

IBM APPLIED DATA SCIENCE CAPSTONE PROJECT

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1. Introduction

1.1 Description of the Problem

The population of London has grown considerably over the last decades. London is very diverse. It represents what is called the reflection of the old British Empire. In London, you can get fresh food supplies from Africa. One begins to wonder how efficient the supply mechanism is.

The real deal is that as much as there are many fine restaurants in London – Asian, Middle Eastern, Latin and American restaurants, you can struggle to find good place to dine in the finest of West African cuisine that has combination of Nigerian, Ghanaian, Cameroonian, Senegalese and more.

Eating in a cosy environment with a blend of multicultural background and finely made West African dishes, on time and on point in a London location accessible to tourists, within central London and not far from the "unofficial" capital african market place - Peckham.

1.2 Discussion of the Background

My client, a successful restaurant chain in Africa is looking to expand operation into Europe through London. They want to create a high-end restaurant that comes with organic mix and healthy. Their target is not only West Africans, but they are pro-organic and healthy eating. To them every meal counts and counts as a royal when you eat.

Since the London demography is so big, my client needs deeper insight from available data in order to decide where to establish the first Europe “palace” restaurant. This company spends a lot on research and provides customers with data insight into the ingredients used at restaurants.

1.3 Target Audience

Considering the diversity of London, there is a high multicultural sense. London is a place where different shades live. As such, in the search for an high-end African-inclined restaurant, there is a high shortage. The target audience is broad, it ranges from Londoners, tourists and those who are passionate about organic food.

2. Data

2.1 Description of Data

This project will rely on public data from Wikipedia and Foursquare.

2.1.1 Dataset 1:

In this project, London will be used as synonymous to the "Greater London Area" in this project. Within the Greater London Area, there are areas that are within the London Area Postcode. The focus of this project will be the neighbourhoods that are within the London Post Code area.

The London Area consists of 32 Boroughs and the "City of London". Our data will be from the link - Greater London Area <https://en.wikipedia.org/wiki/List_of_areas_of_London (https://en.wikipedia.org/wiki/List_of_areas_of_London) >

The web scrapped of the Wikipedia page for the Greater London Area data is provided below:

```
In [124]: # Library for BeautifulSoup
from bs4 import BeautifulSoup

# Library to handle data in a vectorized manner
import numpy as np

# Library for data analysis
import pandas as pd
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)

# Library to handle JSON files
import json
print('numpy, pandas, ..., imported...')

!pip -q install geopy
# conda install -c conda-forge geopy --yes # uncomment this line if you have
#n't completed the Foursquare API Lab
print('geopy installed...')
# convert an address into Latitude and Longitude values
from geopy.geocoders import Nominatim
print('Nominatim imported...')

# Library to handle requests
import requests
print('requests imported...')

# tranform JSON file into a pandas dataframe
from pandas.io.json import json_normalize
print('json_normalize imported...')

# Matplotlib and associated plotting modules
import matplotlib.cm as cm
import matplotlib.colors as colors
print('matplotlib imported...')

# import k-means from clustering stage
from sklearn.cluster import KMeans
print('Kmeans imported...')
# install the Geocoder
!pip -q install geocoder
import geocoder

# import time
import time

# !conda install -c conda-forge folium=0.5.0 --yes # uncomment this line if yo
#u haven't completed the Foursquare API Lab
!pip -q install folium
print('folium installed...')
import folium # map rendering library
print('folium imported...')
print('...Done')
```

```

numpy, pandas, ..., imported...
geopy installed...
Nominatim imported...
requests imported...
json_normalize imported...
matplotlib imported...
Kmeans imported...
folium installed...
folium imported...
...Done

```

```

In [4]: wikipedia_link = 'https://en.wikipedia.org/wiki/List_of_areas_of_London'
headers = {'User-Agent': 'Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:64.0) Gecko/20100101 Firefox/64.0'}
wikipedia_page = requests.get(wikipedia_link, headers = headers)
wikipedia_page

```

Out[4]: <Response [200]>

```

In [5]: # Cleans html file
soup = BeautifulSoup(wikipedia_page.content, 'html.parser')
# This extracts the "tbody" within the table where class is "wikitable sortable"
table = soup.find('table', {'class': 'wikitable sortable'}).tbody

```

```

In [6]: # Extracts all "tr" (table rows) within the table above
rows = table.find_all('tr')

```

```

In [7]: # Extracts the column headers, removes and replaces possible '\n' with space for the "th" tag
columns = [i.text.replace('\n', ' ')
            for i in rows[0].find_all('th')]

```

```

In [8]: # Converts columns to pd dataframe
df = pd.DataFrame(columns = columns)
df

```

Out[8]:

Location	London borough	Post town	Postcode district	Dial code	OS grid ref
----------	----------------	-----------	-------------------	-----------	-------------

```

In [9]: # Extracts every row with corresponding columns
# Then appends the values to the create pd dataframe "df"
# Please note that the first row (row[0]) is skipped because it is already the
header
for i in range(1, len(rows)):
    tds = rows[i].find_all('td')

    if len(tds) == 7:
        values = [tds[0].text, tds[1].text, tds[2].text.replace('\n', '').replace('\xa0', ''), tds[3].text, tds[4].text.replace('\n', '').replace('\xa0', ''),
tds[5].text.replace('\n', '').replace('\xa0', ''), tds[6].text.replace('\n', '').replace('\xa0', '')]
    else:
        values = [td.text.replace('\n', '').replace('\xa0', '') for td in tds]

    df = df.append(pd.Series(values, index = columns), ignore_index = True
)

df

```

```
In [10]: df.head(5)
```

Out[10]:

	Location	London borough	Post town	Postcode district	Dial code	OS grid ref
0	Abbey Wood	Bexley, Greenwich [7]	LONDON	SE2	020	TQ465785
1	Acton	Ealing, Hammersmith and Fulham[8]	LONDON	W3, W4	020	TQ205805
2	Addington	Croydon[8]	CROYDON	CR0	020	TQ375645
3	Addiscombe	Croydon[8]	CROYDON	CR0	020	TQ345665
4	Albany Park	Bexley	BEXLEY, SIDCUP	DA5, DA14	020	TQ478728

```

In [11]: df = df.rename(index=str, columns = {'Location': 'Location', 'London\xa0boroug
h': 'Borough', 'Post town': 'Post-town', 'Postcode\xa0district': 'Postcode',
'Dial\xa0code': 'Dial-code', 'OS grid ref': 'OSGridRef'})

```

In [12]: `df.head(5)`

Out[12]:

	Location	Borough	Post-town	Postcode	Dial-code	OSGridRef
0	Abbey Wood	Bexley, Greenwich [7]	LONDON	SE2	020	TQ465785
1	Acton	Ealing, Hammersmith and Fulham[8]	LONDON	W3, W4	020	TQ205805
2	Addington	Croydon[8]	CROYDON	CR0	020	TQ375645
3	Addiscombe	Croydon[8]	CROYDON	CR0	020	TQ345665
4	Albany Park	Bexley	BEXLEY, SIDCUP	DA5, DA14	020	TQ478728

Looking the data, under the Borough, there are borough names with []. These are references extracted from the wiki page. So remove these, the following was done:

In [13]: `df['Borough'] = df['Borough'].map(lambda x: x.rstrip(']').rstrip('0123456789')).rstrip('[')])`

In [14]: `df.shape`

Out[14]: (533, 6)

In [15]: `df.head(5)`

Out[15]:

	Location	Borough	Post-town	Postcode	Dial-code	OSGridRef
0	Abbey Wood	Bexley, Greenwich	LONDON	SE2	020	TQ465785
1	Acton	Ealing, Hammersmith and Fulham	LONDON	W3, W4	020	TQ205805
2	Addington	Croydon	CROYDON	CR0	020	TQ375645
3	Addiscombe	Croydon	CROYDON	CR0	020	TQ345665
4	Albany Park	Bexley	BEXLEY, SIDCUP	DA5, DA14	020	TQ478728

London is big and due to the limitations in the number of calls for the Foursquare API, the following assumptions are made to confine this project to only South East London.

Assumption 1: Where the Postcode are more than one, (for example, in Acton, there are 2 postcodes - W3 and W4), the postcodes are spread to multi-rows and assigned the same values from the other columns

In [16]: `df0 = df.drop('Postcode', axis=1).join(df['Postcode'].str.split(',', expand=True).stack().reset_index(level=1, drop=True).rename('Postcode'))`

In [17]: `df0.head(5)`

Out[17]:

	Location		Borough	Post-town	Dial-code	OSGridRef	Postcode
0	Abbey Wood		Bexley, Greenwich	LONDON	020	TQ465785	SE2
1	Acton	Ealing, Hammersmith and Fulham		LONDON	020	TQ205805	W3
1	Acton	Ealing, Hammersmith and Fulham		LONDON	020	TQ205805	W4
10	Angel		Islington	LONDON	020	TQ345665	EC1
10	Angel		Islington	LONDON	020	TQ345665	N1

In [18]: `df0.shape`

Out[18]: (637, 6)

As seen above, there are separate rows for Postcodes - W3 and W4; same goes for the others too.

Assumption 2: From the data, only the 'Location', 'Borough', 'Postcode', 'Post-town' will be used for this project. So they are extracted into a new data frame.

In [19]: `df1 = df0[['Location', 'Borough', 'Postcode', 'Post-town']].reset_index(drop=True)`

In [20]: `df1.head(5)`

Out[20]:

	Location		Borough	Postcode	Post-town
0	Abbey Wood		Bexley, Greenwich	SE2	LONDON
1	Acton	Ealing, Hammersmith and Fulham		W3	LONDON
2	Acton	Ealing, Hammersmith and Fulham		W4	LONDON
3	Angel		Islington	EC1	LONDON
4	Angel		Islington	N1	LONDON

In [21]: `df1.shape`

Out[21]: (637, 4)

Assumption 3: Now, only the Boroughs with London Post-town will be used for our search of location. Therefore, all the non-post-town are dropped.

In [22]: `df2 = df1
df21 = df2[df2['Post-town'].str.contains('LONDON')]`

In [23]: `df21.head(5)`

Out[23]:

	Location	Borough	Postcode	Post-town
0	Abbey Wood	Bexley, Greenwich	SE2	LONDON
1	Acton	Ealing, Hammersmith and Fulham	W3	LONDON
2	Acton	Ealing, Hammersmith and Fulham	W4	LONDON
3	Angel	Islington	EC1	LONDON
4	Angel	Islington	N1	LONDON

In [24]: `df21.shape`

Out[24]: (381, 4)

From assumption 3, there are now 381 instances, which is a drop from 637 because of the drop of non-London post-towns.

In [25]: `# Re-assigns the df21 to new dataframe without the Post-town`
`df3 = df21[['Location', 'Borough', 'Postcode']].reset_index(drop=True)`

In [26]: `df3.head(10)`

Out[26]:

	Location	Borough	Postcode
0	Abbey Wood	Bexley, Greenwich	SE2
1	Acton	Ealing, Hammersmith and Fulham	W3
2	Acton	Ealing, Hammersmith and Fulham	W4
3	Angel	Islington	EC1
4	Angel	Islington	N1
5	Church End	Brent	NW10
6	Church End	Barnet	N3
7	Clapham	Lambeth, Wandsworth	SW4
8	Clerkenwell	Islington	EC1
9	Colindale	Barnet	NW9

In [27]: `df_london = df3`
`df_london.to_csv('LondonLocations.csv', index = False)`

Assumption 4: Due to its more diverse outlook, proximity to afro-caribbean markets and accessible facilities, only the South East areas of London will be considered for our analysis. The South East areas has postcodes starting with SE.

So, first, we remove the whitespaces at the start of some of the postcodes and then drop the other non-SE postcodes.

In [28]: `df_london.head(5)`

Out[28]:

	Location		Borough	Postcode
0	Abbey Wood		Bexley, Greenwich	SE2
1	Acton	Ealing, Hammersmith and Fulham		W3
2	Acton	Ealing, Hammersmith and Fulham		W4
3	Angel		Islington	EC1
4	Angel		Islington	N1

In [29]: `df_london.Postcode = df_london.Postcode.str.strip()`

In [30]: `df_london.head(5)`

Out[30]:

	Location		Borough	Postcode
0	Abbey Wood		Bexley, Greenwich	SE2
1	Acton	Ealing, Hammersmith and Fulham		W3
2	Acton	Ealing, Hammersmith and Fulham		W4
3	Angel		Islington	EC1
4	Angel		Islington	N1

In [31]: `# New dataframe for South East London postcodes - df_se`
`df_se = df_london[df_london['Postcode'].str.startswith(('SE'))].reset_index(drop=True)`

In [32]: `df_se.head(10)`

Out[32]:

	Location	Borough	Postcode
0	Abbey Wood	Bexley, Greenwich	SE2
1	Crofton Park	Lewisham	SE4
2	Crossness	Bexley	SE2
3	Crystal Palace	Bromley	SE19
4	Crystal Palace	Bromley	SE20
5	Crystal Palace	Bromley	SE26
6	Denmark Hill	Southwark	SE5
7	Deptford	Lewisham	SE8
8	Dulwich	Southwark	SE21
9	East Dulwich	Southwark	SE22

Now, our data is ready. `df_se` is the data we will focus on.

Assumption 5: This assumption will focus on the demography of London where there are predominantly more multicultural groups. According to the proportion of races by London borough as seen in Demography of London, the top 5 Black Africans or Caribbeans are shown below:

```
In [33]: demograph_link = 'https://en.wikipedia.org/wiki/Demography_of_London'
headers = {'User-Agent': 'Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:64.0) Gecko/20100101 Firefox/64.0'}
demograph_page = requests.get(demograph_link, headers = headers)
soup1 = BeautifulSoup(demograph_page.content, 'html.parser')
table1 = soup1.find('table', {'class': 'wikitable sortable'}).tbody
rows1 = table1.find_all('tr')
columns1 = [i.text.replace('\n', '')
             for i in rows1[0].find_all('th')]
```

In [34]: `columns1`

Out[34]: `['Local authority', 'White', 'Mixed', 'Asian', 'Black', 'Other']`

In [35]: `demo_london = pd.DataFrame(columns = columns1)`

In [36]: `demo_london.head(5)`

Out[36]:

Local authority	White	Mixed	Asian	Black	Other
-----------------	-------	-------	-------	-------	-------

```
In [37]: for j in range(1, len(rows1)):
        tds1 = rows1[j].find_all('td')
        if len(tds1) == 7:
            values1 = [tds1[0].text, tds1[1].text, tds1[2].text.replace('\n', '').replace('\xa0', ''), tds1[3].text, tds1[4].text.replace('\n', '').replace('\xa0', ''), tds1[5].text.replace('\n', '').replace('\xa0', '')]
        else:
            values1 = [td1.text.replace('\n', '').replace('\xa0', '') for td1 in tds1]

        demo_london = demo_london.append(pd.Series(values1, index = columns1), ignore_index = True)

        demo_london
```

```
In [38]: demo_london['Black'] = demo_london['Black'].astype('float')
```

```
In [39]: demo_london_sorted = demo_london.sort_values(by='Black', ascending = False)
```

```
In [40]: demo_london_sorted.head(5)
```

Out[40]:

	Local authority	White	Mixed	Asian	Black	Other
22	Lewisham	53.5	7.4	9.3	27.2	2.6
27	Southwark	54.3	6.2	9.4	26.9	3.3
21	Lambeth	57.1	7.6	6.9	25.9	2.4
11	Hackney	54.7	6.4	10.5	23.1	5.3
7	Croydon	55.1	6.6	16.4	20.2	1.8

Assumption 6: Our next assumption will be based on the top 5 areas will significantly high "Black", "Mixed" and other races. These leaves us with Lewisham, Southwark, Lambeth, Hackney and Croydon.

In [41]: df_se

Out[41]:

	Location	Borough	Postcode
0	Abbey Wood	Bexley, Greenwich	SE2
1	Crofton Park	Lewisham	SE4
2	Crossness	Bexley	SE2
3	Crystal Palace	Bromley	SE19
4	Crystal Palace	Bromley	SE20
5	Crystal Palace	Bromley	SE26
6	Denmark Hill	Southwark	SE5
7	Deptford	Lewisham	SE8
8	Dulwich	Southwark	SE21
9	East Dulwich	Southwark	SE22
10	Elephant and Castle	Southwark	SE1
11	Elephant and Castle	Southwark	SE11
12	Elephant and Castle	Southwark	SE17
13	Eltham	Greenwich	SE9
14	Falconwood	Bexley, Greenwich	SE9
15	Bankside	Southwark	SE1
16	Forest Hill	Lewisham	SE23
17	Gipsy Hill	Lambeth	SE19
18	Gipsy Hill	Lambeth	SE27
19	Greenwich	Greenwich	SE10
20	Grove Park	Lewisham	SE12
21	Herne Hill	Lambeth	SE24
22	Hither Green	Lewisham	SE13
23	Honor Oak	Lewisham	SE23
24	Horn Park	Greenwich, Lewisham	SE12
25	Kennington	Lambeth, Southwark	SE11
26	Kidbrooke	Greenwich	SE3
27	Ladywell	Lewisham	SE4
28	Ladywell	Lewisham	SE13
29	Lambeth	Lambeth	SE1
30	Lee	Lewisham	SE12
31	Lewisham	Lewisham	SE13
32	Beckenham	Bromley	SE20
33	Longlands	Bexley	SE9
34	Maze Hill	Greenwich	SE10

	Location	Borough	Postcode
35	Middle Park	Greenwich	SE9
36	Mottingham	Bromley	SE9
37	New Cross	Lewisham	SE14
38	New Eltham	Greenwich	SE9
39	Newington	Southwark	SE1
40	Newington	Southwark	SE17
41	Nunhead	Southwark	SE15
42	Oval	Lambeth	SE11
43	Bellingham	Lewisham	SE6
44	Peckham	Southwark	SE15
45	Penge	Bromley	SE20
46	Plumstead	Greenwich	SE18
47	Rotherhithe	Southwark	SE16
48	Selhurst	Croydon	SE25
49	Shooter's Hill	Greenwich	SE18
50	Bermondsey	Southwark	SE1
51	South Norwood	Croydon	SE25
52	Southend	Lewisham	SE6
53	St Johns	Lewisham	SE4
54	Bexleyheath (also Bexley New Town)	Bexley	SE2
55	Surrey Quays	Southwark	SE16
56	Sydenham (also Lower Sydenham, Upper Sydenham)	Lewisham, Bromley	SE26
57	Sydenham Hill	Lewisham, Southwark	SE21
58	Sydenham Hill	Lewisham, Southwark	SE26
59	Thamesmead	Bexley, Greenwich	SE28
60	Thamesmead	Bexley, Greenwich	SE2
61	Tulse Hill	Lambeth	SE24
62	Tulse Hill	Lambeth	SE27
63	Upper Norwood	Croydon	SE19
64	Walworth	Southwark	SE17
65	Well Hall	Greenwich	SE9
66	Blackheath	Lewisham	SE3
67	West Heath	Bexley	SE2
68	Blackheath Royal Standard	Greenwich	SE3
69	Blackheath Royal Standard	Greenwich	SE12
70	West Norwood	Lambeth	SE27

	Location	Borough	Postcode
71	Westcombe Park	Greenwich	SE3
72	Woolwich	Greenwich	SE18
73	Brixton	Lambeth	SE5
74	Brockley	Lewisham	SE4
75	Camberwell	Southwark	SE5
76	Catford	Lewisham	SE6
77	Charlton	Greenwich	SE7
78	Anerley	Bromley	SE20
79	Chinbrook	Lewisham	SE12

```
In [42]: df_se_top = df_se[df_se['Borough'].isin(['Lewisham', 'Southwark', 'Lambeth',
'Hackney', 'Croydon'])].reset_index(drop=True)
```

Just to be sure with syntax, Hackney is in North London, so it will not be returned. The resulting dataframe is df_se_top.

```
In [43]: df_se_top.head(5)
```

Out[43]:

	Location	Borough	Postcode
0	Crofton Park	Lewisham	SE4
1	Denmark Hill	Southwark	SE5
2	Deptford	Lewisham	SE8
3	Dulwich	Southwark	SE21
4	East Dulwich	Southwark	SE22

```
In [44]: df_se_top.shape
```

Out[44]: (46, 3)

```
In [45]: df_se.shape
```

Out[45]: (80, 3)

So we have our working dataframe to be df_se_top to work with.

2.1.2 Dataset 2:

In obtaining the location data of the locations, the Geocoder package is used with the `arcgis_geocoder` to obtain the latitude and longitude of the needed locations.

These will help to create a new dataframe that will be used subsequently for the South East London areas.

```
In [46]: # Geocoder starts here
# Defining a function to use --> get_latlng()'''
def get_latlng(arcgis_geocoder):

    # Initialize the Location (lat. and long.) to "None"
    lat_lng_coors = None

    # While loop helps to create a continuous run until all the location coordi
nates are geocoded
    while(lat_lng_coors is None):
        g = geocoder.arcgis('{}, London, United Kingdom'.format(arcgis_geocode
r))
        lat_lng_coors = g.latlng
    return lat_lng_coors
# Geocoder ends here
```

Testing the function above for a sample postcode - SE2.

```
In [47]: sample = get_latlng('SE2')
sample
```

```
Out[47]: [51.492450000000076, 0.12127000000003818]
```

And reverse geocoding this, using the geocodefarm geocoder, gives the following:

```
In [48]: gg = geocoder.geocodefarm(sample, method = 'reverse')
gg
```

```
Out[48]: <[OK] Geocodefarm - Reverse [Harrow Manor Way, London, SE2 9SW, United Kingdo
m]>
```

So, we are certain that the geocoder works fine. So we proceed to applying it to our dataframe `df_se_top`.


```
In [49]: start = time.time()

postal_codes = df_se_top['Postcode']
coordinates = [get_latlng(postal_code) for postal_code in postal_codes.tolist()]

end = time.time()
print("Time of execution: ", end - start, "seconds")
```

Time of execution: 28.8045871257782 seconds

Then we proceed to store the location data - latitude and longitude as follows. The obtained coordinates are then joined to df_se_top to create new data frame.

```
In [50]: df_se_loc = df_se_top

# The obtained coordinates (Latitude and Longitude) are joined with the dataframe as shown
df_se_coordinates = pd.DataFrame(coordinates, columns = ['Latitude', 'Longitude'])
df_se_loc['Latitude'] = df_se_coordinates['Latitude']
df_se_loc['Longitude'] = df_se_coordinates['Longitude']
```

```
In [51]: df_se_loc.head(5)
```

Out[51]:

	Location	Borough	Postcode	Latitude	Longitude
0	Crofton Park	Lewisham	SE4	51.46268	-0.03558
1	Denmark Hill	Southwark	SE5	51.47480	-0.09313
2	Deptford	Lewisham	SE8	51.48114	-0.02467
3	Dulwich	Southwark	SE21	51.44100	-0.08897
4	East Dulwich	Southwark	SE22	51.45256	-0.07076

```
In [52]: df_se_loc.to_csv('SELondonLocationsCoordinates.csv', index = False)
```

```
In [53]: df_se_loc.shape
```

Out[53]: (46, 5)

2.1.3 Dataset 3:

The Foursquare API will be used to obtain the South East London Area venues for the geographical location data . These will be used to explore the neighbourhoods of London accordingly.

The venues within the neighbourhoods of South East London like the areas's restaurants and proximity to amenities would be correlated. Also, accessibility and ease of supplies would be considered as it relates to venues.

To use the Foursquare API, we define the Foursquare Credentials and Version as shown below:

Please note that due to privacy, the personal Foursquare Credential has been stored in a .json <fsquarecredential.json> and called appropriately as shown below:

```
In [54]: import json
filename = 'fsquarecredential.json'
with open(filename) as f:
    data = json.load(f)
```

```
In [55]: CLIENT_ID = 'OKY2Z5WIRS5FZGGRTPNKQZ0YFCCUBQ3CQAFT3FL01NAALY25' # your Foursqua
re ID
CLIENT_SECRET = 'PACBFXAS2V31I5L3YXASC30JKHWHFWMP1LNE44B0IBLTSB2' # your Four
square Secret
VERSION = '20180605' # Foursquare API version
LIMIT = 100 # Limit of number of venues returned by Foursquare API
radius = 800 # define radius
```

3. Methodology

3.1 Data Exploration

3.1.1 Single Neighbourhood

An initial exploration of a single Neighbourhood within the London area was done to examine the Foursquare workability. The Lewisham Borough postcode SE13 and Location - Lewisham is used for this.

```
In [56]: # Resets the current index to a new
se_df = df_se_loc.reset_index().drop('index', axis = 1)
```

```
In [57]: se_df.shape
```

```
Out[57]: (46, 5)
```

In [58]: `se_df`

Out[58]:

	Location	Borough	Postcode	Latitude	Longitude
0	Crofton Park	Lewisham	SE4	51.46268	-0.03558
1	Denmark Hill	Southwark	SE5	51.47480	-0.09313
2	Deptford	Lewisham	SE8	51.48114	-0.02467
3	Dulwich	Southwark	SE21	51.44100	-0.08897
4	East Dulwich	Southwark	SE22	51.45256	-0.07076
5	Elephant and Castle	Southwark	SE1	51.49996	-0.09568
6	Elephant and Castle	Southwark	SE11	51.49084	-0.11108
7	Elephant and Castle	Southwark	SE17	51.48764	-0.09542
8	Bankside	Southwark	SE1	51.49996	-0.09568
9	Forest Hill	Lewisham	SE23	51.44122	-0.04764
10	Gipsy Hill	Lambeth	SE19	51.41990	-0.08808
11	Gipsy Hill	Lambeth	SE27	51.43407	-0.10375
12	Grove Park	Lewisham	SE12	51.44759	0.01350
13	Herne Hill	Lambeth	SE24	51.45529	-0.09928
14	Hither Green	Lewisham	SE13	51.46196	-0.00754
15	Honor Oak	Lewisham	SE23	51.44122	-0.04764
16	Ladywell	Lewisham	SE4	51.46268	-0.03558
17	Ladywell	Lewisham	SE13	51.46196	-0.00754
18	Lambeth	Lambeth	SE1	51.49996	-0.09568
19	Lee	Lewisham	SE12	51.44759	0.01350
20	Lewisham	Lewisham	SE13	51.46196	-0.00754
21	New Cross	Lewisham	SE14	51.47489	-0.04038
22	Newington	Southwark	SE1	51.49996	-0.09568
23	Newington	Southwark	SE17	51.48764	-0.09542
24	Nunhead	Southwark	SE15	51.47218	-0.06779
25	Oval	Lambeth	SE11	51.49084	-0.11108
26	Bellingham	Lewisham	SE6	51.43722	-0.01868
27	Peckham	Southwark	SE15	51.47218	-0.06779
28	Rotherhithe	Southwark	SE16	51.49574	-0.05157
29	Selhurst	Croydon	SE25	51.39925	-0.07414
30	Bermondsey	Southwark	SE1	51.49996	-0.09568
31	South Norwood	Croydon	SE25	51.39925	-0.07414
32	Southend	Lewisham	SE6	51.43722	-0.01868
33	St Johns	Lewisham	SE4	51.46268	-0.03558
34	Surrey Quays	Southwark	SE16	51.49574	-0.05157

	Location	Borough	Postcode	Latitude	Longitude
35	Tulse Hill	Lambeth	SE24	51.45529	-0.09928
36	Tulse Hill	Lambeth	SE27	51.43407	-0.10375
37	Upper Norwood	Croydon	SE19	51.41990	-0.08808
38	Walworth	Southwark	SE17	51.48764	-0.09542
39	Blackheath	Lewisham	SE3	51.47138	0.02338
40	West Norwood	Lambeth	SE27	51.43407	-0.10375
41	Brixton	Lambeth	SE5	51.47480	-0.09313
42	Brockley	Lewisham	SE4	51.46268	-0.03558
43	Camberwell	Southwark	SE5	51.47480	-0.09313
44	Catford	Lewisham	SE6	51.43722	-0.01868
45	Chinbrook	Lewisham	SE12	51.44759	0.01350

In [59]: `se_df.loc[se_df['Location'] == 'Lewisham']`

Out[59]:

	Location	Borough	Postcode	Latitude	Longitude
20	Lewisham	Lewisham	SE13	51.46196	-0.00754

Now, let's use the Lewisham with the index location 20.

In [60]: `se_df.loc[20, 'Location']`

Out[60]: 'Lewisham'

```
In [61]: lewisham_lat = se_df.loc[20, 'Latitude']
lewisham_long = se_df.loc[20, 'Longitude']
lewisham_loc = se_df.loc[20, 'Location']
lewisham_postcode = se_df.loc[20, 'Postcode']

print('The latitude and longitude values of {} with postcode {}, are {}, {}'.format(
    lewisham_loc,
    lewisham_postcode,
    lewisham_lat,
    lewisham_long))
```

The latitude and longitude values of Lewisham with postcode SE13, are 51.46196000000003, -0.00753999999999949032.

Let's explore the top 100 venues that are within a 2000 metres radius of Lewisham.

And then, let's create the GET request URL, and then the url is named.

```
In [62]: # Credentials are provided already for this part
LIMIT = 100 # limit of number of venues returned by Foursquare API
radius = 2000 # define radius
url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&limit={}'.format(
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    lewisham_lat,
    lewisham_long,
    radius,
    LIMIT)

# displays URL
url
```

```
Out[62]: 'https://api.foursquare.com/v2/venues/explore?&client_id=OKY2Z5WIRS5FZGGRTPNK
QZ0YFCCUBQ3CQAFT3FL01NAALY25&client_secret=PACBFXAS2V31I5L3YXASC30JKHWHFWMP1
LNE44B0IBLTSB2&v=20180605&ll=51.46196000000003,-0.00753999999999949032&radius=2
000&limit=100'
```

Then, send the GET request and examine the results.

```
In [63]: results = requests.get(url).json()  
results
```

```

Out[63]: {'meta': {'code': 200, 'requestId': '5e8cbeb2c94979001b95ffec'},
  'response': {'suggestedFilters': {'header': 'Tap to show:',
    'filters': [{'name': 'Open now', 'key': 'openNow'}]},
    'headerLocation': 'Lewisham Central',
    'headerFullLocation': 'Lewisham Central, London',
    'headerLocationGranularity': 'neighborhood',
    'totalResults': 187,
    'suggestedBounds': {'ne': {'lat': 51.47996001800005,
      'lng': 0.021296961190459426},
      'sw': {'lat': 51.44395998200002, 'lng': -0.03637696119035749}},
    'groups': [{'type': 'Recommended Places',
      'name': 'recommended',
      'items': [{'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
          'type': 'general',
          'reasonName': 'globalInteractionReason'}]}],
      'venue': {'id': '535823bc498ec8d8da9aad5f',
        'name': 'Street Feast Model Market',
        'location': {'address': '196 Lewisham High St',
          'crossStreet': 'entrance at Molesworth St',
          'lat': 51.46020945743763,
          'lng': -0.012199022914877357,
          'labeledLatLngs': [{'label': 'display',
            'lat': 51.46020945743763,
            'lng': -0.012199022914877357}]},
        'distance': 377,
        'postalCode': 'SE13 6LS',
        'cc': 'GB',
        'neighborhood': 'Lewisham Central, London, Greater London',
        'city': 'Lewisham Central',
        'state': 'Greater London',
        'country': 'United Kingdom',
        'formattedAddress': ['196 Lewisham High St (entrance at Molesworth S
t)',
      'Lewisham Central',
      'Greater London',
      'SE13 6LS',
      'United Kingdom']},
      'categories': [{'id': '53e0feef498e5aac066fd8a9',
        'name': 'Street Food Gathering',
        'pluralName': 'Street Food Gatherings',
        'shortName': 'Street Food Gathering',
        'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/stre
etfood_',
          'suffix': '.png'},
        'primary': True}],
      'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-535823bc498ec8d8da9aad5f-0'},
    {'reasons': {'count': 0,
      'items': [{'summary': 'This spot is popular',
        'type': 'general',
        'reasonName': 'globalInteractionReason'}]}],
      'venue': {'id': '4bd2b69377b29c7434478f82',
        'name': "Maggie's Kitchen",
        'location': {'address': '320-322 Lewisham Rd.',
          'lat': 51.46537957272932,
          'lng': -0.011213018572287086,

```



```

        'labeledLatLngs': [{ 'label': 'display',
            'lat': 51.46537957272932,
            'lng': -0.011213018572287086}],
        'distance': 458,
        'postalCode': 'SE13 7PA',
        'cc': 'GB',
        'city': 'London',
        'state': 'Greater London',
        'country': 'United Kingdom',
        'formattedAddress': ['320-322 Lewisham Rd.',
            'Lewisham',
            'Greater London',
            'SE13 7PA',
            'United Kingdom']},
        'categories': [{ 'id': '4bf58dd8d48988d16d941735',
            'name': 'Café',
            'pluralName': 'Cafés',
            'shortName': 'Café',
            'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/cafe
_ ',
                'suffix': '.png'},
            'primary': True}],
        'photos': { 'count': 0, 'groups': []}},
        'referralId': 'e-0-4bd2b69377b29c7434478f82-1'},
        { 'reasons': { 'count': 0,
            'items': [{ 'summary': 'This spot is popular',
                'type': 'general',
                'reasonName': 'globalInteractionReason'}]},
            'venue': { 'id': '4b640ce6f964a520ee9c2ae3',
                'name': 'Levante restaurant',
                'location': { 'address': '11 Lewis Grove',
                    'crossStreet': 'Belmont Hill',
                    'lat': 51.46207211451613,
                    'lng': -0.009490926926344812,
                    'labeledLatLngs': [{ 'label': 'display',
                        'lat': 51.46207211451613,
                        'lng': -0.009490926926344812}],
                    'distance': 135,
                    'postalCode': 'SE13 BG',
                    'cc': 'GB',
                    'city': 'London',
                    'state': 'Greater London',
                    'country': 'United Kingdom',
                    'formattedAddress': ['11 Lewis Grove (Belmont Hill)',
                        'Lewisham',
                        'Greater London',
                        'SE13 BG',
                        'United Kingdom']},
                    'categories': [{ 'id': '4bf58dd8d48988d1c4941735',
                        'name': 'Restaurant',
                        'pluralName': 'Restaurants',
                        'shortName': 'Restaurant',
                        'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/defa
ult_',
                            'suffix': '.png'},
                            'primary': True}],
                        'photos': { 'count': 0, 'groups': []}},

```

```

    'referralId': 'e-0-4b640ce6f964a520ee9c2ae3-2'},
    {'reasons': {'count': 0,
      'items': [{ 'summary': 'This spot is popular',
        'type': 'general',
        'reasonName': 'globalInteractionReason' } ]},
    'venue': { 'id': '4d56efce9e508cfa8dee149b',
      'name': 'Levante Pide Restaurant',
      'location': { 'address': '187 Lewisham High St',
        'lat': 51.459848264113056,
        'lng': -0.011476481770328631,
        'labeledLatLngs': [ { 'label': 'display',
          'lat': 51.459848264113056,
          'lng': -0.011476481770328631 } ]},
      'distance': 360,
      'postalCode': 'SE13 6AA',
      'cc': 'GB',
      'neighborhood': 'Lewisham Central',
      'city': 'London',
      'state': 'Greater London',
      'country': 'United Kingdom',
      'formattedAddress': [ '187 Lewisham High St',
        'Lewisham',
        'Greater London',
        'SE13 6AA',
        'United Kingdom' ]},
    'categories': [ { 'id': '4f04af1f2fb6e1c99f3db0bb',
      'name': 'Turkish Restaurant',
      'pluralName': 'Turkish Restaurants',
      'shortName': 'Turkish',
      'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/turk
ish_',
        'suffix': '.png' },
      'primary': True } ]},
    'photos': { 'count': 0, 'groups': [ ] }},
    'referralId': 'e-0-4d56efce9e508cfa8dee149b-3'},
    {'reasons': {'count': 0,
      'items': [{ 'summary': 'This spot is popular',
        'type': 'general',
        'reasonName': 'globalInteractionReason' } ]},
    'venue': { 'id': '512c80cbe4b0a7144ed5dc7a',
      'name': 'Corte',
      'location': { 'address': '189 Lewisham High St',
        'lat': 51.45977605027753,
        'lng': -0.01155377601146681,
        'labeledLatLngs': [ { 'label': 'display',
          'lat': 51.45977605027753,
          'lng': -0.01155377601146681 } ]},
      'distance': 369,
      'postalCode': 'SE13 6AA',
      'cc': 'GB',
      'city': 'London',
      'state': 'Greater London',
      'country': 'United Kingdom',
      'formattedAddress': [ '189 Lewisham High St',
        'Lewisham',
        'Greater London',
        'SE13 6AA',

```

```

    'United Kingdom']},
    'categories': [{ 'id': '4bf58dd8d48988d1e0931735',
        'name': 'Coffee Shop',
        'pluralName': 'Coffee Shops',
        'shortName': 'Coffee Shop',
        'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/coffee_shop_',
            'suffix': '.png'},
        'primary': True}],
    'photos': { 'count': 0, 'groups': []},
    'referralId': 'e-0-512c80cbe4b0a7144ed5dc7a-4'},
    { 'reasons': { 'count': 0,
        'items': [{ 'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason'}]},
    'venue': { 'id': '4b3e9b40f964a520a99f25e3',
        'name': 'Manor House Gardens',
        'location': { 'address': 'Old Rd',
            'crossStreet': 'Aislibie Rd',
            'lat': 51.45668630808165,
            'lng': 0.004684430062631204,
            'labeledLatLngs': [{ 'label': 'display',
                'lat': 51.45668630808165,
                'lng': 0.004684430062631204}],
            'distance': 1031,
            'postalCode': 'S E12',
            'cc': 'GB',
            'neighborhood': 'Lee Green',
            'city': 'London',
            'state': 'Greater London',
            'country': 'United Kingdom',
            'formattedAddress': ['Old Rd (Aislibie Rd)',
                'Lewisham',
                'Greater London',
                'S E12',
                'United Kingdom']},
        'categories': [{ 'id': '4bf58dd8d48988d163941735',
            'name': 'Park',
            'pluralName': 'Parks',
            'shortName': 'Park',
            'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/parks_outdoors/park_',
                'suffix': '.png'},
            'primary': True}],
        'photos': { 'count': 0, 'groups': []},
        'referralId': 'e-0-4b3e9b40f964a520a99f25e3-5'},
        { 'reasons': { 'count': 0,
            'items': [{ 'summary': 'This spot is popular',
                'type': 'general',
                'reasonName': 'globalInteractionReason'}]},
        'venue': { 'id': '4ac518c7f964a52053a520e3',
            'name': 'Dirty South',
            'location': { 'address': '162 Lee High Rd',
                'lat': 51.458846296121216,
                'lng': -0.0026656179995295853,
                'labeledLatLngs': [{ 'label': 'display',
                    'lat': 51.458846296121216,

```

```

    'lng': -0.0026656179995295853}],
    'distance': 484,
    'postalCode': 'SE13 5PR',
    'cc': 'GB',
    'neighborhood': 'Lewisham',
    'city': 'London',
    'state': 'Greater London',
    'country': 'United Kingdom',
    'formattedAddress': ['162 Lee High Rd',
        'Lewisham',
        'Greater London',
        'SE13 5PR',
        'United Kingdom']],
    'categories': [{ 'id': '4bf58dd8d48988d11b941735',
        'name': 'Pub',
        'pluralName': 'Pubs',
        'shortName': 'Pub',
        'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/nightlif
e/pub_',
            'suffix': '.png'},
        'primary': True}],
    'photos': { 'count': 0, 'groups': []}},
    'referralId': 'e-0-4ac518c7f964a52053a520e3-6'},
    { 'reasons': { 'count': 0,
        'items': [{ 'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason'}]},
        'venue': { 'id': '50c5e8e8e4b049cab1a7a58b',
            'name': 'Côte Brasserie',
            'location': { 'address': '15-16 Royal Parade',
                'lat': 51.4673781623608,
                'lng': 0.00717625771325699,
                'labeledLatLngs': [{ 'label': 'display',
                    'lat': 51.4673781623608,
                    'lng': 0.00717625771325699}],
                'distance': 1185,
                'postalCode': 'SE3 0TL',
                'cc': 'GB',
                'city': 'Blackheath',
                'state': 'Greater London',
                'country': 'United Kingdom',
                'formattedAddress': ['15-16 Royal Parade',
                    'Blackheath',
                    'Greater London',
                    'SE3 0TL',
                    'United Kingdom']},
                'categories': [{ 'id': '4bf58dd8d48988d10c941735',
                    'name': 'French Restaurant',
                    'pluralName': 'French Restaurants',
                    'shortName': 'French',
                    'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/fren
ch_',
                        'suffix': '.png'},
                    'primary': True}],
                'photos': { 'count': 0, 'groups': []}},
                'referralId': 'e-0-50c5e8e8e4b049cab1a7a58b-7'},
                { 'reasons': { 'count': 0,

```

```

    'items': [{ 'summary': 'This spot is popular',
                  'type': 'general',
                  'reasonName': 'globalInteractionReason' } ] ],
    'venue': { 'id': '4b52d617f964a520fa8827e3',
                'name': "Blackheath Farmers' Market",
                'location': { 'address': 'Blackheath Village',
                              'lat': 51.46591346191698,
                              'lng': 0.007945118368659382,
                              'labeledLatLngs': [ { 'label': 'display',
                                                       'lat': 51.46591346191698,
                                                       'lng': 0.007945118368659382 } ] ],
                'distance': 1160,
                'cc': 'GB',
                'city': 'Blackheath',
                'state': 'Greater London',
                'country': 'United Kingdom',
                'formattedAddress': [ 'Blackheath Village',
                                      'Blackheath',
                                      'Greater London',
                                      'United Kingdom' ] ],
    'categories': [ { 'id': '4bf58dd8d48988d1fa941735',
                      'name': 'Farmers Market',
                      'pluralName': 'Farmers Markets',
                      'shortName': "Farmer's Market",
                      'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/food_farmersmarket_',
                                'suffix': '.png' },
                      'primary': True } ] ],
    'photos': { 'count': 0, 'groups': [ ] },
    'referralId': 'e-0-4b52d617f964a520fa8827e3-8' },
  { 'reasons': { 'count': 0,
                  'items': [ { 'summary': 'This spot is popular',
                                'type': 'general',
                                'reasonName': 'globalInteractionReason' } ] ],
    'venue': { 'id': '4c66be678e9120a1ecb3d864',
                'name': 'Gennaro Delicatessan',
                'location': { 'address': '23 Lewis Grove',
                              'lat': 51.4617645065367,
                              'lng': -0.009725767238995344,
                              'labeledLatLngs': [ { 'label': 'display',
                                                       'lat': 51.4617645065367,
                                                       'lng': -0.009725767238995344 } ] ],
                'distance': 153,
                'postalCode': 'SE13 6BG',
                'cc': 'GB',
                'city': 'London',
                'state': 'Greater London',
                'country': 'United Kingdom',
                'formattedAddress': [ '23 Lewis Grove',
                                      'Lewisham',
                                      'Greater London',
                                      'SE13 6BG',
                                      'United Kingdom' ] ],
    'categories': [ { 'id': '4bf58dd8d48988d146941735',
                      'name': 'Deli / Bodega',
                      'pluralName': 'Delis / Bodegas',
                      'shortName': 'Deli / Bodega',

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```

      'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/deli
    - ',
      'suffix': '.png'},
      'primary': True}},
      'photos': {'count': 0, 'groups': []}},
      'referralId': 'e-0-4c66be678e9120a1ecb3d864-9'},
      {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
          'type': 'general',
          'reasonName': 'globalInteractionReason'}]},
        'venue': {'id': '4bc5c1334a9aa5939cd8067b',
          'name': 'The Sausage Man',
          'location': {'address': '90-98 Lewisham High St',
            'lat': 51.46250733182629,
            'lng': -0.01024845973388549,
            'labeledLatLngs': [{'label': 'display',
              'lat': 51.46250733182629,
              'lng': -0.01024845973388549}]},
            'distance': 197,
            'postalCode': 'SE1 3 6',
            'cc': 'GB',
            'neighborhood': 'Lewisham Central',
            'city': 'London',
            'state': 'Greater London',
            'country': 'United Kingdom',
            'formattedAddress': ['90-98 Lewisham High St',
              'Lewisham',
              'Greater London',
              'SE1 3 6',
              'United Kingdom']},
            'categories': [{'id': '4bf58dd8d48988d1cb941735',
              'name': 'Food Truck',
              'pluralName': 'Food Trucks',
              'shortName': 'Food Truck',
              'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/stre
etfood_',
                'suffix': '.png'},
                'primary': True}},
                'photos': {'count': 0, 'groups': []}},
                'referralId': 'e-0-4bc5c1334a9aa5939cd8067b-10'},
                {'reasons': {'count': 0,
                  'items': [{'summary': 'This spot is popular',
                    'type': 'general',
                    'reasonName': 'globalInteractionReason'}]},
                    'venue': {'id': '4afd75a5f964a520f42722e3',
                      'name': 'Hilly Fields',
                      'location': {'address': 'Adelaide Ave',
                        'crossStreet': 'Montague Ave',
                        'lat': 51.46001017998527,
                        'lng': -0.025599002838134766,
                        'labeledLatLngs': [{'label': 'display',
                          'lat': 51.46001017998527,
                          'lng': -0.025599002838134766}]},
                        'distance': 1271,
                        'postalCode': 'SE13 7JL',
                        'cc': 'GB',
                        'city': 'London',

```

```

    'state': 'Greater London',
    'country': 'United Kingdom',
    'formattedAddress': ['Adelaide Ave (Montague Ave)',
    'London',
    'Greater London',
    'SE13 7JL',
    'United Kingdom']},
    'categories': [{ 'id': '4bf58dd8d48988d163941735',
    'name': 'Park',
    'pluralName': 'Parks',
    'shortName': 'Park',
    'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/parks_out
doors/park_',
    'suffix': '.png'},
    'primary': True}],
    'photos': { 'count': 0, 'groups': []}},
    'referralId': 'e-0-4afd75a5f964a520f42722e3-11'},
    { 'reasons': { 'count': 0,
    'items': [{ 'summary': 'This spot is popular',
    'type': 'general',
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'United Kingdom']},
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ault_',

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        'United Kingdom']},
        'categories': [{'id': '52e81612bcbc57f1066b79fb',
        'name': 'Himalayan Restaurant',
        'pluralName': 'Himalayan Restaurants',
        'shortName': 'Himalayan',
        'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/defa
ult_',
        'suffix': '.png'},
        'primary': True]],
        'photos': {'count': 0, 'groups': []}},
        'referralId': 'e-0-4e272727d4c007d41a99e3bf-99'}}]]]]}

```

From the results, the necessary information needs to be obtained from items key. To do this, the `get_category_type` function is used from the Foursquare lab.

```

In [64]: # 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']

```

The result is then cleaned up from json to a structured pandas dataframe as shown below:

```
In [65]: 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]
```

In [66]: nearby_venues

Out[66]:

	name	categories	lat	lng
0	Street Feast Model Market	Street Food Gathering	51.460209	-0.012199
1	Maggie's Kitchen	Café	51.465380	-0.011213
2	Levante restaurant	Restaurant	51.462072	-0.009491
3	Levante Pide Restaurant	Turkish Restaurant	51.459848	-0.011476
4	Corte	Coffee Shop	51.459776	-0.011554
5	Manor House Gardens	Park	51.456686	0.004684
6	Dirty South	Pub	51.458846	-0.002666
7	Côte Brasserie	French Restaurant	51.467378	0.007176
8	Blackheath Farmers' Market	Farmers Market	51.465913	0.007945
9	Gennaro Delicatessan	Deli / Bodega	51.461765	-0.009726
10	The Sausage Man	Food Truck	51.462507	-0.010248
11	Hilly Fields	Park	51.460010	-0.025599
12	Buenos Aires Cafe	Argentinian Restaurant	51.467260	0.007083
13	Cafe Oscar's	Coffee Shop	51.456432	-0.020194
14	Brockley Market	Farmers Market	51.467980	-0.024795
15	Le Bouchon Wine Bar	Wine Bar	51.467004	0.007067
16	Everest Curry King	Sri Lankan Restaurant	51.466012	-0.019656
17	Spit And Roast	Food Truck	51.466138	-0.019618
18	Pistachios In The Park	Café	51.460144	-0.024263
19	Ladywell Fields	Park	51.453579	-0.020084
20	Ladywell Tavern	Pub	51.456485	-0.021502
21	Blackheath Common	Park	51.472322	0.007381
22	Dark Fluid	Food Truck	51.467981	-0.024662
23	GAIL's Bakery	Bakery	51.465696	0.009166
24	The Brookmill	Pub	51.470849	-0.021869
25	Asda	Supermarket	51.465088	-0.016627
26	Suttons Radio	Pub	51.461011	-0.010554
27	Meze Mangal	Turkish Restaurant	51.469493	-0.027656
28	The Spice Of Life	Indian Restaurant	51.458654	0.002613
29	Golden Chippy	Fish & Chips Shop	51.475992	-0.018595
30	Greenwich Park	Park	51.477521	0.000858
31	The Point Greenwich	Scenic Lookout	51.473202	-0.009293
32	Sparrow	Restaurant	51.463487	-0.011139
33	Peter Harrison Planetarium	Planetarium	51.477115	-0.000754
34	Friendly Place	Speakeasy	51.472374	-0.015076

	name	categories	lat	lng
35	Greenwich Meridian	Historic Site	51.477915	-0.001529
36	Budget Gym Lewisham	Gym	51.462687	-0.009891
37	The Station Hotel	Gastropub	51.453080	-0.000358
38	Greenwich Park Flower Garden	Garden	51.475983	0.005271
39	The Greenwich Union	Pub	51.476587	-0.009842
40	Brockley's Rock	Fish & Chips Shop	51.459457	-0.033868
41	Full Nelson	Vegetarian / Vegan Restaurant	51.474699	-0.025303
42	Royal Teas	Café	51.476074	-0.009884
43	Old Royal Observatory Garden	Garden	51.477591	-0.001550
44	Royal Observatory	Observatory	51.477322	-0.000869
45	Greenwich Park Rose Garden	Garden	51.473685	-0.001137
46	Quaggy Café	Café	51.471535	-0.014752
47	The Wilderness Deer Park	Zoo Exhibit	51.475637	0.007237
48	Greenwich Picturehouse	Indie Movie Theater	51.479619	-0.009778
49	London Velo	Coffee Shop	51.475413	-0.026005
50	Heap's Sausages	Café	51.479516	-0.007875
51	Enish Restaurant + Grill	African Restaurant	51.459036	-0.012386
52	Something Fishy	Fish & Chips Shop	51.461697	-0.010277
53	Hand Made Food	Café	51.466488	0.008229
54	The Fox and Firkin	Pub	51.456780	-0.014161
55	Princess of Wales	Pub	51.469334	0.010360
56	McDonald's	Fast Food Restaurant	51.460508	-0.011228
57	Zerodegrees	Bar	51.467417	0.008440
58	The Orchard	Gastropub	51.463678	-0.035699
59	Greenwich Theatre	Theater	51.479531	-0.007637
60	Richard the First	Pub	51.476614	-0.009756
61	Oliver's Jazz & Piano Bar	Jazz Club	51.479458	-0.008096
62	The Birds Nest	Pub	51.476203	-0.022738
63	Panda Panda	Sandwich Place	51.474800	-0.025123
64	The Gym Group	Gym	51.466384	-0.016964
65	Le Délice	Bakery	51.456610	-0.019732
66	The Creaky Shed	Grocery Store	51.477436	-0.009823
67	Deptford Cinema	Indie Movie Theater	51.474683	-0.024053
68	Aldi	Supermarket	51.448675	-0.017781
69	You Don't Bring Me Flowers	Flower Shop	51.453017	-0.000687
70	The Dacre Arms	Pub	51.461075	0.003312

	name	categories	lat	lng
71	The Ivy Cafe	Restaurant	51.467600	0.008155
72	TK Maxx	Clothing Store	51.461017	-0.010850
73	The Lord Northbrook	Pub	51.450906	0.012225
74	Flying Tiger	Gift Shop	51.462198	-0.011849
75	Pets at Home	Pet Store	51.472462	-0.016981
76	The Prince of Greenwich	Pub	51.476195	-0.009947
77	PureGym	Gym / Fitness Center	51.476181	-0.018384
78	Cheeseboard	Cheese Shop	51.477360	-0.009728
79	H&M	Clothing Store	51.461367	-0.011812
80	DoubleTree by Hilton	Hotel	51.474425	-0.019505
81	The Hare & Billet	Gastropub	51.468117	0.003667
82	The Gantry	Gastropub	51.463597	-0.036127
83	Brockley Brewery (The Brockley Brewing Company)	Brewery	51.462265	-0.036132
84	Greenwich Picturehouse Bar	Bar	51.479523	-0.009860
85	Rivington Greenwich	Gastropub	51.479318	-0.009925
86	Luciano's	Italian Restaurant	51.450567	0.012553
87	The Talbot	Gastropub	51.467257	-0.023487
88	Greenwich Park Herb Garden	Garden	51.479539	-0.006233
89	Kitcho	Japanese Restaurant	51.475899	-0.018861
90	Guildford Arms	Pub	51.474406	-0.014961
91	Archery Fit	Athletics & Sports	51.476373	-0.019819
92	OneSE8 Gym	Gym / Fitness Center	51.472866	-0.021289
93	Carola	Italian Restaurant	51.456741	0.011377
94	Blackheath Tea Hut	Breakfast Spot	51.471802	-0.000100
95	Montpeliers	Café	51.467508	0.008477
96	Muffin Break	Café	51.461794	-0.012106
97	Staycity Aparthotels Deptford Bridge Station	Hotel	51.474259	-0.023102
98	The Junk Shop	Thrift / Vintage Store	51.477712	-0.012022
99	Everest Inn Gurkha's Restaurant	Himalayan Restaurant	51.467654	0.008438

```
In [67]: nearby_venues_lewisham_unique = nearby_venues['categories'].value_counts().to_
         frame(name='Count')
```

```
In [68]: nearby_venues_lewisham_unique.head(5)
```

Out[68]:

	Count
Pub	13
Café	8
Gastropub	6
Park	5
Garden	4

Interestingly, even though there are restaurants in the Lewisham area, they are not even in the top 5 venues. It should be noted that since we are limited by data availability, our perspectives will be on what we have.

```
In [69]: print('{} venues were returned by Foursquare.'.format(nearby_venues.shape[0]))
100 venues were returned by Foursquare.
```

So in this case, 100 venues were returned for Lewisham.

3.1.2 Multiple Neighbourhoods

Now let's explore (Multiple) Neighborhoods in the South East London area.

To do this, the function `getNearbyVenues` is used and it's created to repeat the same process for all neighborhoods.

```

In [70]: def getNearbyVenues(names, latitudes, longitudes, radius=2000):

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

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

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

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

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

    return(nearby_venues)

```

The created function - getNearbyVenues is then used on each neighbourhoods. And creates a new dataframe called london_venues.


```
In [71]: se_venues = getNearbyVenues(names=se_df['Location'],  
                                     latitudes=se_df['Latitude'],  
                                     longitudes=se_df['Longitude']  
                                     )
```

Crofton Park
Denmark Hill
Deptford
Dulwich
East Dulwich
Elephant and Castle
Elephant and Castle
Elephant and Castle
Bankside
Forest Hill
Gipsy Hill
Gipsy Hill
Grove Park
Herne Hill
Hither Green
Honor Oak
Ladywell
Ladywell
Lambeth
Lee
Lewisham
New Cross
Newington
Newington
Nunhead
Oval
Bellingham
Peckham
Rotherhithe
Selhurst
Bermondsey
South Norwood
Southend
St Johns
Surrey Quays
Tulse Hill
Tulse Hill
Upper Norwood
Walworth
Blackheath
West Norwood
Brixton
Brockley
Camberwell
Catford
Chinbrook

```
In [72]: se_venues.shape
```

```
Out[72]: (4253, 7)
```

In [73]: `len(se_venues)`

Out[73]: 4253

In [74]: `se_venues['Neighbourhood'].value_counts()
se_venues.to_csv('se_venues.csv')`

In [75]: `se_venues.head(5)`

Out[75]:

	Neighbourhood	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Latitude	Venue Longitude	Ve Categ
0	Crofton Park	51.46268	-0.03558	The Orchard	51.463678	-0.035699	Gastro
1	Crofton Park	51.46268	-0.03558	Brockley's Rock	51.459457	-0.033868	Fis Cr Sl
2	Crofton Park	51.46268	-0.03558	Browns Of Brockley	51.464513	-0.037346	Co Sl
3	Crofton Park	51.46268	-0.03558	Waterintobeer	51.463712	-0.038826	Beer Sl
4	Crofton Park	51.46268	-0.03558	Saka Maka	51.464826	-0.036437	Inc Restau

The number of venues returned for each neighbourhoods is then explored as follows:

```
In [76]: se_venues.groupby('Neighbourhood').count()
```

Out[76]:

	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Neighbourhood						
Bankside	100	100	100	100	100	100
Bellingham	72	72	72	72	72	72
Bermondsey	100	100	100	100	100	100
Blackheath	93	93	93	93	93	93
Brixton	100	100	100	100	100	100
Brockley	100	100	100	100	100	100
Camberwell	100	100	100	100	100	100
Catford	72	72	72	72	72	72
Chinbrook	55	55	55	55	55	55
Crofton Park	100	100	100	100	100	100
Denmark Hill	100	100	100	100	100	100
Deptford	100	100	100	100	100	100
Dulwich	100	100	100	100	100	100
East Dulwich	69	69	69	69	69	69
Elephant and Castle	300	300	300	300	300	300
Forest Hill	100	100	100	100	100	100
Gipsy Hill	200	200	200	200	200	200
Grove Park	55	55	55	55	55	55
Herne Hill	100	100	100	100	100	100
Hither Green	100	100	100	100	100	100
Honor Oak	100	100	100	100	100	100
Ladywell	200	200	200	200	200	200
Lambeth	100	100	100	100	100	100
Lee	55	55	55	55	55	55
Lewisham	100	100	100	100	100	100
New Cross	100	100	100	100	100	100
Newington	200	200	200	200	200	200
Nunhead	100	100	100	100	100	100
Oval	100	100	100	100	100	100
Peckham	100	100	100	100	100	100
Rotherhithe	100	100	100	100	100	100
Selhurst	55	55	55	55	55	55
South Norwood	55	55	55	55	55	55

	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Neighbourhood						
Southend	72	72	72	72	72	72
St Johns	100	100	100	100	100	100
Surrey Quays	100	100	100	100	100	100
Tulse Hill	200	200	200	200	200	200
Upper Norwood	100	100	100	100	100	100
Walworth	100	100	100	100	100	100
West Norwood	100	100	100	100	100	100

The next step is to check how many unique categories can be returned for the venues. See as follows:

```
In [77]: print('There are {} uniques categories.'.format(len(se_venues['Venue Category'].unique())))
```

There are 198 uniques categories.

```
In [78]: se_venue_unique_count = se_venues['Venue Category'].value_counts().to_frame(name='Count')
```

```
In [79]: se_venue_unique_count.head(5)
```

Out[79]:

	Count
Pub	420
Coffee Shop	310
Café	271
Park	208
Grocery Store	164

```
In [80]: se_venue_unique_count.describe()
```

Out[80]:

	Count
count	198.000000
mean	21.479798
std	47.645978
min	1.000000
25%	4.000000
50%	8.000000
75%	17.750000
max	420.000000

3.2 Clustering

For this section, the neighbourhoods in South East London will be clustered based on the processed data obtained above.

3.2.1 Libraries

To get started, all the necessary libraries have been called in the libraries section above.

3.2.2 Map Visualization

Using the geopy library, the latitude and longitude values of London is obtained.

```
In [81]: address = 'London, United Kingdom'

geolocator = Nominatim(user_agent="ln_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geograpical coordinate of London are {}, {}'.format(latitude, longitude))
```

The geograpical coordinate of London are 51.5073219, -0.1276474.

The folium library is then used to obtain the coordinates

```
In [82]: # df_London_coordinates  
map_london = folium.Map(location = [latitude, longitude], zoom_start = 12)  
map_london
```

Out[82]:



The South East London neighbourhoods are then superimposed on top as shown below, still using the foliumlibrary. Please note due to the location of the South East Loondon, you might need to zoom to see the superimposed areas

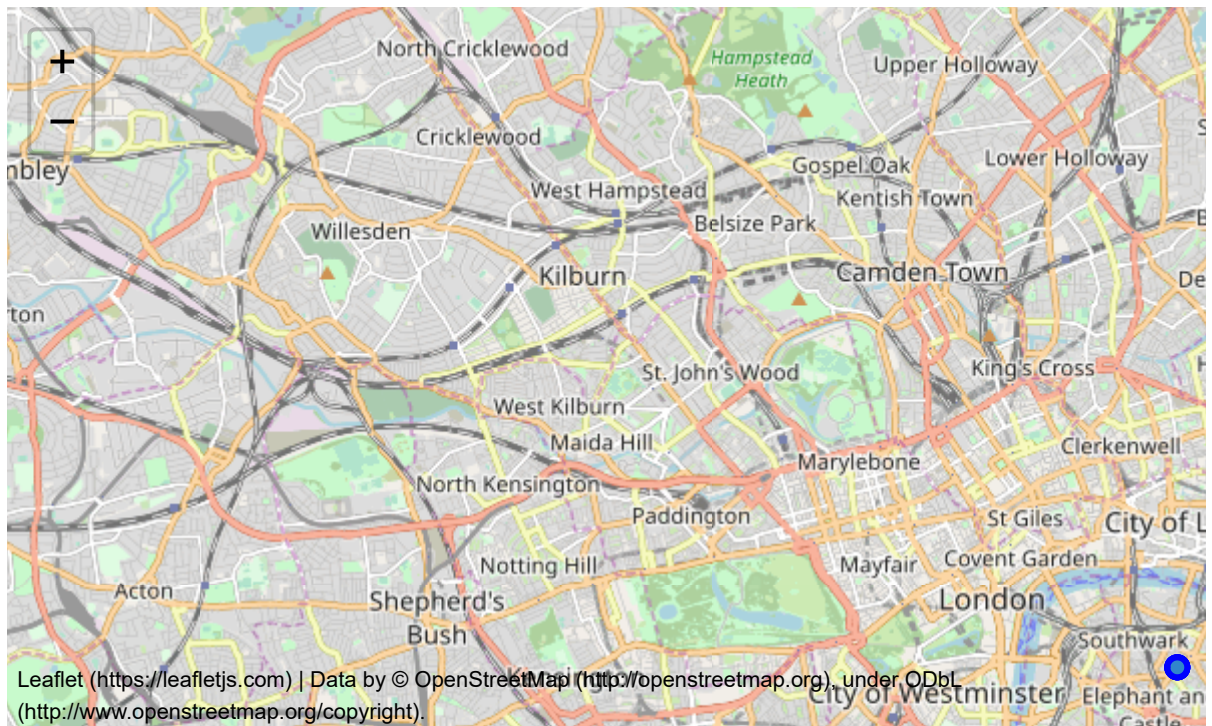

```

In [83]: # Adding markers to map
for lat, lng, borough, loc in zip(se_df['Latitude'],
                                  se_df['Longitude'],
                                  se_df['Borough'],
                                  se_df['Location']):

    label = '{} - {}'.format(loc, borough)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7).add_to(map_london)

display(map_london)

```



```

In [84]: type(se_df)

```

```

Out[84]: pandas.core.frame.DataFrame

```

3.2.3 Analysing Each Neighborhood

In this section, the objective is to check and explore the venues in each neighbourhood.

One Hot Encoding


```
In [85]: # one hot encoding
se_onehot = pd.get_dummies(se_venues[['Venue Category']], prefix = "", prefix_sep = "")
```

Then the Neighbourhood column is added back to the dataframe.

```
In [86]: # add neighborhood column back to dataframe
se_onehot['Neighbourhood'] = se_venues['Neighbourhood']
```

Some re-arrangement - move the new Neighbourhood column to the first column.

```
In [87]: # move neighborhood column to the first column
fixed_columns = [se_onehot.columns[-1]] + list(se_onehot.columns[:-1])
se_onehot = se_onehot[fixed_columns]
```

Therefore, the new one hot encoded dataframe is:

```
In [88]: se_onehot.head(5)
```

Out[88]:

	Neighbourhood	African Restaurant	American Restaurant	Antique Shop	Aquarium	Argentinian Restaurant	Art Gallery	Art Museum	C S
0	Crofton Park	0	0	0	0	0	0	0	
1	Crofton Park	0	0	0	0	0	0	0	
2	Crofton Park	0	0	0	0	0	0	0	
3	Crofton Park	0	0	0	0	0	0	0	
4	Crofton Park	0	0	0	0	0	0	0	

In [89]: `se_onehot.loc[se_onehot['African Restaurant'] != 0]`

Out[89]:

	Neighbourhood	African Restaurant	American Restaurant	Antique Shop	Aquarium	Argentinian Restaurant	Art Gallery	Art Museum
137	Denmark Hill	1	0	0	0	0	0	0
636	Elephant and Castle	1	0	0	0	0	0	0
714	Elephant and Castle	1	0	0	0	0	0	0
1012	Gipsy Hill	1	0	0	0	0	0	0
1375	Hither Green	1	0	0	0	0	0	0
1675	Ladywell	1	0	0	0	0	0	0
1930	Lewisham	1	0	0	0	0	0	0
2021	New Cross	1	0	0	0	0	0	0
2055	New Cross	1	0	0	0	0	0	0
2224	Newington	1	0	0	0	0	0	0
2311	Nunhead	1	0	0	0	0	0	0
2367	Nunhead	1	0	0	0	0	0	0
2446	Oval	1	0	0	0	0	0	0
2583	Peckham	1	0	0	0	0	0	0
2639	Peckham	1	0	0	0	0	0	0
2758	Selhurst	1	0	0	0	0	0	0
2913	South Norwood	1	0	0	0	0	0	0
3476	Upper Norwood	1	0	0	0	0	0	0
3578	Walworth	1	0	0	0	0	0	0
3863	Brixton	1	0	0	0	0	0	0
4063	Camberwell	1	0	0	0	0	0	0

```
In [90]: se_onehot.loc[se_onehot['Neighbourhood'] == 'Lewisham']
```

Out[90]:

	Neighbourhood	African Restaurant	American Restaurant	Antique Shop	Aquarium	Argentinian Restaurant	Art Gallery	Art Museum
1879	Lewisham	0	0	0	0	0	0	0
1880	Lewisham	0	0	0	0	0	0	0
1881	Lewisham	0	0	0	0	0	0	0
1882	Lewisham	0	0	0	0	0	0	0
1883	Lewisham	0	0	0	0	0	0	0
1884	Lewisham	0	0	0	0	0	0	0
1885	Lewisham	0	0	0	0	0	0	0
1886	Lewisham	0	0	0	0	0	0	0
1887	Lewisham	0	0	0	0	0	0	0
1888	Lewisham	0	0	0	0	0	0	0
1889	Lewisham	0	0	0	0	0	0	0
1890	Lewisham	0	0	0	0	0	0	0
1891	Lewisham	0	0	0	0	1	0	0
1892	Lewisham	0	0	0	0	0	0	0
1893	Lewisham	0	0	0	0	0	0	0
1894	Lewisham	0	0	0	0	0	0	0
1895	Lewisham	0	0	0	0	0	0	0
1896	Lewisham	0	0	0	0	0	0	0
1897	Lewisham	0	0	0	0	0	0	0
1898	Lewisham	0	0	0	0	0	0	0
1899	Lewisham	0	0	0	0	0	0	0
1900	Lewisham	0	0	0	0	0	0	0
1901	Lewisham	0	0	0	0	0	0	0
1902	Lewisham	0	0	0	0	0	0	0
1903	Lewisham	0	0	0	0	0	0	0
1904	Lewisham	0	0	0	0	0	0	0
1905	Lewisham	0	0	0	0	0	0	0
1906	Lewisham	0	0	0	0	0	0	0
1907	Lewisham	0	0	0	0	0	0	0
1908	Lewisham	0	0	0	0	0	0	0
1909	Lewisham	0	0	0	0	0	0	0
1910	Lewisham	0	0	0	0	0	0	0
1911	Lewisham	0	0	0	0	0	0	0
1912	Lewisham	0	0	0	0	0	0	0

	Neighbourhood	African Restaurant	American Restaurant	Antique Shop	Aquarium	Argentinian Restaurant	Art Gallery	Art Museum
1913	Lewisham	0	0	0	0	0	0	0
1914	Lewisham	0	0	0	0	0	0	0
1915	Lewisham	0	0	0	0	0	0	0
1916	Lewisham	0	0	0	0	0	0	0
1917	Lewisham	0	0	0	0	0	0	0
1918	Lewisham	0	0	0	0	0	0	0
1919	Lewisham	0	0	0	0	0	0	0
1920	Lewisham	0	0	0	0	0	0	0
1921	Lewisham	0	0	0	0	0	0	0
1922	Lewisham	0	0	0	0	0	0	0
1923	Lewisham	0	0	0	0	0	0	0
1924	Lewisham	0	0	0	0	0	0	0
1925	Lewisham	0	0	0	0	0	0	0
1926	Lewisham	0	0	0	0	0	0	0
1927	Lewisham	0	0	0	0	0	0	0
1928	Lewisham	0	0	0	0	0	0	0
1929	Lewisham	0	0	0	0	0	0	0
1930	Lewisham	1	0	0	0	0	0	0
1931	Lewisham	0	0	0	0	0	0	0
1932	Lewisham	0	0	0	0	0	0	0
1933	Lewisham	0	0	0	0	0	0	0
1934	Lewisham	0	0	0	0	0	0	0
1935	Lewisham	0	0	0	0	0	0	0
1936	Lewisham	0	0	0	0	0	0	0
1937	Lewisham	0	0	0	0	0	0	0
1938	Lewisham	0	0	0	0	0	0	0
1939	Lewisham	0	0	0	0	0	0	0
1940	Lewisham	0	0	0	0	0	0	0
1941	Lewisham	0	0	0	0	0	0	0
1942	Lewisham	0	0	0	0	0	0	0
1943	Lewisham	0	0	0	0	0	0	0
1944	Lewisham	0	0	0	0	0	0	0
1945	Lewisham	0	0	0	0	0	0	0
1946	Lewisham	0	0	0	0	0	0	0
1947	Lewisham	0	0	0	0	0	0	0

	Neighbourhood	African Restaurant	American Restaurant	Antique Shop	Aquarium	Argentinian Restaurant	Art Gallery	Art Museum
1948	Lewisham	0	0	0	0	0	0	0
1949	Lewisham	0	0	0	0	0	0	0
1950	Lewisham	0	0	0	0	0	0	0
1951	Lewisham	0	0	0	0	0	0	0
1952	Lewisham	0	0	0	0	0	0	0
1953	Lewisham	0	0	0	0	0	0	0
1954	Lewisham	0	0	0	0	0	0	0
1955	Lewisham	0	0	0	0	0	0	0
1956	Lewisham	0	0	0	0	0	0	0
1957	Lewisham	0	0	0	0	0	0	0
1958	Lewisham	0	0	0	0	0	0	0
1959	Lewisham	0	0	0	0	0	0	0
1960	Lewisham	0	0	0	0	0	0	0
1961	Lewisham	0	0	0	0	0	0	0
1962	Lewisham	0	0	0	0	0	0	0
1963	Lewisham	0	0	0	0	0	0	0
1964	Lewisham	0	0	0	0	0	0	0
1965	Lewisham	0	0	0	0	0	0	0
1966	Lewisham	0	0	0	0	0	0	0
1967	Lewisham	0	0	0	0	0	0	0
1968	Lewisham	0	0	0	0	0	0	0
1969	Lewisham	0	0	0	0	0	0	0
1970	Lewisham	0	0	0	0	0	0	0
1971	Lewisham	0	0	0	0	0	0	0
1972	Lewisham	0	0	0	0	0	0	0
1973	Lewisham	0	0	0	0	0	0	0
1974	Lewisham	0	0	0	0	0	0	0
1975	Lewisham	0	0	0	0	0	0	0
1976	Lewisham	0	0	0	0	0	0	0
1977	Lewisham	0	0	0	0	0	0	0
1978	Lewisham	0	0	0	0	0	0	0

As can be seen from above, Lewisham with its demography has no African restaurants within the top spots.

```
In [91]: se_onehot.to_csv('se_london_onehot.csv', index = False)
```

The new dataframe size is given below

```
In [92]: se_onehot.shape
```

```
Out[92]: (4253, 199)
```

Regrouping and Category Statistics

```
In [93]: se_grouped = se_onehot.groupby('Neighbourhood').mean().reset_index()
se_grouped.head()
```

```
Out[93]:
```

	Neighbourhood	African Restaurant	American Restaurant	Antique Shop	Aquarium	Argentinian Restaurant	Art Gallery	Art Museum	C S
0	Bankside	0.00	0.000000	0.0	0.0	0.010000	0.01	0.03	
1	Bellingham	0.00	0.000000	0.0	0.0	0.000000	0.00	0.00	
2	Bermondsey	0.00	0.000000	0.0	0.0	0.010000	0.01	0.03	
3	Blackheath	0.00	0.010753	0.0	0.0	0.010753	0.00	0.00	
4	Brixton	0.01	0.000000	0.0	0.0	0.000000	0.01	0.00	

```
In [94]: print("Before One-hot encoding:", se_df.shape)
print("After One-hot encoding:", se_grouped.shape)
```

```
Before One-hot encoding: (46, 5)
After One-hot encoding: (40, 199)
```

```
In [95]: se_grouped.to_csv('london_grouped.csv', index = False)
```

Grouping of each Neighbourhoods with 10 common venues:

```
In [96]: num_top_venues = 10 # Top common venues needed

for hood in se_grouped['Neighbourhood']:
    print("-----"+hood+"-----")
    temp = se_grouped[se_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')
```


----Bankside----

	venue	freq
0	Coffee Shop	0.08
1	Hotel	0.06
2	Pub	0.05
3	Italian Restaurant	0.05
4	Theater	0.04
5	Cocktail Bar	0.04
6	Seafood Restaurant	0.03
7	Tapas Restaurant	0.03
8	Restaurant	0.03
9	Art Museum	0.03

----Bellingham----

	venue	freq
0	Grocery Store	0.14
1	Park	0.08
2	Supermarket	0.07
3	Café	0.06
4	Coffee Shop	0.06
5	Pub	0.06
6	Italian Restaurant	0.04
7	Fast Food Restaurant	0.04
8	Fried Chicken Joint	0.03
9	Gas Station	0.03

----Bermondsey----

	venue	freq
0	Coffee Shop	0.08
1	Hotel	0.06
2	Pub	0.05
3	Italian Restaurant	0.05
4	Theater	0.04
5	Cocktail Bar	0.04
6	Seafood Restaurant	0.03
7	Tapas Restaurant	0.03
8	Restaurant	0.03
9	Art Museum	0.03

----Blackheath----

	venue	freq
0	Pub	0.13
1	Grocery Store	0.08
2	Coffee Shop	0.06
3	Park	0.05
4	Clothing Store	0.04
5	Bakery	0.03
6	Garden	0.03
7	Café	0.03
8	Italian Restaurant	0.03
9	Supermarket	0.02

----Brixton----

	venue	freq
0	Café	0.09
1	Coffee Shop	0.07
2	Park	0.06
3	Pub	0.05
4	Cocktail Bar	0.04
5	Italian Restaurant	0.04
6	Middle Eastern Restaurant	0.04
7	Indian Restaurant	0.03
8	Grocery Store	0.03
9	Bar	0.03

----Brockley----

	venue	freq
0	Coffee Shop	0.13
1	Pub	0.12
2	Café	0.07
3	Park	0.06
4	Gastropub	0.04
5	Bar	0.04
6	Cocktail Bar	0.03
7	Indian Restaurant	0.03
8	Italian Restaurant	0.03
9	Gym / Fitness Center	0.02

----Camberwell----

	venue	freq
0	Café	0.09
1	Coffee Shop	0.07
2	Park	0.06
3	Pub	0.05
4	Cocktail Bar	0.04
5	Italian Restaurant	0.04
6	Middle Eastern Restaurant	0.04
7	Indian Restaurant	0.03
8	Grocery Store	0.03
9	Bar	0.03

----Catford----

	venue	freq
0	Grocery Store	0.14
1	Park	0.08
2	Supermarket	0.07
3	Café	0.06
4	Coffee Shop	0.06
5	Pub	0.06
6	Italian Restaurant	0.04
7	Fast Food Restaurant	0.04
8	Fried Chicken Joint	0.03
9	Gas Station	0.03

----Chinbrook----

	venue	freq
--	-------	------

0	Grocery Store	0.15
1	Pub	0.13
2	Park	0.09
3	Café	0.07
4	Gym / Fitness Center	0.05
5	Coffee Shop	0.05
6	Indian Restaurant	0.05
7	Italian Restaurant	0.05
8	Fast Food Restaurant	0.04
9	Supermarket	0.04

----Crofton Park----

	venue	freq
0	Coffee Shop	0.13
1	Pub	0.12
2	Café	0.07
3	Park	0.06
4	Gastropub	0.04
5	Bar	0.04
6	Cocktail Bar	0.03
7	Indian Restaurant	0.03
8	Italian Restaurant	0.03
9	Gym / Fitness Center	0.02

----Denmark Hill----

	venue	freq
0	Café	0.09
1	Coffee Shop	0.07
2	Park	0.06
3	Pub	0.05
4	Cocktail Bar	0.04
5	Italian Restaurant	0.04
6	Middle Eastern Restaurant	0.04
7	Indian Restaurant	0.03
8	Grocery Store	0.03
9	Bar	0.03

----Deptford----

	venue	freq
0	Pub	0.12
1	Coffee Shop	0.06
2	Café	0.06
3	Park	0.04
4	Bar	0.04
5	Garden	0.03
6	Trail	0.02
7	Market	0.02
8	Sandwich Place	0.02
9	Grocery Store	0.02

----Dulwich----

	venue	freq
0	Pub	0.14

1	Café	0.07
2	Grocery Store	0.07
3	Park	0.06
4	Coffee Shop	0.06
5	Bakery	0.06
6	Pizza Place	0.03
7	Brewery	0.03
8	Gym / Fitness Center	0.03
9	Farmers Market	0.03

----East Dulwich----

	venue	freq
0	Pub	0.12
1	Café	0.09
2	Pizza Place	0.07
3	Coffee Shop	0.07
4	Park	0.06
5	Italian Restaurant	0.06
6	Gastropub	0.04
7	Platform	0.03
8	Forest	0.03
9	Mediterranean Restaurant	0.03

----Elephant and Castle----

	venue	freq
0	Café	0.08
1	Pub	0.07
2	Coffee Shop	0.07
3	Hotel	0.05
4	Theater	0.04
5	Italian Restaurant	0.04
6	Park	0.03
7	Restaurant	0.02
8	Pizza Place	0.02
9	Tapas Restaurant	0.02

----Forest Hill----

	venue	freq
0	Pub	0.15
1	Grocery Store	0.07
2	Coffee Shop	0.07
3	Café	0.06
4	Park	0.05
5	Gym / Fitness Center	0.03
6	Supermarket	0.03
7	Gastropub	0.02
8	Forest	0.02
9	Fish & Chips Shop	0.02

----Gipsy Hill----

	venue	freq
0	Pub	0.12
1	Coffee Shop	0.08

2	Grocery Store	0.06
3	Park	0.06
4	Café	0.06
5	Bakery	0.05
6	Italian Restaurant	0.04
7	Movie Theater	0.02
8	Sandwich Place	0.02
9	Pizza Place	0.02

----Grove Park----

	venue	freq
0	Grocery Store	0.15
1	Pub	0.13
2	Park	0.09
3	Café	0.07
4	Gym / Fitness Center	0.05
5	Coffee Shop	0.05
6	Indian Restaurant	0.05
7	Italian Restaurant	0.05
8	Fast Food Restaurant	0.04
9	Supermarket	0.04

----Herne Hill----

	venue	freq
0	Coffee Shop	0.10
1	Pub	0.06
2	Café	0.05
3	Market	0.04
4	Cocktail Bar	0.04
5	Pizza Place	0.04
6	Park	0.03
7	Gym / Fitness Center	0.03
8	Brewery	0.03
9	Restaurant	0.03

----Hither Green----

	venue	freq
0	Pub	0.13
1	Café	0.08
2	Gastropub	0.06
3	Park	0.05
4	Garden	0.04
5	Fish & Chips Shop	0.03
6	Food Truck	0.03
7	Coffee Shop	0.03
8	Restaurant	0.03
9	Farmers Market	0.02

----Honor Oak----

	venue	freq
0	Pub	0.15
1	Grocery Store	0.07
2	Coffee Shop	0.07

3	Café	0.06
4	Park	0.05
5	Gym / Fitness Center	0.03
6	Supermarket	0.03
7	Gastropub	0.02
8	Forest	0.02
9	Fish & Chips Shop	0.02

----Ladywell----

	venue	freq
0	Pub	0.12
1	Coffee Shop	0.08
2	Café	0.08
3	Park	0.06
4	Gastropub	0.05
5	Bar	0.03
6	Indie Movie Theater	0.02
7	Gym / Fitness Center	0.02
8	Cocktail Bar	0.02
9	Food Truck	0.02

----Lambeth----

	venue	freq
0	Coffee Shop	0.08
1	Hotel	0.06
2	Pub	0.05
3	Italian Restaurant	0.05
4	Theater	0.04
5	Cocktail Bar	0.04
6	Seafood Restaurant	0.03
7	Tapas Restaurant	0.03
8	Restaurant	0.03
9	Art Museum	0.03

----Lee----

	venue	freq
0	Grocery Store	0.15
1	Pub	0.13
2	Park	0.09
3	Café	0.07
4	Gym / Fitness Center	0.05
5	Coffee Shop	0.05
6	Indian Restaurant	0.05
7	Italian Restaurant	0.05
8	Fast Food Restaurant	0.04
9	Supermarket	0.04

----Lewisham----

	venue	freq
0	Pub	0.13
1	Café	0.08
2	Gastropub	0.06
3	Park	0.05

4	Garden	0.04
5	Fish & Chips Shop	0.03
6	Food Truck	0.03
7	Coffee Shop	0.03
8	Restaurant	0.03
9	Farmers Market	0.02

----New Cross----

	venue	freq
0	Pub	0.12
1	Coffee Shop	0.08
2	Café	0.07
3	Italian Restaurant	0.04
4	Bar	0.04
5	Gastropub	0.03
6	Brewery	0.03
7	Indian Restaurant	0.03
8	Park	0.03
9	Pizza Place	0.02

----Newington----

	venue	freq
0	Coffee Shop	0.08
1	Pub	0.07
2	Café	0.06
3	Theater	0.04
4	Italian Restaurant	0.04
5	Hotel	0.04
6	Cocktail Bar	0.03
7	Burger Joint	0.02
8	Brewery	0.02
9	Street Food Gathering	0.02

----Nunhead----

	venue	freq
0	Pub	0.11
1	Café	0.07
2	Pizza Place	0.05
3	Coffee Shop	0.05
4	Park	0.05
5	Bar	0.04
6	Gastropub	0.03
7	Cocktail Bar	0.03
8	Italian Restaurant	0.03
9	Burger Joint	0.03

----Oval----

	venue	freq
0	Café	0.13
1	Pub	0.08
2	Hotel	0.06
3	Park	0.05
4	Coffee Shop	0.04

5	Theater	0.04
6	Bar	0.02
7	Street Food Gathering	0.02
8	Sandwich Place	0.02
9	Garden	0.02

----Peckham----

	venue	freq
0	Pub	0.11
1	Café	0.07
2	Pizza Place	0.05
3	Coffee Shop	0.05
4	Park	0.05
5	Bar	0.04
6	Gastropub	0.03
7	Cocktail Bar	0.03
8	Italian Restaurant	0.03
9	Burger Joint	0.03

----Rotherhithe----

	venue	freq
0	Pub	0.10
1	Brewery	0.08
2	Coffee Shop	0.06
3	Park	0.06
4	Bar	0.05
5	Café	0.04
6	Food Truck	0.03
7	Beer Bar	0.03
8	Vietnamese Restaurant	0.03
9	Supermarket	0.02

----Selhurst----

	venue	freq
0	Pub	0.11
1	Park	0.09
2	Grocery Store	0.09
3	Supermarket	0.07
4	Platform	0.05
5	Café	0.05
6	Coffee Shop	0.05
7	Tram Station	0.04
8	African Restaurant	0.02
9	Gym / Fitness Center	0.02

----South Norwood----

	venue	freq
0	Pub	0.11
1	Park	0.09
2	Grocery Store	0.09
3	Supermarket	0.07
4	Platform	0.05
5	Café	0.05

6	Coffee Shop	0.05
7	Tram Station	0.04
8	African Restaurant	0.02
9	Gym / Fitness Center	0.02

----Southend----

	venue	freq
0	Grocery Store	0.14
1	Park	0.08
2	Supermarket	0.07
3	Café	0.06
4	Coffee Shop	0.06
5	Pub	0.06
6	Italian Restaurant	0.04
7	Fast Food Restaurant	0.04
8	Fried Chicken Joint	0.03
9	Gas Station	0.03

----St Johns----

	venue	freq
0	Coffee Shop	0.13
1	Pub	0.12
2	Café	0.07
3	Park	0.06
4	Gastropub	0.04
5	Bar	0.04
6	Cocktail Bar	0.03
7	Indian Restaurant	0.03
8	Italian Restaurant	0.03
9	Gym / Fitness Center	0.02

----Surrey Quays----

	venue	freq
0	Pub	0.10
1	Brewery	0.08
2	Coffee Shop	0.06
3	Park	0.06
4	Bar	0.05
5	Café	0.04
6	Food Truck	0.03
7	Beer Bar	0.03
8	Vietnamese Restaurant	0.03
9	Supermarket	0.02

----Tulse Hill----

	venue	freq
0	Pub	0.10
1	Coffee Shop	0.10
2	Café	0.06
3	Grocery Store	0.05
4	Pizza Place	0.04
5	Bakery	0.04
6	Park	0.04

7	Gym / Fitness Center	0.03
8	Market	0.02
9	Brewery	0.02

----Upper Norwood----

	venue	freq
0	Pub	0.12
1	Park	0.07
2	Coffee Shop	0.06
3	Café	0.05
4	Italian Restaurant	0.05
5	Bakery	0.05
6	Train Station	0.04
7	Grocery Store	0.03
8	Gastropub	0.03
9	Lake	0.02

----Walworth----

	venue	freq
0	Café	0.10
1	Coffee Shop	0.09
2	Pub	0.09
3	Park	0.04
4	Italian Restaurant	0.04
5	Art Gallery	0.03
6	Theater	0.03
7	Brewery	0.03
8	Pizza Place	0.03
9	Gay Bar	0.02

----West Norwood----

	venue	freq
0	Pub	0.13
1	Grocery Store	0.10
2	Coffee Shop	0.09
3	Café	0.06
4	Bakery	0.05
5	Park	0.04
6	Pizza Place	0.03
7	Pharmacy	0.03
8	Gym / Fitness Center	0.03
9	Italian Restaurant	0.02

Creating new dataframe:

Putting the common venues into pandas dataframe, the following return_most_common_venues is used to sort the venues in descending order.

```
In [97]: 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]
```

Then we create a new panda dataframe with 10 most common venues as shown below:

```
In [98]: 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'] = se_grouped['Neighbourhood']

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

```
In [99]: neighbourhoods_venues_sorted.head()
```

Out[99]:

	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	Bankside	Coffee Shop	Hotel	Pub	Italian Restaurant	Theater	Cocktail Bar	School
1	Bellingham	Grocery Store	Park	Supermarket	Café	Pub	Coffee Shop	Italian Restaurant
2	Bermondsey	Coffee Shop	Hotel	Pub	Italian Restaurant	Theater	Cocktail Bar	School
3	Blackheath	Pub	Grocery Store	Coffee Shop	Park	Clothing Store	Italian Restaurant	
4	Brixton	Café	Coffee Shop	Park	Pub	Italian Restaurant	Cocktail Bar	Middle East Restaurant

```
In [100]: neighbourhoods_venues_sorted.to_csv('neighbourhoods_venues_sorted.csv', index
= False)
```

```
In [101]: se_grouped_clustering = se_grouped.drop('Neighbourhood', 1)
```

3.2.4 Clustering of Neighbourhoods

```
In [102]: kclusters = 5

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

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

```
Out[102]: array([2, 0, 2, 4, 1, 3, 1, 0, 0, 3], dtype=int32)
```

```
In [103]: kmeans.labels_[0:10]
```

```
Out[103]: array([2, 0, 2, 4, 1, 3, 1, 0, 0, 3], dtype=int32)
```

Now creating a new dataframe that includes the clusters as well as the top 10 venues for each neighbourhoods

```
In [104]: # add clustering labels
neighbourhoods_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)
```

```
In [105]: se_merged = se_df
```

```
In [106]: se_merged.head(3)
```

```
Out[106]:
```

	Location	Borough	Postcode	Latitude	Longitude
0	Crofton Park	Lewisham	SE4	51.46268	-0.03558
1	Denmark Hill	Southwark	SE5	51.47480	-0.09313
2	Deptford	Lewisham	SE8	51.48114	-0.02467

```
In [107]: # match/merge SE London data with Latitude/Longitude for each neighborhood
se_merged_latlong = se_merged.join(neighbourhoods_venues_sorted.set_index('Neighbourhood'), on = 'Location')
```

In [108]: `se_merged_latlong.head(5)`

Out[108]:

	Location	Borough	Postcode	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
0	Crofton Park	Lewisham	SE4	51.46268	-0.03558	3	Coffee Shop	Pub	Café
1	Denmark Hill	Southwark	SE5	51.47480	-0.09313	1	Café	Coffee Shop	Park
2	Deptford	Lewisham	SE8	51.48114	-0.02467	3	Pub	Café	Coffee Shop
3	Dulwich	Southwark	SE21	51.44100	-0.08897	4	Pub	Grocery Store	Café
4	East Dulwich	Southwark	SE22	51.45256	-0.07076	1	Pub	Café	Coffee Shop

In [109]: `se_clusters = se_merged_latlong`

Please note, that the number of clusters was chosen as 5 for initial run.

3.2.5 Optimal Number of Clusters for K-mean

To get the optimal number of clusters to be used for the K-mean, there are a number ways possible for the evaluation. Therefore, in this task, the following are used:

1. Elbow (Criterion) Method 2. Silhouette Coefficient

1. Elbow Method

The elbow method is used to solve the problem of selecting k. Interestingly, the elbow method is not perfect either but it gives significant insight that is perhaps not top optimal but sub-optimal to choosing the optimal number of clusters by fitting the model with a range of values for k.

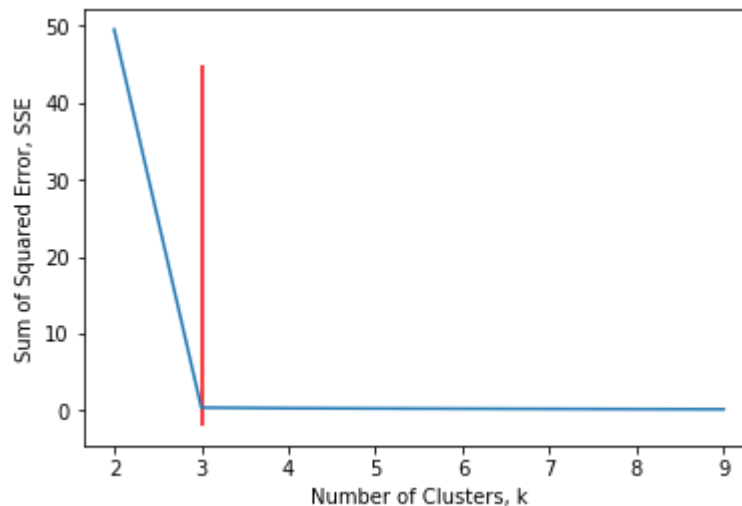
The approach for this is to run the k-means clustering for a range of value k and for each value of k, the Sum of the Squared Errors (SSE) is calculated., calculate sum of squared errors (SSE). When this is done, a plot of k and the corresponding SSEs are then made. At the elbow (just like arm), that is where the optimal value of k is. And that will be the number of clusters to be used. The whole idea is to have minimum SSE.

```
In [112]: %matplotlib inline
import matplotlib
import numpy as np
```

```
In [113]: from sklearn.cluster import KMeans
import matplotlib.pyplot as plt

# SSE is initialize with empty values
# n_clusters is the "k"
sse = {}
for n_cluster1 in range(2, 10):
    kmeans1 = KMeans(n_clusters = n_cluster1, max_iter = 500).fit(se_grouped_c
lustering)
    se_grouped_clustering["clusters"] = kmeans1.labels_

    # The inertia is the sum of distances of samples to their closest cluster
    centre
    sse[n_cluster1] = kmeans1.inertia_
plt.figure()
plt.plot(list(sse.keys()), list(sse.values()))
plt.xlabel("Number of Clusters, k")
plt.ylabel("Sum of Squared Error, SSE")
# vertical line
plt.vlines(3, ymin = -2, ymax = 45, colors = 'red')
plt.show()
```



Depending on the number of iteration (in this case, 500 iterations were used), the number of cluster, k is 3.

2. Silhouette Coefficient

To find the optimal value of the number of clusters, k, the number of clusters is iterated corresponding Silhouette Coefficient is calculated for each of the k-values used. The highest Silhouette Coefficient gives the best match to its own cluster. Please see below:

```
In [114]: from sklearn.metrics import silhouette_score
from sklearn.cluster import KMeans

for n_cluster2 in range(2, 10):
    kmeans2 = KMeans(n_clusters = n_cluster2, random_state = 0).fit(se_grouped_
_clustering)
    label2 = kmeans2.labels_
    sil_coeff = silhouette_score(se_grouped_clustering, label2, metric = 'euclidean')
    print("Where n_clusters = {}, the Silhouette Coefficient is {}".format(n_c
luster2, sil_coeff))
```

```
Where n_clusters = 2, the Silhouette Coefficient is 0.6228086343684874
Where n_clusters = 3, the Silhouette Coefficient is 0.6618454787413641
Where n_clusters = 4, the Silhouette Coefficient is 0.6520826202080521
Where n_clusters = 5, the Silhouette Coefficient is 0.6854128867290191
Where n_clusters = 6, the Silhouette Coefficient is 0.7271608400634918
Where n_clusters = 7, the Silhouette Coefficient is 0.837002499689455
Where n_clusters = 8, the Silhouette Coefficient is 0.8691040323314135
Where n_clusters = 9, the Silhouette Coefficient is 0.9324981511688628
```

From the result, the high the `n_clusters` the better the silhouette coefficient. For this project, a cluster value of 5 will be used.

```
In [115]: se_clusters.columns
```

```
Out[115]: Index(['Location', 'Borough', 'Postcode', 'Latitude', 'Longitude',
'Cluster Labels', '1st Most Common Venue', '2nd Most Common Venue',
'3rd Most Common Venue', '4th Most Common Venue',
'5th Most Common Venue', '6th Most Common Venue',
'7th Most Common Venue', '8th Most Common Venue',
'9th Most Common Venue', '10th Most Common Venue'],
dtype='object')
```

```

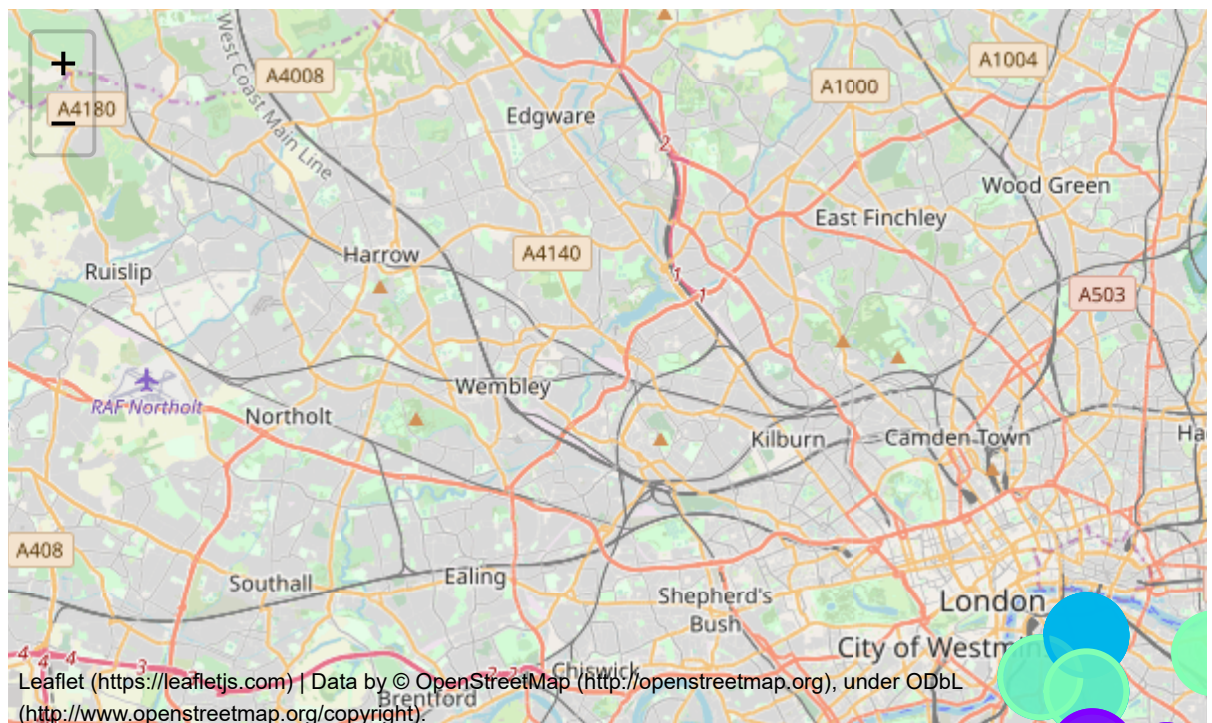
In [116]: # create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

# 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(se_clusters['Latitude'], se_clusters['Longitude'], se_clusters['Location'], se_clusters['Cluster Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=20,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters)

display(map_clusters)

```



Cluster 1


```
In [117]: se_clusters.loc[se_clusters['Cluster Labels'] == 0, se_clusters.columns[[1] +
list(range(5, se_clusters.shape[1]))]]
```

Out[117]:

	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	
12	Lewisham	0	Grocery Store	Pub	Park	Café	Coffee Shop	Italian Restaurant	
19	Lewisham	0	Grocery Store	Pub	Park	Café	Coffee Shop	Italian Restaurant	
26	Lewisham	0	Grocery Store	Park	Supermarket	Café	Pub	Coffee Shop	R
29	Croydon	0	Pub	Grocery Store	Park	Supermarket	Coffee Shop	Café	
31	Croydon	0	Pub	Grocery Store	Park	Supermarket	Coffee Shop	Café	
32	Lewisham	0	Grocery Store	Park	Supermarket	Café	Pub	Coffee Shop	R
44	Lewisham	0	Grocery Store	Park	Supermarket	Café	Pub	Coffee Shop	R
45	Lewisham	0	Grocery Store	Pub	Park	Café	Coffee Shop	Italian Restaurant	

Clusters 2

In [118]:

se_clusters.loc[se_clusters['Cluster Labels'] == 1, se_clusters.columns[[1] +
list(range(5, se_clusters.shape[1]))]]

Out[118]:

	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
1	Southwark	1	Café	Coffee Shop	Park	Pub	Italian Restaurant	Cocktail Bar	Middle Eastern Restaurant
4	Southwark	1	Pub	Café	Coffee Shop	Pizza Place	Park	Italian Restaurant	Gastro Pub
13	Lambeth	1	Coffee Shop	Pub	Café	Cocktail Bar	Market	Pizza Place	Restaurant
24	Southwark	1	Pub	Café	Coffee Shop	Pizza Place	Park	Bar	Italian Restaurant
27	Southwark	1	Pub	Café	Coffee Shop	Pizza Place	Park	Bar	Italian Restaurant
41	Lambeth	1	Café	Coffee Shop	Park	Pub	Italian Restaurant	Cocktail Bar	Middle Eastern Restaurant
43	Southwark	1	Café	Coffee Shop	Park	Pub	Italian Restaurant	Cocktail Bar	Middle Eastern Restaurant

Cluster 3

In [119]:

se_clusters.loc[se_clusters['Cluster Labels'] == 2, se_clusters.columns[[1] +
list(range(5, se_clusters.shape[1]))]]

Out[119]:

	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
5	Southwark	2	Café	Pub	Coffee Shop	Hotel	Theater	Italian Restaurant	Pa
6	Southwark	2	Café	Pub	Coffee Shop	Hotel	Theater	Italian Restaurant	Pa
7	Southwark	2	Café	Pub	Coffee Shop	Hotel	Theater	Italian Restaurant	Pa
8	Southwark	2	Coffee Shop	Hotel	Pub	Italian Restaurant	Theater	Cocktail Bar	Scen Looko
18	Lambeth	2	Coffee Shop	Hotel	Pub	Italian Restaurant	Theater	Cocktail Bar	Scen Looko
22	Southwark	2	Coffee Shop	Pub	Café	Italian Restaurant	Hotel	Theater	Cockt B
23	Southwark	2	Coffee Shop	Pub	Café	Italian Restaurant	Hotel	Theater	Cockt B
30	Southwark	2	Coffee Shop	Hotel	Pub	Italian Restaurant	Theater	Cocktail Bar	Scen Looko

Cluster 4

```
In [120]: se_clusters.loc[se_clusters['Cluster Labels'] == 3, se_clusters.columns[[1] +
list(range(5, se_clusters.shape[1]))]]
```

Out[120]:

	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
0	Lewisham	3	Coffee Shop	Pub	Café	Park	Gastropub	Bar	Cocktail
2	Lewisham	3	Pub	Café	Coffee Shop	Bar	Park	Garden	In Mc Theater
14	Lewisham	3	Pub	Café	Gastropub	Park	Garden	Food Truck	Fish Ch Shop
16	Lewisham	3	Pub	Coffee Shop	Café	Park	Gastropub	Bar	Fo Tr
17	Lewisham	3	Pub	Coffee Shop	Café	Park	Gastropub	Bar	Fo Tr
20	Lewisham	3	Pub	Café	Gastropub	Park	Garden	Food Truck	Fish Ch Shop
21	Lewisham	3	Pub	Coffee Shop	Café	Bar	Italian Restaurant	Brewery	Gastropub
25	Lambeth	3	Café	Pub	Hotel	Park	Theater	Coffee Shop	Gay
28	Southwark	3	Pub	Brewery	Park	Coffee Shop	Bar	Café	Fo Tr
33	Lewisham	3	Coffee Shop	Pub	Café	Park	Gastropub	Bar	Cocktail
34	Southwark	3	Pub	Brewery	Park	Coffee Shop	Bar	Café	Fo Tr
38	Southwark	3	Café	Coffee Shop	Pub	Park	Italian Restaurant	Pizza Place	Gall
42	Lewisham	3	Coffee Shop	Pub	Café	Park	Gastropub	Bar	Cocktail

Cluster 5

```
In [121]: se_clusters.loc[se_clusters['Cluster Labels'] == 4, se_clusters.columns[[1] +
list(range(5, se_clusters.shape[1]))]]
```

Out[121]:

	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
3	Southwark	4	Pub	Grocery Store	Café	Coffee Shop	Bakery	Park	F (
9	Lewisham	4	Pub	Grocery Store	Coffee Shop	Café	Park	Gym / Fitness Center	Supern
10	Lambeth	4	Pub	Coffee Shop	Grocery Store	Café	Park	Bakery	Resti
11	Lambeth	4	Pub	Coffee Shop	Grocery Store	Café	Park	Bakery	Resti
15	Lewisham	4	Pub	Grocery Store	Coffee Shop	Café	Park	Gym / Fitness Center	Supern
35	Lambeth	4	Coffee Shop	Pub	Café	Grocery Store	Pizza Place	Park	E
36	Lambeth	4	Coffee Shop	Pub	Café	Grocery Store	Pizza Place	Park	E
37	Croydon	4	Pub	Park	Coffee Shop	Italian Restaurant	Café	Bakery	Train S
39	Lewisham	4	Pub	Grocery Store	Coffee Shop	Park	Clothing Store	Italian Restaurant	
40	Lambeth	4	Pub	Grocery Store	Coffee Shop	Café	Bakery	Park	F (

4. Result

The following are the highlights of the 5 clusters above:

1. Pubs, Cafe, Coffee Shops are popular in the South East London.
2. As for restaurants, the Italian Restaurants are very popular in the South East London area. Especially in Southwark and Lambeth areas.
3. With the Lewisham area being the most condensed area of Africans in the South East Area, it is surprising to see how in the top 10 venues, you can barely see restaurants in the top 5 venues.
4. Although, the Clusters have variations, a very visible presence is the predominance of pubs.

5. Discussion and Conclusion

It is very important to note that Clusters 2 and 3 are the most viable clusters to create a brand African Restaurant. Their proximity to other amenities and accessibility to station are paramount. These 2 clusters do not have top restaurants that could rival their standards if they are created. And the proximity to resources needed is paramount as Lewisham and Lambeth are not far out from Peckham (under Southwark).

In conclusion, this project would have had better results if there were more data in terms of crime data within the area, traffic access and allowance of more venues exploration with the Foursquare (limited venues for free calls).

Also, getting the ratings and feedbacks of the current restaurants within the clusters would have helped in providing more insight into the best location.

In []: