Description of the data and how it will be used to solve the problem

Data Acquisition and Data Cleaning:

1. Data Acquisition

The data acquired for the project is the combination data from three sources. The first source of the project uses London Coronavirus Infected cases in London.
The dataset contains following columns:

- **Borough:** Common Name of London Borough
- **Confirmed Cases:** No. of Coronavirus infected patients in a Borough

The second source of data is scraped from the Wikipedia page that contains the list of London Boroughs. The page contains additional information about the borough. The dataset contains the following columns:

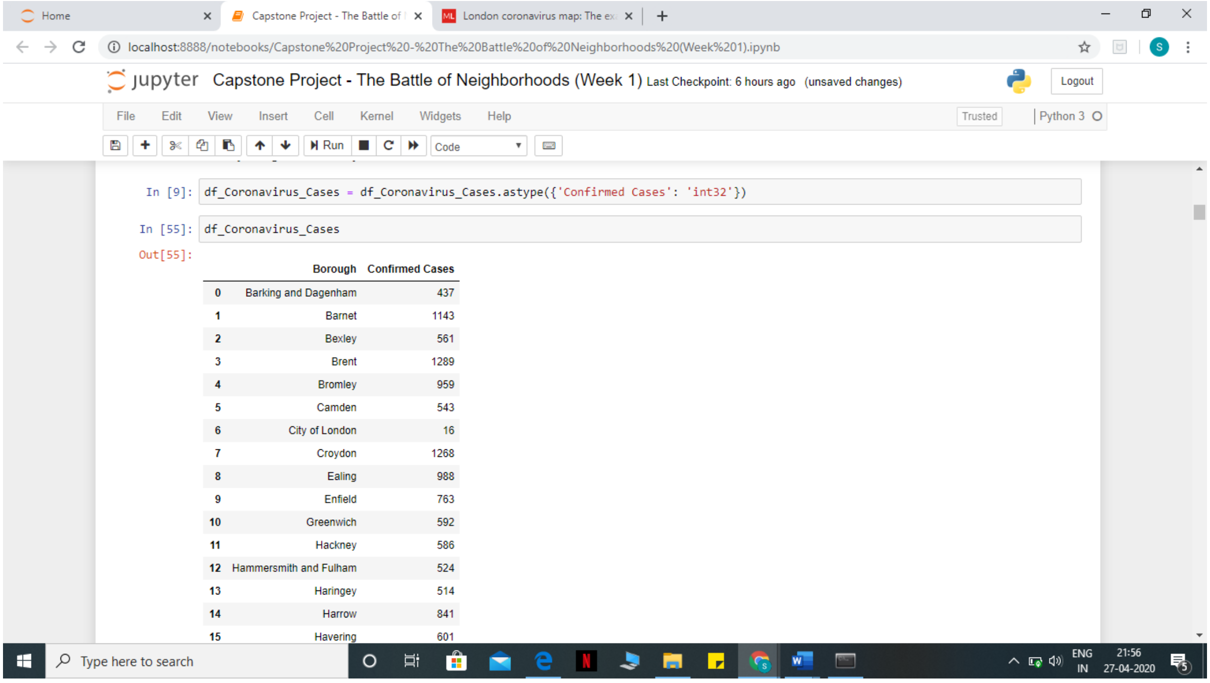
- **Borough**: The names of the 33 London boroughs.
- **Inner**: Categorizing the borough as an Inner London borough or an Outer London Borough.
- **Status**: Categorizing the borough as Royal, City or other borough.
- **Local authority:** The local authority assigned to the borough.
- **Political control:** The political party that control the borough.
- **Headquarters:** Headquarters of the Boroughs.
- **Area (sq mi):** Area of the borough in square miles.
- **Population (2013 est)[1]:** The population in the borough recorded during the year 2013.
- **Co-ordinates:** The latitude and longitude of the boroughs.
- **Nr. in map:** The number assigned to each borough to represent visually on a map.

The third data source is the list of Neighbourhoods in the Royal Borough of Kingston upon Thames as found on a Wikipedia page. This dataset is created from scratch using the list of neighbourhoods available on the site, the following are columns:

- **Neighbourhood:** Name of the neighbourhood in the Borough.
- **Borough:** Name of the Borough**.**
- **Latitude:** Latitude of the Borough.
- **Longitude:** Longitude of the Borough.

2. Data Cleaning

The data preparation for each of the three sources of data is done separately. Initially, we took the data from showing total number of confirmed infections in each borough as shown in the fig.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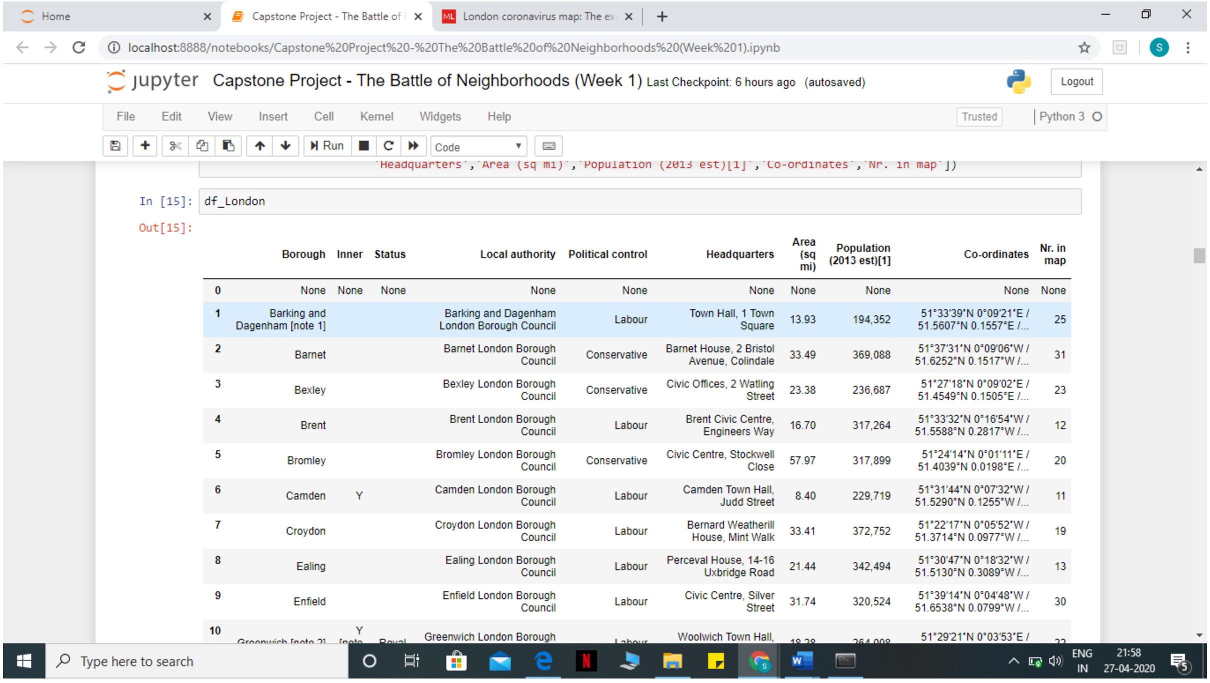
```
In [9]: df_Coronavirus_Cases = df_Coronavirus_Cases.astype({'Confirmed Cases': 'int32'})

In [55]: df_Coronavirus_Cases

Out[55]:
```

	Borough	Confirmed Cases
0	Barking and Dagenham	437
1	Barnet	1143
2	Bexley	561
3	Brent	1289
4	Bromley	959
5	Camden	543
6	City of London	16
7	Croydon	1268
8	Ealing	988
9	Enfield	763
10	Greenwich	592
11	Hackney	586
12	Hammersmith and Fulham	524
13	Haringey	514
14	Harrow	841
15	Havering	601

The second data is scraped from a Wikipedia page using the Beautiful Soup library in python. Using this library, we can extract the data in the tabular format as shown in the website. After the web scraping, string manipulation is required to get the names of the boroughs in the correct form. This is important because we will be merging the two datasets together using the Borough names.



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```
'Headquarters','Area (sq mi)','Population (2013 est)[1]','Co-ordinates','Nr. in map'])
```

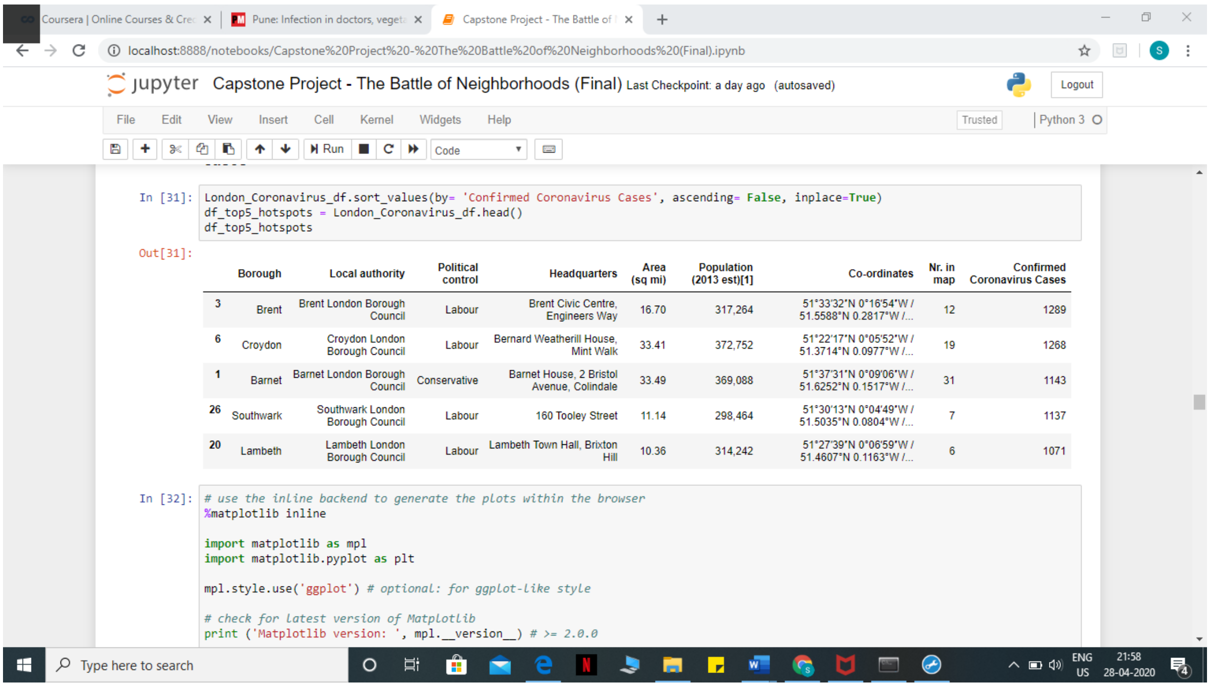
In [15]:

```
df_London
```

Out[15]:

	Borough	Inner	Status	Local authority	Political control	Headquarters	Area (sq mi)	Population (2013 est)[1]	Co-ordinates	Nr. in map
0	None	None	None	None	None	None	None	None	None	None
1	Barking and Dagenham [note 1]			Barking and Dagenham London Borough Council	Labour	Town Hall, 1 Town Square	13.93	194,352	51°33′39″N 0°09′21″E / 51.5607°N 0.1557°E /...	25
2	Barnet			Barnet London Borough Council	Conservative	Barnet House, 2 Bristol Avenue, Colindale	33.49	369,088	51°37′31″N 0°09′06″W / 51.6252°N 0.1517°W /...	31
3	Bexley			Bexley London Borough Council	Conservative	Civic Offices, 2 Watling Street	23.38	236,687	51°27′18″N 0°09′02″E / 51.4549°N 0.1505°E /...	23
4	Brent			Brent London Borough Council	Labour	Brent Civic Centre, Engineers Way	16.70	317,264	51°33′32″N 0°16′54″W / 51.5588°N 0.2817°W /...	12
5	Bromley			Bromley London Borough Council	Conservative	Civic Centre, Stockwell Close	57.97	317,899	51°24′14″N 0°01′11″E / 51.4039°N 0.0198°E /...	20
6	Camden	Y		Camden London Borough Council	Labour	Camden Town Hall, Judd Street	8.40	229,719	51°31′44″N 0°07′32″W / 51.5290°N 0.1255°W /...	11
7	Croydon			Croydon London Borough Council	Labour	Bernard Weatherill House, Mint Walk	33.41	372,752	51°22′17″N 0°05′52″W / 51.3714°N 0.0977°W /...	19
8	Ealing			Ealing London Borough Council	Labour	Perceval House, 14-16 Uxbridge Road	21.44	342,494	51°30′47″N 0°18′32″W / 51.5130°N 0.3089°W /...	13
9	Enfield			Enfield London Borough Council	Labour	Civic Centre, Silver Street	31.74	320,524	51°39′14″N 0°04′48″W / 51.6538°N 0.0799°W /...	30
10	Greenwich [note 2]	Y [note	Royal	Greenwich London Borough	Labour	Woolwich Town Hall,	18.28	264,008	51°29′21″N 0°03′53″E /	22

The two datasets are merged on the Borough names to form a new dataset that combines the necessary information in one dataset. The purpose of this dataset is to visualize the coronavirus infection rates in each borough and identify the worst effected borough with the maximum number of coronavirus cases recorded so far.



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In [31]:

```
London_Coronavirus_df.sort_values(by= 'Confirmed Coronavirus Cases', ascending= False, inplace=True)
df_top5_hotspots = London_Coronavirus_df.head()
df_top5_hotspots
```

Out[31]:

	Borough	Local authority	Political control	Headquarters	Area (sq mi)	Population (2013 est)[1]	Co-ordinates	Nr. in map	Confirmed Coronavirus Cases
3	Brent	Brent London Borough Council	Labour	Brent Civic Centre, Engineers Way	16.70	317,264	51°33′32″N 0°16′54″W / 51.5588°N 0.2817°W /...	12	1289
6	Croydon	Croydon London Borough Council	Labour	Bernard Weatherill House, Mint Walk	33.41	372,752	51°22′17″N 0°05′52″W / 51.3714°N 0.0977°W /...	19	1268
1	Barnet	Barnet London Borough Council	Conservative	Barnet House, 2 Bristol Avenue, Colindale	33.49	369,088	51°37′31″N 0°09′06″W / 51.6252°N 0.1517°W /...	31	1143
26	Southwark	Southwark London Borough Council	Labour	160 Tooley Street	11.14	298,464	51°30′13″N 0°04′49″W / 51.5035°N 0.0804°W /...	7	1137
20	Lambeth	Lambeth London Borough Council	Labour	Lambeth Town Hall, Brixton Hill	10.36	314,242	51°27′39″N 0°06′59″W / 51.4607°N 0.1163°W /...	6	1071

In [32]:

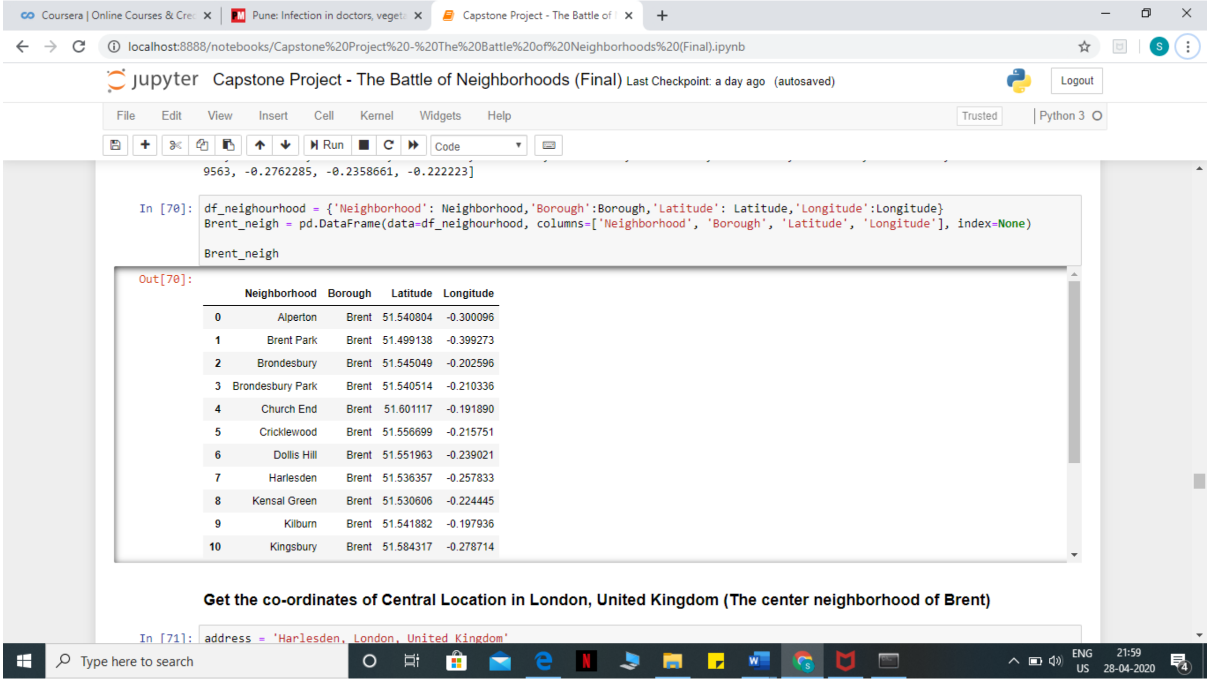
```
# use the inline backend to generate the plots within the browser
%matplotlib inline

import matplotlib as mpl
import matplotlib.pyplot as plt

mpl.style.use('ggplot') # optional: for ggplot-like style

# check for latest version of Matplotlib
print ('Matplotlib version: ', mpl.__version__) # >= 2.0.0
```

After visualizing the coronavirus cases in each borough, we can find the borough with the maximum number of cases and hence tag that borough as the worst effected borough. The third source of data is acquired from the list of neighbourhoods in the worst affected borough on Wikipedia. This dataset is created from scratch, the pandas data frame is created with the names of the neighbourhoods and the name of the borough with the latitude and longitude are obtained using Google Maps API geocoding to get the final dataset.



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```
9563, -0.2762285, -0.2358661, -0.222223]
```

```
In [70]: df_neighourhood = {'Neighborhood': Neighborhood,'Borough':Borough,'Latitude': Latitude,'Longitude':Longitude}
         Brent_neigh = pd.DataFrame(data=df_neighourhood, columns=['Neighborhood', 'Borough', 'Latitude', 'Longitude'], index=None)

         Brent_neigh
```

Out[70]:

	Neighborhood	Borough	Latitude	Longitude
0	Alperton	Brent	51.540804	-0.300096
1	Brent Park	Brent	51.499138	-0.399273
2	Brondesbury	Brent	51.545049	-0.202596
3	Brondesbury Park	Brent	51.540514	-0.210336
4	Church End	Brent	51.601117	-0.191890
5	Cricklewood	Brent	51.556699	-0.215751
6	Dollis Hill	Brent	51.551963	-0.239021
7	Harlesden	Brent	51.536357	-0.257833
8	Kensal Green	Brent	51.530606	-0.224445
9	Kilburn	Brent	51.541882	-0.197936
10	Kingsbury	Brent	51.584317	-0.278714

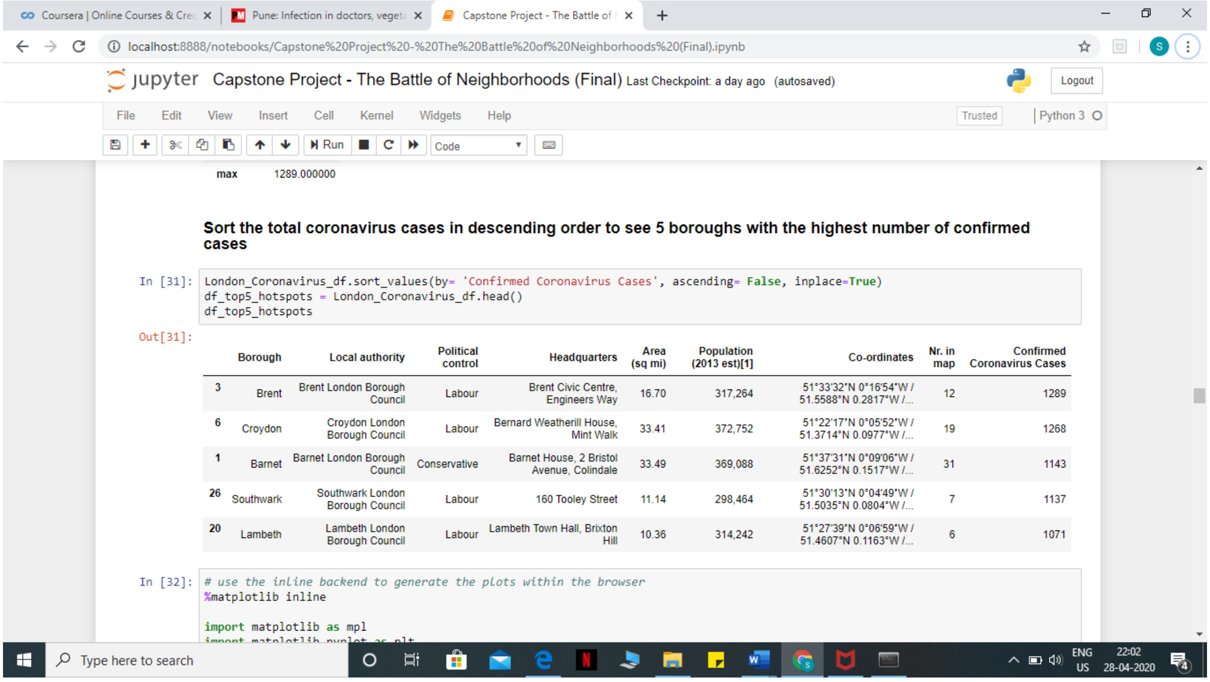
Get the co-ordinates of Central Location in London, United Kingdom (The center neighborhood of Brent)

```
In [71]: address = 'Harlesden, London, United Kingdom'
```

Solution of the Problem:

This is a critical problem that happened globally so the only solution suggested by the experts to maintain social distancing and to exhibit lockdown in the cities which are worst affected by the pandemic. This lockdown prohibits the unnecessary travel of the people as well as going out of the homes for the non-essential reasons. Also, building of hospitals along with quarantine facilities and employing the healthcare workers so that critical patients effected by the disease can be better taken care of.

One way is to analyse the worst regions of London and practice strict Lockdown there. Along with that the regions have to be critically monitored for the spread.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```
max        1289.000000
```

Sort the total coronavirus cases in descending order to see 5 boroughs with the highest number of confirmed cases

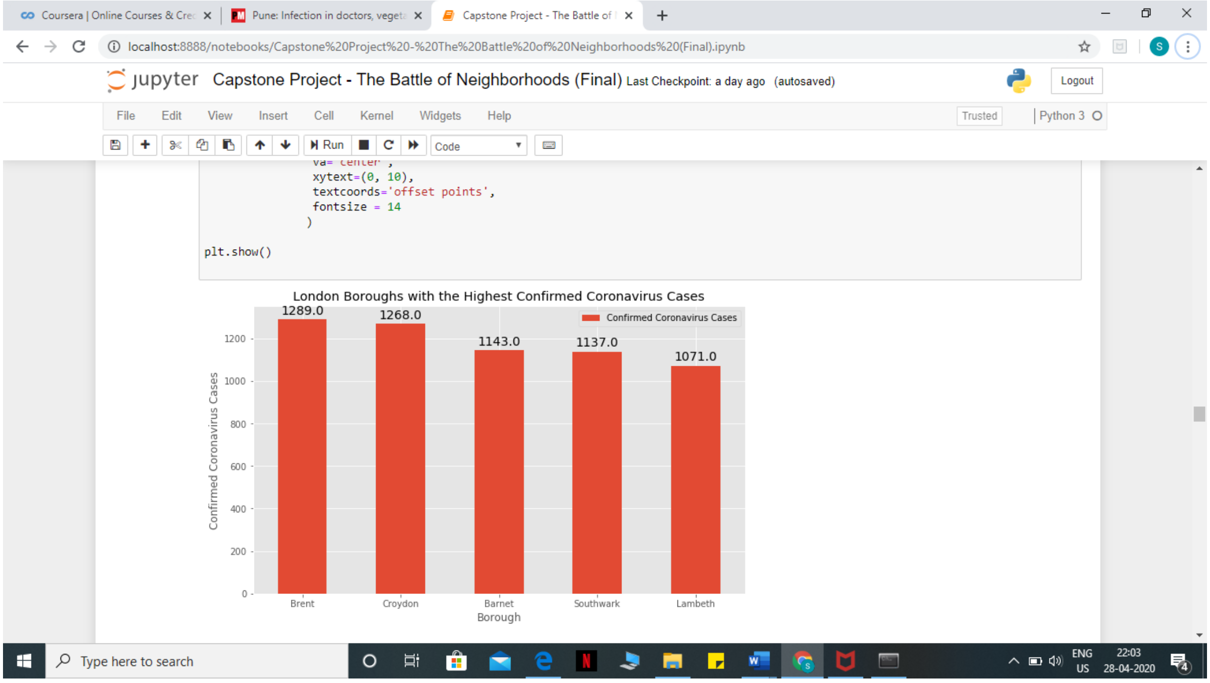
```
In [31]: London_Coronavirus_df.sort_values(by= 'Confirmed Coronavirus Cases', ascending= False, inplace=True)
         df_top5_hotspots = London_Coronavirus_df.head()
         df_top5_hotspots
```

Out[31]:

	Borough	Local authority	Political control	Headquarters	Area (sq mi)	Population (2013 est)[1]	Co-ordinates	Nr. in map	Confirmed Coronavirus Cases
3	Brent	Brent London Borough Council	Labour	Brent Civic Centre, Engineers Way	16.70	317,264	51°33′32″N 0°16′54″W / 51.5588°N 0.2817°W /...	12	1289
6	Croydon	Croydon London Borough Council	Labour	Bernard Weatherill House, Mint Walk	33.41	372,752	51°22′17″N 0°05′52″W / 51.3714°N 0.0977°W /...	19	1268
1	Barnet	Barnet London Borough Council	Conservative	Barnet House, 2 Bristol Avenue, Colindale	33.49	369,088	51°37′31″N 0°09′06″W / 51.6252°N 0.1517°W /...	31	1143
26	Southwark	Southwark London Borough Council	Labour	160 Tooley Street	11.14	298,464	51°30′13″N 0°04′49″W / 51.5035°N 0.0804°W /...	7	1137
20	Lambeth	Lambeth London Borough Council	Labour	Lambeth Town Hall, Brixton Hill	10.36	314,242	51°27′39″N 0°06′59″W / 51.4607°N 0.1163°W /...	6	1071

```
In [32]: # use the inline backend to generate the plots within the browser
         %matplotlib inline

         import matplotlib as mpl
         import matplotlib.pyplot as plt
```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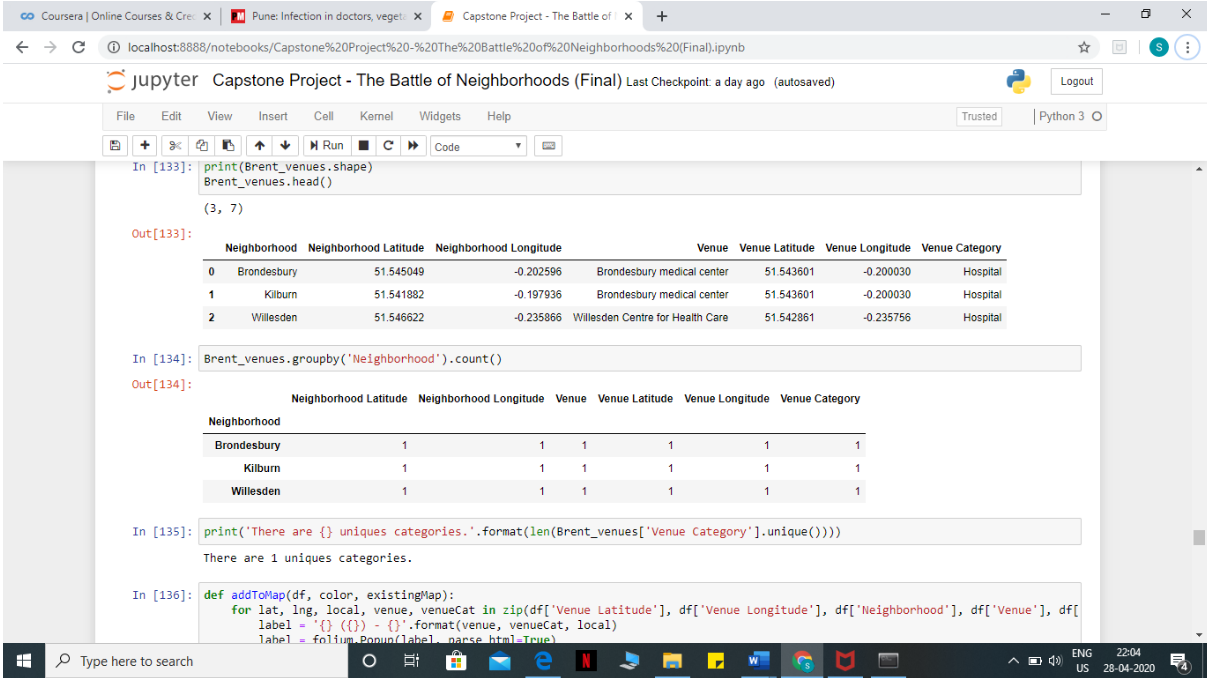
```
                 va= center ,
                 xytext=(0, 10),
                 textcoords='offset points',
                 fontsize = 14
                 )

plt.show()
```

People should not be allowed to go out without masks and only one person per house should permitted to go out for grocery items. No unnecessary travels should be availed for citizens of that region. The infected people should be home quarantine and asked to stay away from other members. Senior Citizens and children below age of 5 should be given extra precautions of that region. The complete region should be declared red zone and strict lockdown should be enforced in the region.

The government should observe serious measures to handle the situation by maintaining required number of hospitals and medical facilities for the severely and critically ill patients infected by the disease. Currently, whatever number of hospitals and health facilities are there should be dedicated mostly to take care of above Covid-19 patients until unless there is an emergency of some other serious illness.

Hence, using the **Foursquare API** we can help locate common venues with hospitals in the neighbourhoods. Since hospitals and other healthcare facilities seems to be very less in the neighbourhoods of Brent which is worst effected, therefore plan should be to convert certain places like malls and restaurants which are closed for now to quarantine places or temporary hospitals where large number of patients can be taken care.

So that where home quarantine for some people is not possible their institutional quarantine should be provided so as to curb down the further spread of the coronavirus infections.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In [133]:
```
print(Brent_venues.shape)
Brent_venues.head()
```

```
(3, 7)
```

Out[133]:

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Brondesbury	51.545049	-0.202596	Brondesbury medical center	51.543601	-0.200030	Hospital
1	Kilburn	51.541882	-0.197936	Brondesbury medical center	51.543601	-0.200030	Hospital
2	Willesden	51.546622	-0.235866	Willesden Centre for Health Care	51.542861	-0.235756	Hospital

In [134]:
```
Brent_venues.groupby('Neighborhood').count()
```

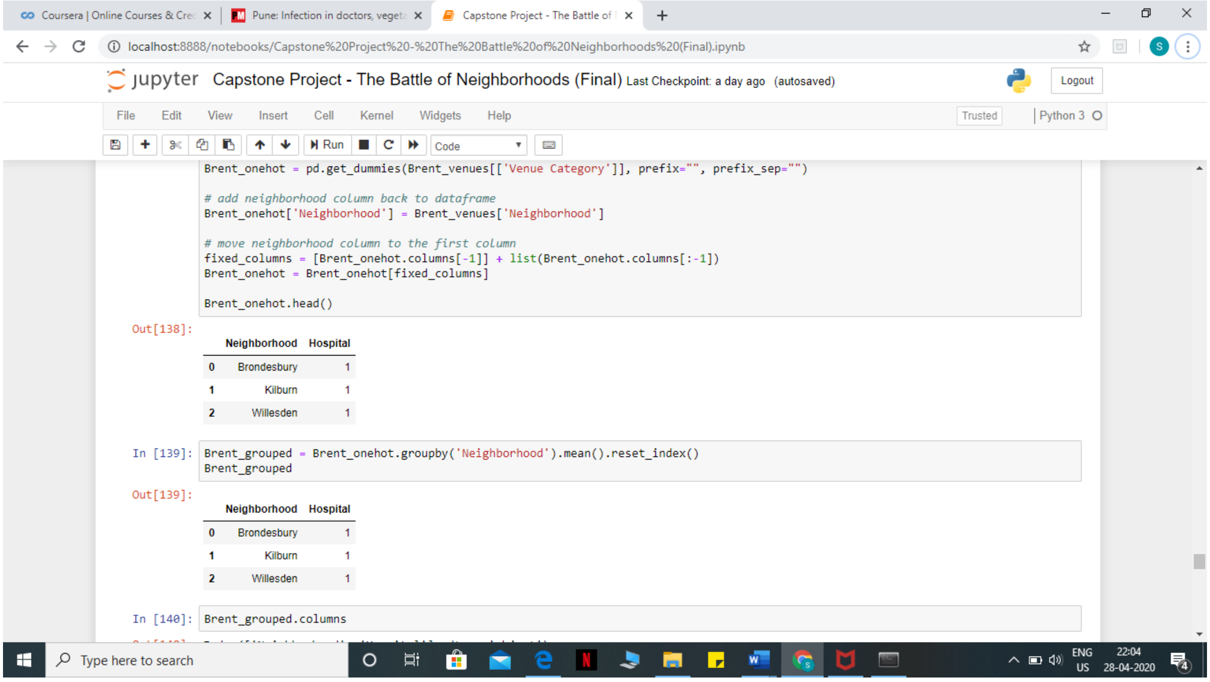
Out[134]:

	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Neighborhood						
Brondesbury	1	1	1	1	1	1
Kilburn	1	1	1	1	1	1
Willesden	1	1	1	1	1	1

In [135]:
```
print('There are {} uniques categories.'.format(len(Brent_venues['Venue Category'].unique())))
```

```
There are 1 uniques categories.
```

In [136]:
```
def addToMap(df, color, existingMap):
    for lat, lng, local, venue, venueCat in zip(df['Venue Latitude'], df['Venue Longitude'], df['Neighborhood'], df['Venue'], df[
        label = '{} ({}) - {}'.format(venue, venueCat, local)
        label = folium.Popup(label, parse_html=True)
```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```
Brent_onehot = pd.get_dummies(Brent_venues[['Venue Category']], prefix="", prefix_sep="")

# add neighborhood column back to dataframe
Brent_onehot['Neighborhood'] = Brent_venues['Neighborhood']

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

Brent_onehot.head()
```

Out[138]:

	Neighborhood	Hospital
0	Brondesbury	1
1	Kilburn	1
2	Willesden	1

In [139]:
```
Brent_grouped = Brent_onehot.groupby('Neighborhood').mean().reset_index()
Brent_grouped
```

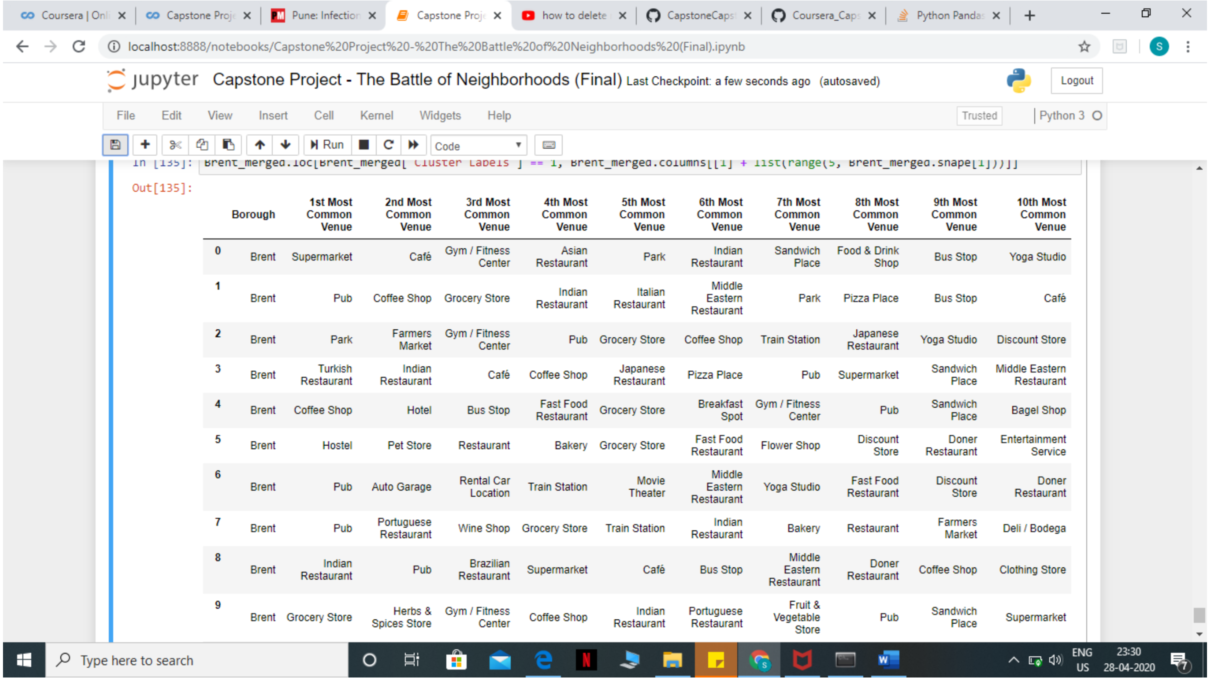
Out[139]:

	Neighborhood	Hospital
0	Brondesbury	1
1	Kilburn	1
2	Willesden	1

In [140]:
```
Brent_grouped.columns
```

Below, screenshot provide venues with restaurants and malls located with help of **Foursquare API** which can be converted to institutional quarantine places.

We can select the cluster with maximum no. of restaurants and studios available which can be utilized to fight the coronavirus pandemic n the region.



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```
In [135]: Brent_merged.loc[Brent_merged['Cluster Labels'] == 1, Brent_merged.columns[[1] + list(range(5, Brent_merged.shape[1]))]]
```

Out[135]:

	Borough	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
0	Brent	Supermarket	Café	Gym / Fitness Center	Asian Restaurant	Park	Indian Restaurant	Sandwich Place	Food & Drink Shop	Bus Stop	Yoga Studio
1	Brent	Pub	Coffee Shop	Grocery Store	Indian Restaurant	Italian Restaurant	Middle Eastern Restaurant	Park	Pizza Place	Bus Stop	Café
2	Brent	Park	Farmers Market	Gym / Fitness Center	Pub	Grocery Store	Coffee Shop	Train Station	Japanese Restaurant	Yoga Studio	Discount Store
3	Brent	Turkish Restaurant	Indian Restaurant	Café	Coffee Shop	Japanese Restaurant	Pizza Place	Pub	Supermarket	Sandwich Place	Middle Eastern Restaurant
4	Brent	Coffee Shop	Hotel	Bus Stop	Fast Food Restaurant	Grocery Store	Breakfast Spot	Gym / Fitness Center	Pub	Sandwich Place	Bagel Shop
5	Brent	Hostel	Pet Store	Restaurant	Bakery	Grocery Store	Fast Food Restaurant	Flower Shop	Discount Store	Doner Restaurant	Entertainment Service
6	Brent	Pub	Auto Garage	Rental Car Location	Train Station	Movie Theater	Middle Eastern Restaurant	Yoga Studio	Fast Food Restaurant	Discount Store	Doner Restaurant
7	Brent	Pub	Portuguese Restaurant	Wine Shop	Grocery Store	Train Station	Indian Restaurant	Bakery	Restaurant	Farmers Market	Deli / Bodega
8	Brent	Indian Restaurant	Pub	Brazilian Restaurant	Supermarket	Café	Bus Stop	Middle Eastern Restaurant	Doner Restaurant	Coffee Shop	Clothing Store
9	Brent	Grocery Store	Herbs & Spices Store	Gym / Fitness Center	Coffee Shop	Indian Restaurant	Portuguese Restaurant	Fruit & Vegetable Store	Pub	Sandwich Place	Supermarket