hotel	Indian Restaurant	Ice Cream Shop	Café	Paper / Office Supplies Store	Middle Eastern Restaurant	Perforr Ve
2	Hyderabad City	0	Women's Store	South Indian Restaurant	Garden	Donut Shop	Electronics Store	Farmers Market	Fast Food Restaurant	F
3	Hyderabad City	0	Women's Store	Café	Hyderabadi Restaurant	Indian Restaurant	Historic Site	Golf Course	Electronics Store	Farr Ma
4	Hyderabad City	0	Train Station	Bus Station	Department Store	Women's Store	Donut Shop	Electronics Store	Farmers Market	Fast F Restau

Conclusion

In majority of part of Hyderabad City "Women's Store" & "Food Court" is the most popular type of service.