

# The Battle of Neighborhoods

**Coursera Capstone Project**



**Explore restaurants in  
Lisbon's Famous Viewpoints**

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# 1. Introduction

This final project explores the famous Viewpoints that exist in Lisbon, regarding the type of restaurants. The goal is to understand the number and type of restaurants present at these specific locations – an information that can be helpful to business personnel who wants to invest or open a restaurant or for a tourist looking for the best places to visit.

Lisbon is the stunning capital city of Portugal, and is one of the most charismatic and vibrant cities of Europe, with an estimated population of 505,526 within its administrative limits in an area of 100.05 km. Lisbon's superb natural setting, spread across seven hills facing the Tagus River, offers a network of terraces from which to contemplate the beauty of the city, that are perfect spots to enjoy the sunset. For that reason, rooftop bars and restaurants are very common and popular at these locations with diverse types of food offer since Portuguese food, Mediterranean, Tapas, among others.

## 1.1. Business problem

The aim of this project is to understand the spatial distribution of the official Viewpoints of Lisbon, and the number and type of restaurants that exist at each one of them in order to understand which locations would be better to open a restaurant or to plan a trip, and what type of food is popular.

## 2. Target Audience

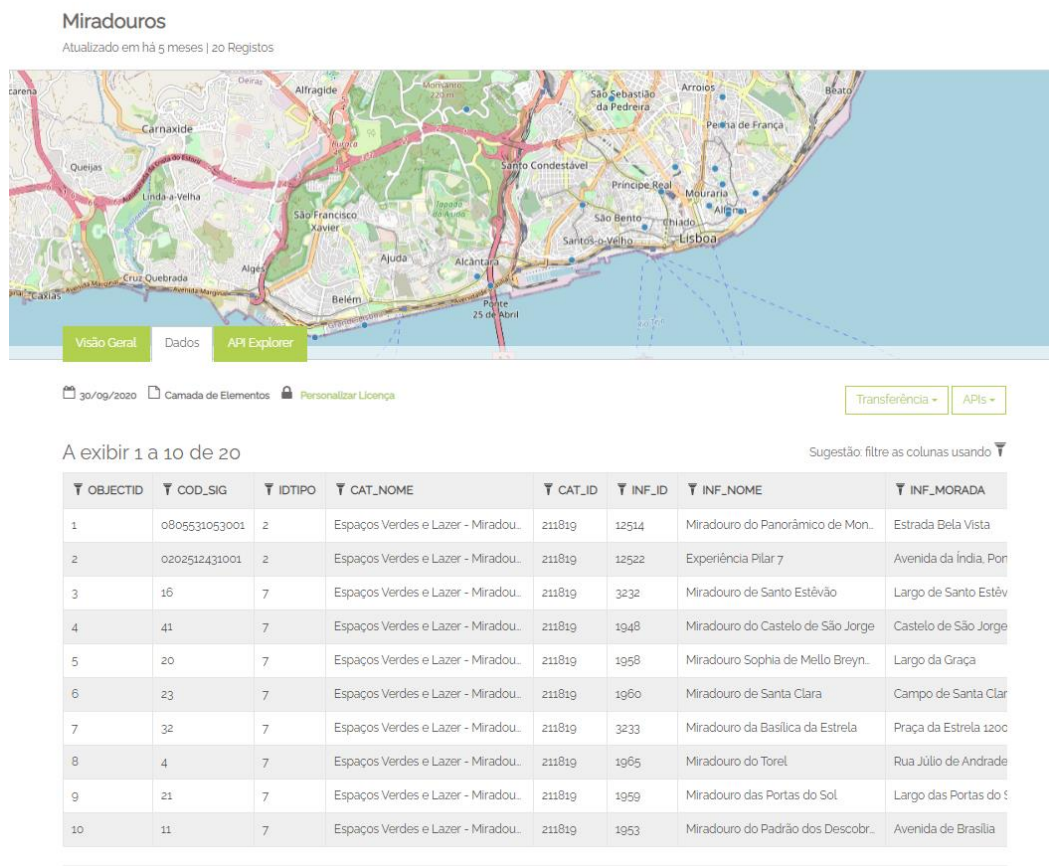
The target of audience for this problem includes:

1. Business entrepreneur who wants to invest or open a restaurant.
2. Tourist who wants to understand the best Viewpoints to visit.
3. A local person who wants to know the best locations to enjoy a meal at the end of the day or schedule an event.
4. A Business Analyst or Data scientist who want to implement exploratory Data Analysis techniques to obtain and analyze data to solve a problem.

### 3. Data section

To solve this problem, the first data required is a dataset of the Viewpoints of Lisbon, regarding its Name and Location. Since there are numerous Viewpoints known, but not all of them are considered official, the data source must be chosen carefully.

Lisbon’s City Council website (<https://www.lisboa.pt>) is the first source that should be consulted. Luckily, it contains the information that is required. This is the page dedicated to Viewpoints:



<https://geodados-cml.hub.arcgis.com/datasets/miradouros/data?geometry=-9.366%2C38.688%2C-8.975%2C38.735>

The table contains the following information for each Viewpoint:

- ID
- Name
- Address
- Phone Number
- Fax
- Email
- Website
- Description
- Municipal Information
- Coordinates

Since the essential information for this project is Name and Location, this dataset is appropriated. So, the next step is to scrape this dataset. After using BeautifulSoup to scrape information from web pages, create a Dataframe and populate it with the content of the website, a complete dataframe is obtained.

Scraping the dataset from the Web Page of Lisbon's City Council

```
In [3]: list_url = "https://geodados-cml.hub.arcgis.com/datasets/miradouros/data"
source = requests.get(list_url).text
soup = BeautifulSoup(source, 'html')
table=soup.find('table')

In [4]: #Create dataframe
column_names = ['OBJECTID','COD_SIG','IDTIPO','CAT_NOME','CAT_ID','INF_ID','INF_NOME','INF_MORADA','INF_TELEFONE','INF_FAX','INF_EMAIL','INF_SITE','INF_DESCRICAO','INF_AUTOR_DESCRICAO','INF_FONTE','INF_OBS','INF_ACTIVO','INF_MUNICIPAL','Globalizacao']
df = pd.DataFrame(columns = column_names)

In [5]: for tr_cell in table.find_all('tr'):
row_data=[]
for td_cell in tr_cell.find_all('td'):
row_data.append(td_cell.text.strip())
if len(row_data)==31:
df.loc[len(df)] = row_data

df
```

OBJECTID	COD_SIG	IDTIPO	CAT_NOME	CAT_ID	INF_ID	INF_NOME	INF_MORADA	INF_TELEFONE	INF_FAX	INF_EMAIL	INF_SITE	INF_DESCRICAO	INF_AUTOR_DESCRICAO	INF_FONTE	INF_OBS	INF_ACTIVO	INF_MUNICIPAL
0	1	0805531053001	Espacos Verdes e Lazer - Miradouros	211819	12514	Miradouro do Panorâmico de Monsanto	Estrada Bela Vista	None	None	None	None	Localizado no Parque Florestal de Monsanto, na...	None	DMEVAE	None	1	0
1	2	0202512431001	Espacos Verdes e Lazer - Miradouros	211819	12522	Experiência Pilar 7	Avenida da Índia, Pórtico 25 de Abril - Pilar 7	+351 211117880	None	info@ismarketing.pt	www.vislisboa.com	None	None	www.vislisboa.com	None	1	0
2	3	16	Espacos Verdes e Lazer - Miradouros	211819	3232	Miradouro de Santo Estêvão	Largo de Santo Estêvão	+351 213 912 600	None	daev@cm-lisboa.pt	None	Situado no coração da Alfama, do adro da Igreja...	None	-	SG/DMC	1	0
3	4	41	Espacos Verdes e Lazer - Miradouros	211819	1948	Miradouro do Castelo de São Jorge	Castelo de São Jorge	+351 218 800 620	None	info@castelodesaogorge.pt	www.castelodesaogorge.pt	O Castelo de São Jorge oferece uma vista privi...	Isabel Santos	-	None	1	0
4	5	20	Espacos Verdes e Lazer - Miradouros	211819	1958	Miradouro de Sophia de Mello Breyner Andersen (M...	Largo da Graça	(351) 213 912 600	None	daev@cm-lisboa.pt	None	Localizado junto à Igreja e antigo Convento da...	Olas Afacinhãs: Guia Ambiental de Lisboa - I...	-	None	1	1
5	6	23	Espacos Verdes e Lazer - Miradouros	211819	1960	Miradouro de Santa Clara	Campo de Santa Clara	+351 218 533 270	None	daev@cm-lisboa.pt	None	É um ponto alto da cidade com vista panorâmica...	None	-	SG/DMC	1	0
6	7	32	Espacos Verdes e Lazer - Miradouros	211819	3233	Miradouro da Basílica da Estrela	Praca da Estrela 1200-667 LISBOA	+351 213 960 915	None	None	None	Do zimbório desfruta-se de bela vista a oeste...	None	-	SG/DMC	1	0
7	8	4	Espacos Verdes e Lazer - Miradouros	211819	1965	Miradouro do Torel	Rua Júlio de Andrade	None	None	None	None	Deste miradouro disfruta-se de uma vista desaf...	None	-	SG/DMC	1	0
8	9	21	Espacos Verdes e Lazer - Miradouros	211819	1959	Miradouro das Portas do Sol	Largo das Portas do Sol	+351 213 912 600	None	daev@cm-lisboa.pt	None	Localizado no Largo das Portas do Sol, daí o s...	http://revelar.cm-lisboa.pt, www.guladacidad...	-	None	1	1
9	10	11	Espacos Verdes e Lazer - Miradouros	211819	1953	Miradouro do Padão dos Descobrimentos	Avenida de Brasília	+351 213 031 950	None	info@padraosdescobrimentos.pt	www.padraosdescobrimentos.pt	No terraço existe um espectáculo miradouro, do...	None	-	None	1	1

In [11]: df.shape

Out[11]: (20, 19)

Since the website also provides a shape file (GeoJson), the table can also be extracted just by using the link:

```
Lisbon_viewpoints_geodf = gpd.read_file('https://opendata.arcgis.com/datasets/02763aa9ec6b4d719841f713e682b12a_1.geojson')
df = Lisbon_viewpoints_geodf
```

Let's then use this table since it additionally contains the coordinates of each Viewpoint:

NICIPAL	GlobalID	geometry
0	6eed37fd-2b1c-4d74-bf46-651b8b94737d	POINT (-9.18461 38.72862)
0	783577af-9715-49a8-a797-b6cef6a60d69	POINT (-9.17955 38.70001)
0	51166c6a-a6bf-4d6a-9fdf-b2490dc737b6	POINT (-9.12773 38.71207)
0	8ced2062-5a41-479a-927f-d17cadd6352a	POINT (-9.13421 38.71299)
	fd0f6c8ba	

Now the complete dataset contains many different information. However, for this problem, the only information needed is Name, Address and Coordinates, so we can create a second dataframe with only this information. Let's also change the columns name for it to be easily understood, and create two new columns for Latitude and Longitude, extracting the values from the "geometry" column:

```
: from shapely.wkt import loads as load_wkt
centroid_list = []

for polygon in df_lisbonviews["Coordinates"]:
    box_str = str(polygon)
    p1 = load_wkt(box_str)
    point = p1.centroid
    # print(type(p1.centroid.x))
    # print(p1.centroid.y)
    centroid_list.append((p1.centroid.y, p1.centroid.x))

lat_centr, lon_centr = zip(*centroid_list)

df_lisbonviews['Latitude'] = lat_centr
df_lisbonviews['Longitude'] = lon_centr

df_lisbonviews.head(10)
```



The final dataset:

	Viewpoint	Adress	Latitude	Longitude
0	Miradouro do Panorâmico de Monsanto	Estrada Bela Vista	38.728618	-9.184607
1	Experiência Pilar 7	Avenida da Índia, Ponte 25 de Abril - Pilar 7	38.700008	-9.179553
2	Miradouro de Santo Estêvão	Largo de Santo Estêvão	38.712070	-9.127729
3	Miradouro do Castelo de São Jorge	Castelo de São Jorge	38.712991	-9.134210
4	Miradouro Sophia de Mello Breyner Andresen (Mi...	Largo da Graça	38.716427	-9.131584
5	Miradouro de Santa Clara	Campo de Santa Clara	38.714970	-9.124694
6	Miradouro da Basílica da Estrela	Praça da Estrela\n1200-667 LISBOA	38.713097	-9.160581
7	Miradouro do Torel	Rua Júlio de Andradel	38.719323	-9.141286
8	Miradouro das Portas do Sol	Largo das Portas do Sol\n	38.712346	-9.130366
9	Miradouro do Padrão dos Descobrimentos	Avenida de Brasília\n	38.693614	-9.205697
10	Miradouro da Rocha de Conde de Óbidos	Rua Presidente Arriaga;	38.704181	-9.162765
11	Miradouro da Penha de França	Largo da Penha de França\n1170-298 LISBOA	38.730633	-9.131550
12	Miradouro de Santa Luzia	Largo de Santa Luzia\n	38.711646	-9.130360
13	Miradouro de Santo Amaro	Calçada de Santo Amaro	38.701464	-9.182371
14	Miradouro do Parque Eduardo VII	Alameda Cardeal Cerejeira\n	38.730358	-9.154480
15	Miradouro de São Pedro de Alcântara	Rua de São Pedro de Alcântara	38.715299	-9.144277
16	Miradouro do Monte Agudo	Rua Heliodoro Salgado	38.726145	-9.131528
17	Miradouro da Torre de Belém	Avenida de Brasília\n1400-038	38.691578	-9.215928
18	Miradouro de Santa Catarina	Rua de Santa Catarina\n1200-403 LISBOA	38.709515	-9.147672
19	Miradouro da Senhora do Monte	Largo do Monte\n	38.718975	-9.132994

### 3. Approach

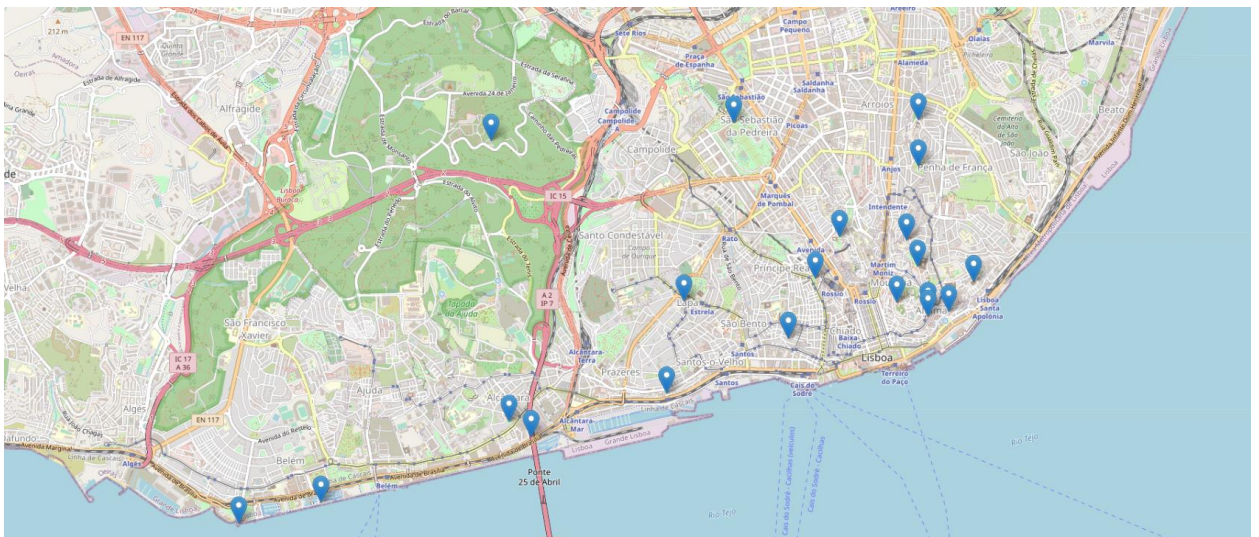
With this clear and simple dataset, is possible to visually analyze the locations of each viewpoint and explore, through the Foursquare API, the venues near this locations. Therefore, the following approach will be realized:

- Visualize the distribution of Viewpoints using Folium
- Use Foursquare API to get all venues for each Viewpoint
- Map the distribution of venues around Viewpoints (Folium)
- Analysis to find the most common types of restaurants
- Analyzing using Clustering (K-Means)
- Compare the different clusters in terms of Location and Number/Type of restaurants
- Inference From these Results and related Conclusions

## 4. Methodology

### 4.1 Visualize Viewpoints Distribution

To visually explore the locations of each Viewpoint the “Folium” python library was used to create an interactive map of Lisbon with markers for each Viewpoint, considering the coordinate data. The following map was obtained:



### 4.2 Get nearby venues

To retrieve the information about the Venues near the Viewpoint’s location, the Foursquare API was used. Since, from the previous map, is possible to see that several Viewpoints are localized near each other, a radius of 1000 meters was chosen.

```
lisbon_viewpoints_venues = getNearbyRestaurants(names=df_lisbonviews['Viewpoint'],
                                                  latitudes=df_lisbonviews['Latitude'],
                                                  longitudes=df_lisbonviews['Longitude'],
                                                  radius=1000)
```

```
print(lisbon_viewpoints_venues.shape)
lisbon_viewpoints_venues.head(20)
```

```
(1733, 7)
```

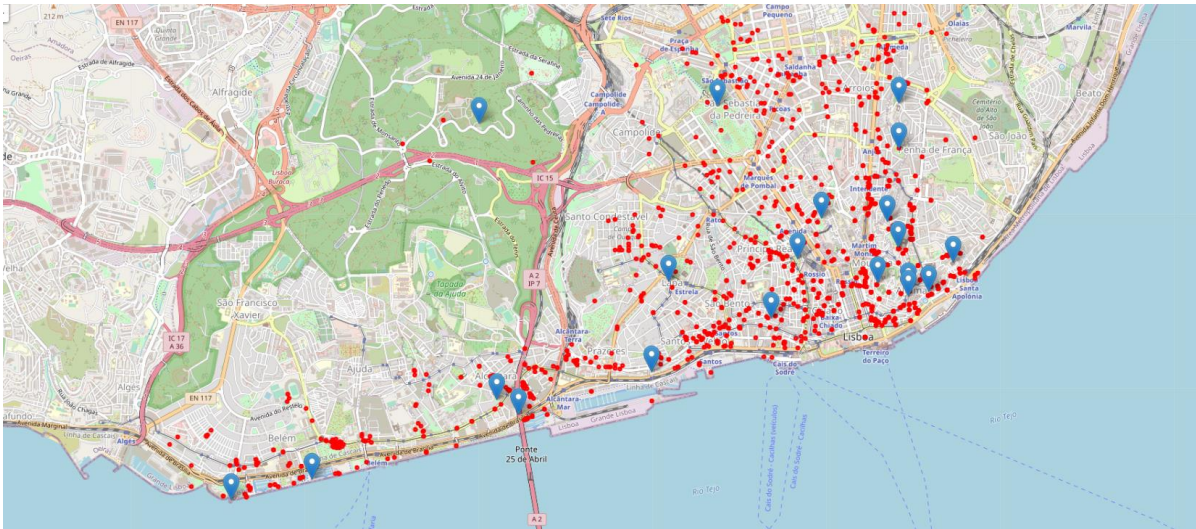


1733 venues are retrieved from Foursquare API.  
The first 20 rows of the dataset obtained:

	Viewpoint	Viewpoint Latitude	Viewpoint Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Miradouro do Panorâmico de Monsanto	38.728618	-9.184607	Messe Monsanto	38.729066	-9.189070	Portuguese Restaurant
1	Miradouro do Panorâmico de Monsanto	38.728618	-9.184607	Monte Verde	38.726703	-9.194175	Portuguese Restaurant
2	Miradouro do Panorâmico de Monsanto	38.728618	-9.184607	Restaurante Monteverde	38.725040	-9.190780	Portuguese Restaurant
3	Miradouro do Panorâmico de Monsanto	38.728618	-9.184607	Pastelaria Snack Bar Creme e Canela	38.724917	-9.177665	Breakfast Spot
4	Miradouro do Panorâmico de Monsanto	38.728618	-9.184607	Papagaio da Serafina	38.733658	-9.177860	Portuguese Restaurant
5	Experiência Pilar 7	38.700008	-9.179553	Village Underground	38.700861	-9.178150	Café
6	Experiência Pilar 7	38.700008	-9.179553	Rio Maravilha	38.701798	-9.178076	Portuguese Restaurant
7	Experiência Pilar 7	38.700008	-9.179553	5 Oceanos	38.699654	-9.178412	Seafood Restaurant
8	Experiência Pilar 7	38.700008	-9.179553	A Padaria Portuguesa	38.702512	-9.180872	Bakery
9	Experiência Pilar 7	38.700008	-9.179553	1300 Taberna	38.702888	-9.178968	Restaurant
10	Experiência Pilar 7	38.700008	-9.179553	Doca de Santo	38.700551	-9.176251	Restaurant
11	Experiência Pilar 7	38.700008	-9.179553	Don Pomodoro	38.699638	-9.178586	Italian Restaurant
12	Experiência Pilar 7	38.700008	-9.179553	Rui dos Pregos	38.700079	-9.175933	Steakhouse
13	Experiência Pilar 7	38.700008	-9.179553	The Therapist	38.701634	-9.177599	Comfort Food Restaurant
14	Experiência Pilar 7	38.700008	-9.179553	Cucurico	38.702564	-9.178860	BBQ Joint
15	Experiência Pilar 7	38.700008	-9.179553	Café Dias	38.702917	-9.184385	Café
16	Experiência Pilar 7	38.700008	-9.179553	O Mercado	38.705005	-9.178732	Mediterranean Restaurant
17	Experiência Pilar 7	38.700008	-9.179553	Cantina LX Factory	38.703228	-9.178896	Portuguese Restaurant
18	Experiência Pilar 7	38.700008	-9.179553	A Tapadinha	38.706576	-9.178730	Eastern European Restaurant
19	Experiência Pilar 7	38.700008	-9.179553	chef nino	38.703059	-9.178802	Café

### 4.3 Analyze venues data

First, visualize the venues distribution in the map of Lisbon’s viewpoints would be interesting the see the density for each location. For that, Folium was used, and the following map was generated:



By grouping the venues by Viewpoint, is possible to see how many places exist for each Viewpoint:

```
: resDF = venues_unique.groupby('Viewpoint').size().reset_index(name='Counts')
resDF
```

2]:

	Viewpoint	Counts
0	Experiência Pilar 7	44
1	Miradouro Sophia de Mello Breyner Andresen (Mi...	100
2	Miradouro da Basílica da Estrela	100
3	Miradouro da Penha de França	100
4	Miradouro da Rocha de Conde de Óbidos	88
5	Miradouro da Senhora do Monte	100
6	Miradouro da Torre de Belém	39
7	Miradouro das Portas do Sol	100
8	Miradouro de Santa Catarina	100
9	Miradouro de Santa Clara	100
10	Miradouro de Santa Luzia	100
11	Miradouro de Santo Amaro	83
12	Miradouro de Santo Estêvão	100
13	Miradouro de São Pedro de Alcântara	100
14	Miradouro do Castelo de São Jorge	100
15	Miradouro do Monte Agudo	100
16	Miradouro do Padrão dos Descobrimentos	74
17	Miradouro do Panorâmico de Monsanto	5
18	Miradouro do Parque Eduardo VII	100
19	Miradouro do Torel	100

Besides, let's analyze the category of venues retrieved, grouping by Venue Category

```
: venueDF = venues_unique.groupby('Venue Category').size().reset_index(name='Counts')
venueDF.sort_values(by=['Counts'], ascending=False).head(10)
```

3]:

	Venue Category	Counts
46	Portuguese Restaurant	502
48	Restaurant	177
12	Café	175
34	Indian Restaurant	84
7	Bakery	75
38	Mediterranean Restaurant	64
65	Vegetarian / Vegan Restaurant	46
52	Seafood Restaurant	46
35	Italian Restaurant	41
44	Pizza Place	35

It's possible to see that Portuguese Restaurants is, by far, the most common type of restaurant.

To better analyze the restaurants in each Viewpoint, one hot encoding was used, and the mean of the frequency of occurrence of each category was obtained:

lisbonviews\_onehot = pd.get\_dummies(venues\_unique['Venue Category'])  
lisbonviews\_onehot.insert(loc=0, column='Viewpoint', value=venues\_unique['Viewpoint'])  
lisbonviews\_grouped = lisbonviews\_onehot.groupby('Viewpoint').mean().reset\_index()  
lisbonviews\_grouped.head(10)

24]:

Viewpoint	African Restaurant	American Restaurant	Argentinian Restaurant	Asian Restaurant	Australian Restaurant	BBQ Joint	Bagel Shop	Bakery	Bistro	Brazilian Restaurant	Breakfast Spot	Burger Joint	Café	Cajun / Creole Restaurant	Chinese Restaurant	Comfort Food Restaurant	Creperie	Deli / Bodega	Diner	Doner Restaurant	Eastern European Restaurant	Empanada Restaurant	Falafel Restaurant	Fast Food Restaurant	Food Court	Food Stand	
0	Experiência Pilar ?	0.00	0.000000	0.022727	0.00	0.00	0.045455	0.00	0.068182	0.00	0.00	0.022727	0.000000	0.090909	0.00	0.00	0.022727	0.00	0.000000	0.000000	0.00	0.022727	0.00	0.000000	0.000000	0.00	0.00
1	Miradouro Sophia de Mello Breyner Andresen (Ml.)	0.00	0.010000	0.000000	0.01	0.00	0.010000	0.00	0.050000	0.02	0.01	0.020000	0.000000	0.130000	0.00	0.03	0.010000	0.01	0.000000	0.000000	0.00	0.000000	0.01	0.000000	0.000000	0.00	0.01
2	Miradouro da Basílica da Estrela	0.01	0.000000	0.000000	0.00	0.01	0.020000	0.01	0.040000	0.01	0.00	0.040000	0.020000	0.080000	0.00	0.01	0.000000	0.00	0.010000	0.000000	0.00	0.000000	0.00	0.010000	0.000000	0.00	0.00
3	Miradouro da Penha de França	0.00	0.000000	0.000000	0.02	0.00	0.030000	0.01	0.070000	0.00	0.01	0.010000	0.010000	0.160000	0.00	0.01	0.000000	0.00	0.010000	0.000000	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.00
4	Miradouro da Rocha de Conde de Odivos	0.00	0.011364	0.000000	0.00	0.00	0.022727	0.00	0.034091	0.00	0.00	0.022727	0.011364	0.056818	0.00	0.00	0.000000	0.00	0.011364	0.011364	0.00	0.000000	0.00	0.011364	0.011364	0.00	0.00
5	Miradouro da Senhora do Monte	0.00	0.010000	0.000000	0.01	0.00	0.010000	0.00	0.050000	0.02	0.01	0.030000	0.000000	0.140000	0.00	0.03	0.010000	0.01	0.000000	0.000000	0.00	0.000000	0.01	0.000000	0.000000	0.00	0.01
6	Miradouro da Torre de Belém	0.00	0.000000	0.000000	0.00	0.00	0.000000	0.00	0.051262	0.00	0.00	0.000000	0.051262	0.179437	0.00	0.00	0.000000	0.00	0.000000	0.025641	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.00
7	Miradouro das Portas do Sol	0.02	0.000000	0.000000	0.00	0.00	0.010000	0.00	0.020000	0.03	0.01	0.010000	0.010000	0.110000	0.00	0.01	0.010000	0.01	0.000000	0.000000	0.00	0.000000	0.01	0.000000	0.000000	0.00	0.00
8	Miradouro de Santa Catarina	0.00	0.000000	0.010000	0.01	0.01	0.000000	0.00	0.040000	0.02	0.02	0.020000	0.030000	0.060000	0.00	0.00	0.010000	0.00	0.020000	0.000000	0.00	0.000000	0.00	0.000000	0.000000	0.02	0.00
9	Miradouro de Santa Clara	0.02	0.000000	0.000000	0.01	0.00	0.010000	0.00	0.050000	0.04	0.00	0.030000	0.010000	0.130000	0.00	0.03	0.010000	0.01	0.010000	0.000000	0.00	0.000000	0.01	0.000000	0.000000	0.00	0.01

To return the most common venues for each row, the following function was used:

```
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]
```

And the 10 most common venues for each Viewpoint were obtained:

```
num_top_venues = 10

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

# create columns according to number of top venues
columns = ['Viewpoint']
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
lisbonviewpoint_venues_sorted = pd.DataFrame(columns=columns)
lisbonviewpoint_venues_sorted['Viewpoint'] = lisbonviews_grouped['Viewpoint']

for ind in np.arange(lisbonviews_grouped.shape[0]):
    lisbonviewpoint_venues_sorted.iloc[ind, 1:] = return_most_common_venues(lisbonviews_grouped.iloc[ind, :], num_top_venues)

lisbonviewpoint_venues_sorted.head(10)
```

	Viewpoint	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	Experiência Pilar 7	Restaurant	Portuguese Restaurant	Mediterranean Restaurant	Café	Bakery	Seafood Restaurant	Italian Restaurant	Pizza Place	BBQ Joint	Sushi Restaurant
1	Miradouro Sophia de Mello Breyner Andersen (Bh.)	Portuguese Restaurant	Café	Indian Restaurant	Restaurant	Mediterranean Restaurant	Bakery	Chinese Restaurant	Vegetarian / Vegan Restaurant	Seafood Restaurant	Breakfast Spot
2	Miradouro da Basílica da Estrela	Portuguese Restaurant	Café	Restaurant	Vegetarian / Vegan Restaurant	Seafood Restaurant	Indian Restaurant	Italian Restaurant	Breakfast Spot	Bakery	Steakhouse
3	Miradouro da Penha de França	Portuguese Restaurant	Café	Indian Restaurant	Restaurant	Bakery	Italian Restaurant	Vegetarian / Vegan Restaurant	Seafood Restaurant	Pizza Place	BBQ Joint
4	Miradouro da Rocha de Conde de Óbidos	Portuguese Restaurant	Restaurant	Café	Mediterranean Restaurant	Italian Restaurant	Seafood Restaurant	Tapas Restaurant	Bakery	Breakfast Spot	Mexican Restaurant
5	Miradouro da Senhora do Monte	Portuguese Restaurant	Café	Indian Restaurant	Restaurant	Bakery	Vegetarian / Vegan Restaurant	Seafood Restaurant	Breakfast Spot	Mediterranean Restaurant	Chinese Restaurant
6	Miradouro da Torre de Belém	Portuguese Restaurant	Café	Restaurant	Food Truck	Japanese Restaurant	Sushi Restaurant	Bakery	Burger Joint	Seafood Restaurant	Indian Restaurant
7	Miradouro das Portas do Sol	Portuguese Restaurant	Café	Restaurant	Indian Restaurant	Mediterranean Restaurant	Vegetarian / Vegan Restaurant	Bistro	African Restaurant	Snack Place	Pizza Place
8	Miradouro de Santa Catarina	Portuguese Restaurant	Restaurant	Tapas Restaurant	Café	Vegetarian / Vegan Restaurant	Italian Restaurant	Bakery	Seafood Restaurant	Peruvian Restaurant	Gastropub
9	Miradouro de Santa Clara	Portuguese Restaurant	Café	Mediterranean Restaurant	Bakery	Bistro	Vegetarian / Vegan Restaurant	Restaurant	Indian Restaurant	Chinese Restaurant	Breakfast Spot

## 4.4 Clustering the Viewpoints

With all the information collected for each Viewpoint, including the location, venues nearby and the corresponding categories, let's try to group the data to find similarities between the Viewpoints that would help analyze and conclude solutions for the problem in question. In order to do that, K-means clustering will be used. The goal of this iterative algorithm is finding K groups in the data, based on the similarity of features that are provided - in this case, the location and number and type of restaurants.

For this problem, a K=5 was defined, and the following code snippet was used:

```
: from sklearn.cluster import KMeans

# set number of clusters
kclusters = 5

lisbonviews_clustering = lisbonviews_grouped.drop('Viewpoint', 1)

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

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

27]: array([0, 1, 3, 4, 3, 1, 4, 1, 3, 1], dtype=int32)

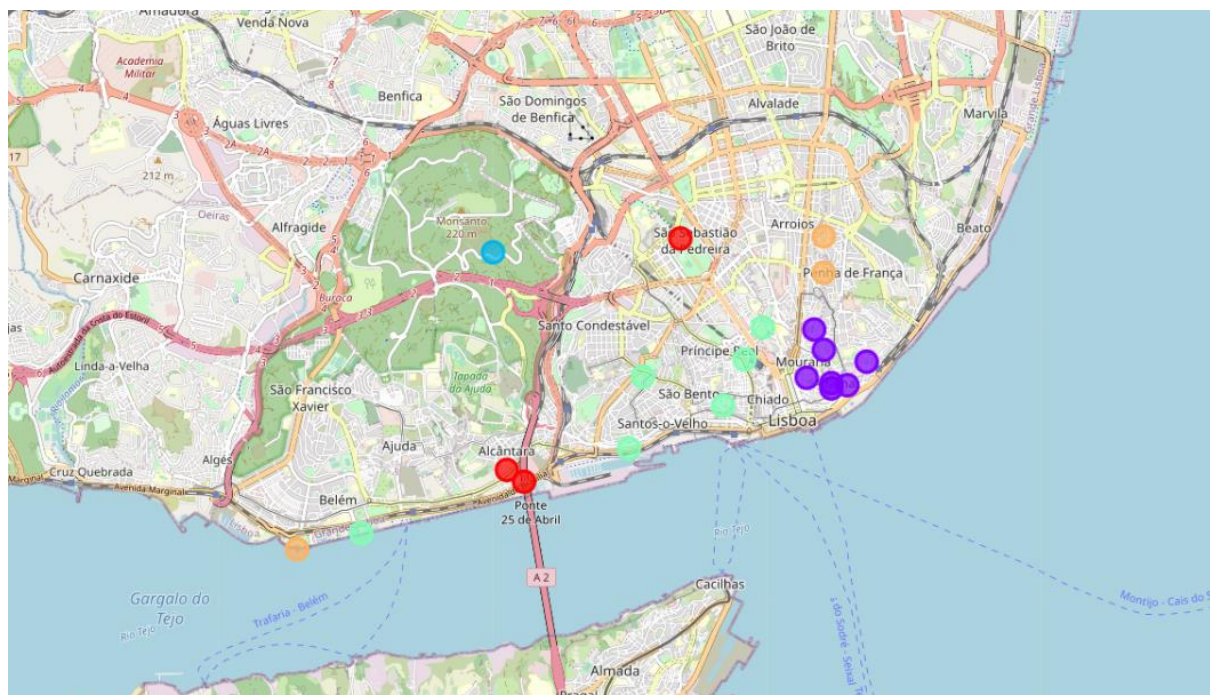
The labels retrieved from the algorithm were added to the dataframe:

```
l1sbonviewpoint_merged.head()
```

```
9]:
```

	Viewpoint	Adress	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
0	Miradouro do Panorâmico de Monsanto	Estrada Bela Vista	38.728618	-9.184687	2	Portuguese Restaurant	Breakfast Spot	Wings Joint	Fast Food Restaurant	Doner Restaurant	Eastern European Restaurant	Empanada Restaurant	Falafel Restaurant	Food Court	Deli / Bodega
1	Experiência Pilar 7	Avenida da Índia, Ponte 25 de Abril - Pilar 7	38.700008	-9.178553	0	Restaurant	Portuguese Restaurant	Mediterranean Restaurant	Café	Bakery	Seafood Restaurant	Italian Restaurant	Pizza Place	BBQ Joint	Sushi Restaurant
2	Miradouro de Santo Estêvão	Largo de Santo Estêvão	38.712070	-9.127729	1	Portuguese Restaurant	Café	Mediterranean Restaurant	Restaurant	Indian Restaurant	Bakery	Creperie	Bistro	Breakfast Spot	Snack Place
3	Miradouro do Castelo de São Jorge	Castelo de São Jorge	38.712991	-9.134210	1	Portuguese Restaurant	Restaurant	Café	Indian Restaurant	Mediterranean Restaurant	Bistro	Chinese Restaurant	Pizza Place	Burger Joint	Seafood Restaurant
4	Miradouro Sophia de Mello Breyner Andersen (M.)	Largo da Graça	38.716427	-9.131584	1	Portuguese Restaurant	Café	Indian Restaurant	Restaurant	Mediterranean Restaurant	Bakery	Chinese Restaurant	Vegetarian / Vegan Restaurant	Seafood Restaurant	Breakfast Spot

Using Folium, is possible to observe the different clusters

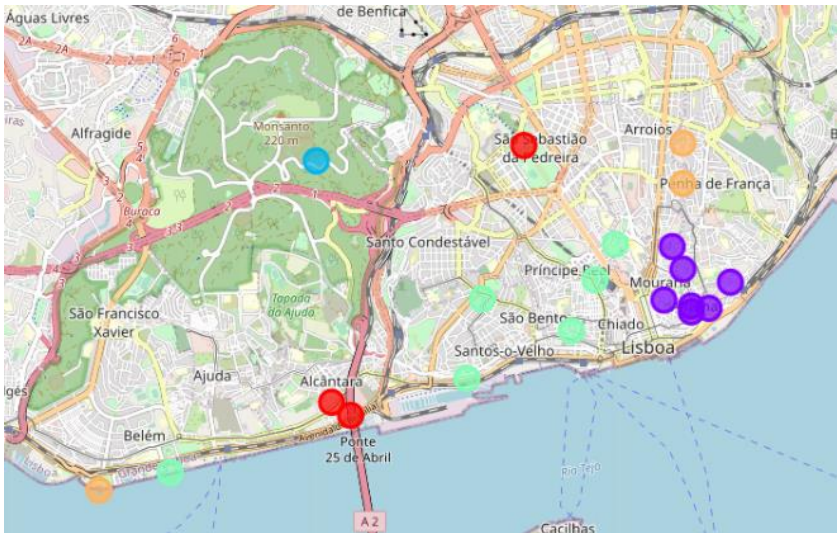


- Cluster 1: Red
- Cluster 2: Purple
- Cluster 3: Blue
- Cluster 4: Green
- Cluster 5: Orange

It is worth analyze each cluster individually.



# Cluster 1 (Red)

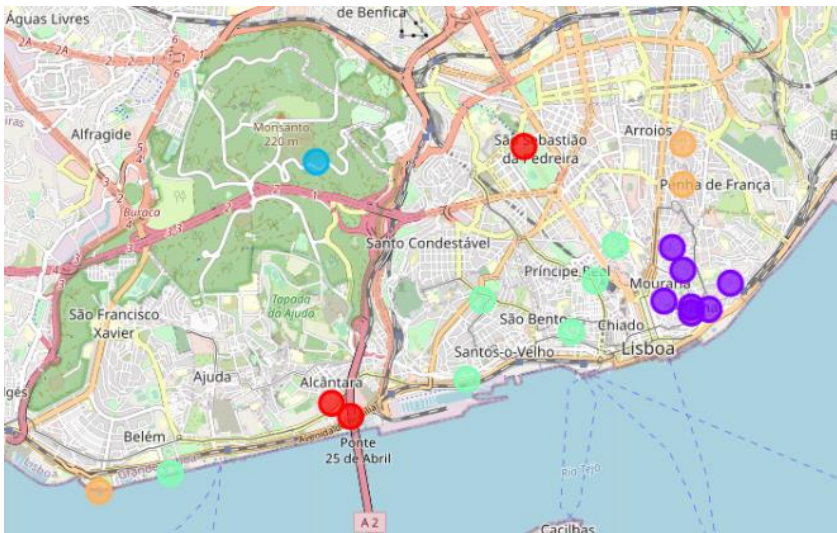


```
#Cluster 1
lisbonviewpoint_merged.loc[lisbonviewpoint_merged['Cluster Labels'] == 0, lisbonviewpoint_merged.columns[0]] = list(range(5, lisbonviewpoint_merged.shape[1]))
```

1):

	Viewpoint	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
1	Experiência Pilar 7	Restaurant	Portuguese Restaurant	Mediterranean Restaurant	Café	Mediterranean Restaurant	Café	Bakery	Seafood Restaurant	Italian Restaurant	Pizza Place
13	Miradouro de Santo Amaro	Restaurant	Portuguese Restaurant	Portuguese Restaurant	Café	Mediterranean Restaurant	Italian Restaurant	Seafood Restaurant	Bakery	Burger Joint	BBO Joint
14	Miradouro do Parque Eduardo VII	Portuguese Restaurant	Restaurant	Italian Restaurant	Café	Japanese Restaurant	Seafood Restaurant	Bakery	Burger Joint	Steakhouse	Sushi Restaurant

# Cluster 2 (Purple)



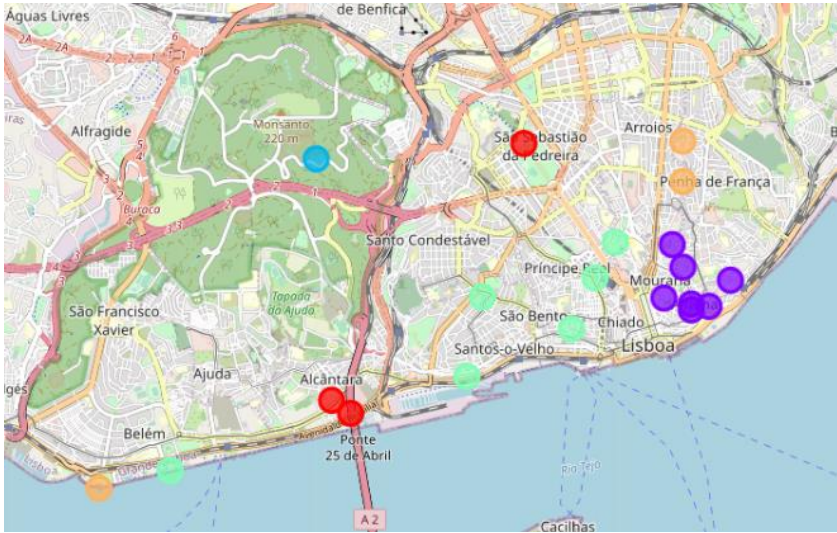
```
#Cluster 2
lisbonviewpoint_merged.loc[lisbonviewpoint_merged['Cluster Labels'] == 1, lisbonviewpoint_merged.columns[0]] = list(range(5, lisbonviewpoint_merged.shape[1]))
```

0):

	Viewpoint	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
2	Miradouro de Santo Estêvão	Portuguese Restaurant	Café	Mediterranean Restaurant	Restaurant	Indian Restaurant	Bakery	Creperie	Bistro	Breakfast Spot	Snack Place
3	Miradouro do Castelo de São Jorge	Portuguese Restaurant	Restaurant	Café	Indian Restaurant	Mediterranean Restaurant	Bistro	Chinese Restaurant	Pizza Place	Burger Joint	Seafood Restaurant
4	Miradouro Sophia de Mello Breyner Andersen (St.)	Portuguese Restaurant	Café	Indian Restaurant	Restaurant	Mediterranean Restaurant	Bakery	Chinese Restaurant	Vegetarian / Vegan Restaurant	Seafood Restaurant	Breakfast Spot
5	Miradouro de Santa Clara	Portuguese Restaurant	Café	Mediterranean Restaurant	Bakery	Bistro	Vegetarian / Vegan Restaurant	Restaurant	Indian Restaurant	Chinese Restaurant	Breakfast Spot
8	Miradouro das Pontas do Sol	Portuguese Restaurant	Café	Restaurant	Indian Restaurant	Mediterranean Restaurant	Vegetarian / Vegan Restaurant	Bistro	African Restaurant	Snack Place	Pizza Place
12	Miradouro de Santa Luzia	Portuguese Restaurant	Café	Restaurant	Indian Restaurant	Mediterranean Restaurant	Bistro	Burger Joint	Pizza Place	Snack Place	African Restaurant
19	Miradouro da Senhora do Monte	Portuguese Restaurant	Café	Indian Restaurant	Restaurant	Bakery	Vegetarian / Vegan Restaurant	Seafood Restaurant	Breakfast Spot	Mediterranean Restaurant	Chinese Restaurant



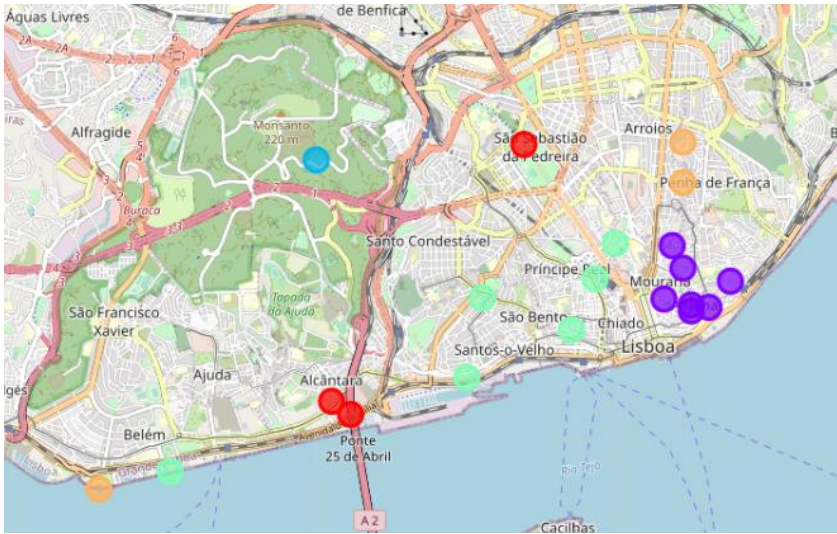
# Cluster 3 (Blue)



```
#Cluster 3
lisbonviewpoint_merged.loc[lisbonviewpoint_merged['Cluster Labels'] == 2, lisbonviewpoint_merged.columns[[0] + list(range(5, lisbonviewpoint_merged.shape[1]))]]
```

	Viewpoint	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	Miradouro do Panorâmico de Monsanto	Portuguese Restaurant	Breakfast Spot	Wings Joint	Fast Food Restaurant	Doner Restaurant	Eastern European Restaurant	Empanada Restaurant	Falafel Restaurant	Food Court	Deli / Bodega

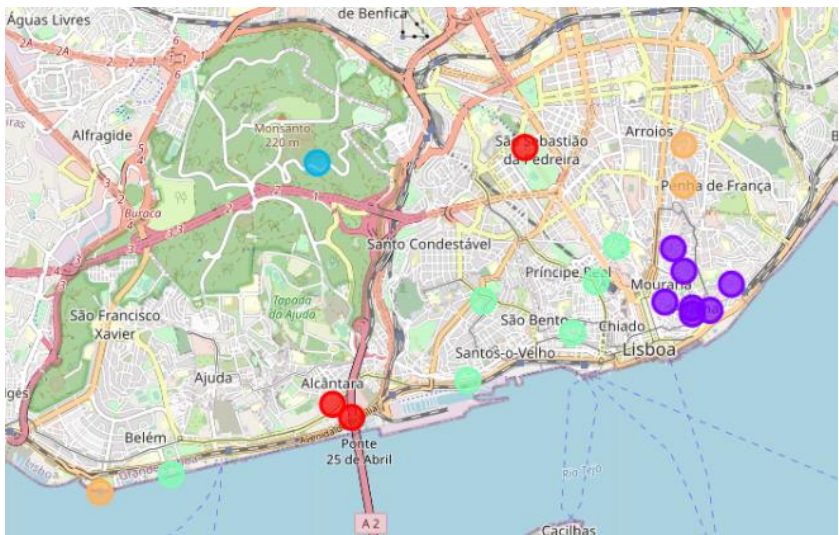
# Cluster 4 (Green)



```
#Cluster 4
lisbonviewpoint_merged.loc[lisbonviewpoint_merged['Cluster Labels'] == 3, lisbonviewpoint_merged.columns[[0] + list(range(5, lisbonviewpoint_merged.shape[1]))]]
```

	Viewpoint	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
6	Miradouro da Basílica da Estrela	Portuguese Restaurant	Café	Restaurant	Vegetarian / Vegan Restaurant	Seafood Restaurant	Indian Restaurant	Italian Restaurant	Breakfast Spot	Bakery	Steakhouse
7	Miradouro do Torel	Portuguese Restaurant	Restaurant	Café	Vegetarian / Vegan Restaurant	Indian Restaurant	Tapas Restaurant	Breakfast Spot	Pizza Place	Gastropub	Bakery
9	Miradouro do Padão dos Descobrimentos	Portuguese Restaurant	Restaurant	Café	Food Truck	Mediterranean Restaurant	Sandwich Place	Bakery	BBQ Joint	Sushi Restaurant	Japanese Restaurant
10	Miradouro da Rocha de Conde de Óbidos	Portuguese Restaurant	Restaurant	Café	Mediterranean Restaurant	Italian Restaurant	Seafood Restaurant	Tapas Restaurant	Bakery	Breakfast Spot	Mexican Restaurant
15	Miradouro de São Pedro de Alcântara	Portuguese Restaurant	Restaurant	Café	Indian Restaurant	Tapas Restaurant	Burger Joint	Seafood Restaurant	Peruvian Restaurant	Pizza Place	Russian Restaurant
16	Miradouro de Santa Catarina	Portuguese Restaurant	Restaurant	Tapas Restaurant	Café	Vegetarian / Vegan Restaurant	Italian Restaurant	Bakery	Seafood Restaurant	Peruvian Restaurant	Gastropub

## Cluster 5 (Orange)



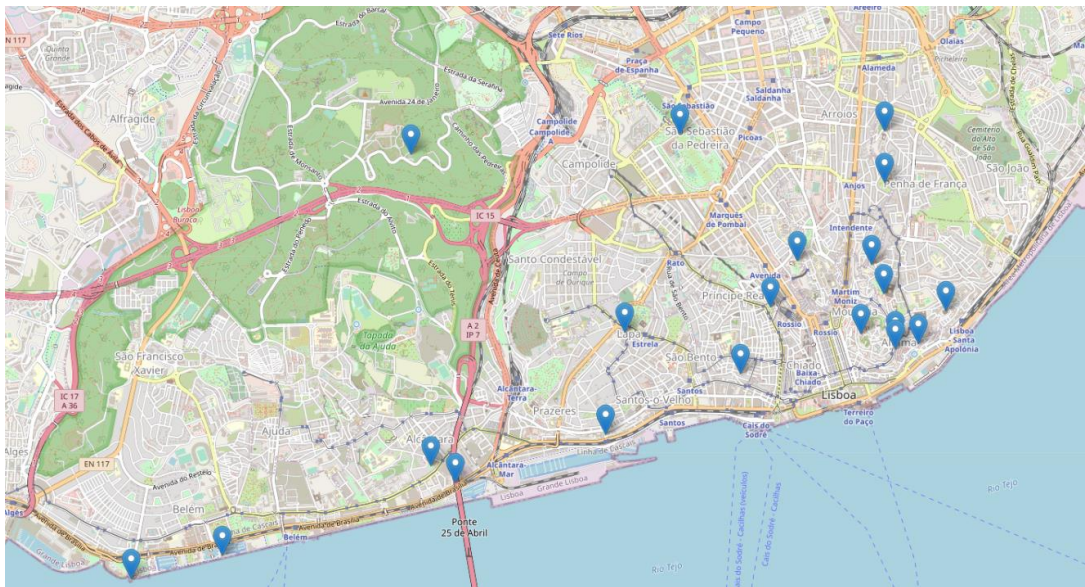
```
#Cluster 5
lisbonviewpoint_merged.loc[lisbonviewpoint_merged['Cluster_Labels'] == 4, lisbonviewpoint_merged.columns[0] + list(range(5, lisbonviewpoint_merged.shape[1]))]
```

	Viewpoint	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
11	Miradouro da Penha de França	Portuguese Restaurant	Cafe	Indian Restaurant	Restaurant	Bakery	Italian Restaurant	Vegetarian / Vegan Restaurant	Seafood Restaurant	Pizza Place	BBQ Joint
16	Miradouro do Monte Agudo	Portuguese Restaurant	Cafe	Bakery	Indian Restaurant	Restaurant	BBQ Joint	Seafood Restaurant	Vegetarian / Vegan Restaurant	Italian Restaurant	Pizza Place
17	Miradouro da Torre de Belém	Portuguese Restaurant	Cafe	Restaurant	Food Truck	Japanese Restaurant	Sushi Restaurant	Bakery	Burger Joint	Seafood Restaurant	Indian Restaurant

## 5. Results and Discussion

As presented in the beginning of this report, the aim of this project was to understand the spatial distribution of the official Viewpoints of Lisbon, and the number and type of restaurants that exist at each one of them in order to understand which locations would be better to open a restaurant or to plan a trip, and what type of food is popular.

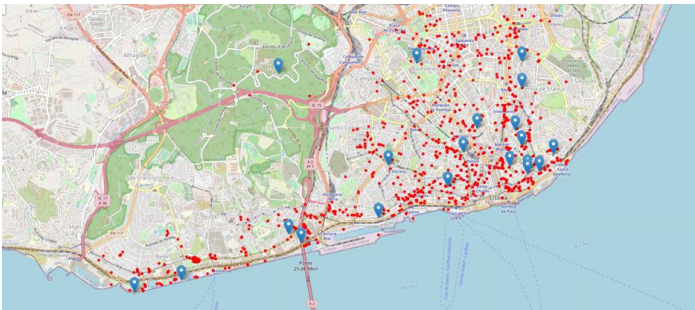
From the data preparation step, it was possible to conclude that exist 20 official Viewpoints in Lisbon, some of them spatially close to each other and other, like “Miradouro do Monsanto”, more far away.



From the map of Viewpoints together with Venue's location and Venues grouped by Viewpoint, it is possible to conclude that the Viewpoints located on the right side of the map have a lot more restaurants that the Viewpoints located more far away. For instance, “Miradouro de Monsanto”, “Miradouro da Torre de Belém” or “Experiência Pilar 7” have a much-reduced number of venues nearby, compared with the other Viewpoints.

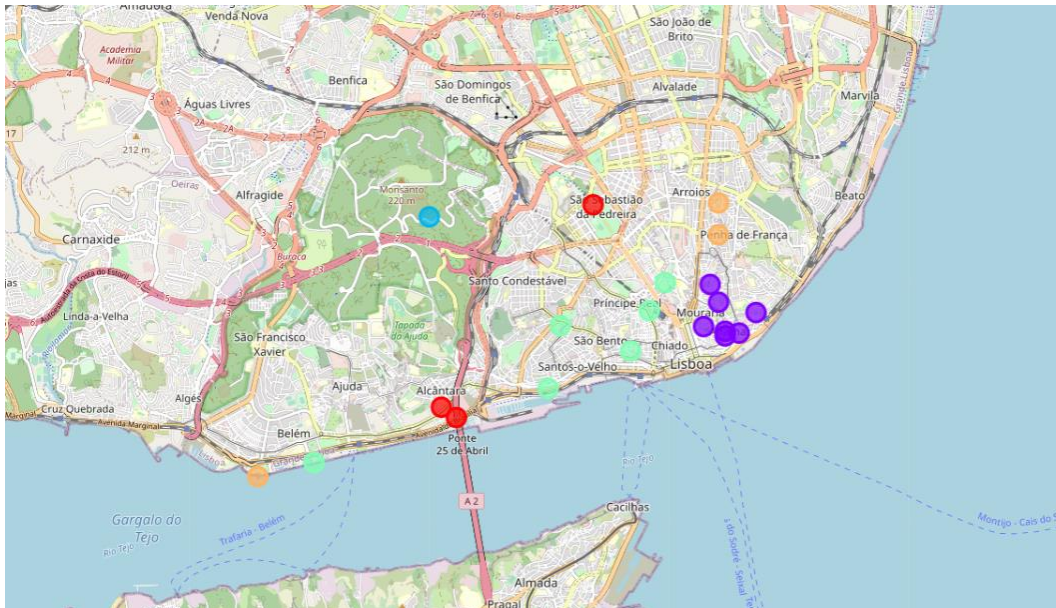
Therefore, to open a restaurant, this locations would have more potential to succeed since there are less competition. However, for a tourist planning a trip, the ViewPoints on the right side of the map like “Miradouro de Santa Catarina” or “Miradouro de Santa Clara”, would have much more offer as venues near by so would be a more interesting choice.

	Viewpoint	Counts
0	Experiência Pilar 7	44
1	Miradouro Sophia de Mello Breyner Andresen (Mi...	100
2	Miradouro da Basílica da Estrela	100
3	Miradouro da Penha de França	98
4	Miradouro da Rocha de Conde Óbidos	88
5	Miradouro da Senhora do Monte	100
6	Miradouro da Torre de Belém	40
7	Miradouro das Portas do Sol	100
8	Miradouro de Santa Catarina	100
9	Miradouro de Santa Clara	100
10	Miradouro de Santa Luzia	100
11	Miradouro de Santo Amaro	81
12	Miradouro de Santo Estêvão	100
13	Miradouro de São Pedro de Alcântara	100
14	Miradouro do Castelo de São Jorge	100
15	Miradouro do Monte Agudo	100
16	Miradouro do Padrão dos Descobrimentos	75
17	Miradouro do Panorâmico de Monsanto	5
18	Miradouro do Parque Eduardo VII	100
19	Miradouro do Torel	100





This conclusions are supported by the Clustering results. Cluster 2 (Purple) includes 7 Viewpoint's nearby that are very similar in terms of the type of restaurants present. On the other hand, Cluster 3 (Blue) or Cluster 5 (Orange) include a reduced number of Viewpoint's with similar venue categories explored, so more opportunities for business entrepreneurs.



Regarding the type of food, the most popular type of restaurant is, by far, Portuguese food, followed by Coffee Spots, being the two most popular venue categories in all clusters. Other categories include Indian restaurants, Bakery, Italian Restaurants and Breakfast Spots. Considering the less explored clusters, Cluster 3 has no Coffee Spots or Vegetarian restaurants and Viewpoints in Cluster 5 like “Miradouro da Torre de Belém” also do not have Vegetarian restaurants. Therefore, this could be promising options to open a restaurant different from what is popular, so with less competition.

## 6. Conclusion

Lisbon's viewpoints are great spots to contemplate the beauty of the city while enjoying a nice meal. The most common categories of restaurants are Portuguese Food and Coffee Spots. Some viewpoints like "Miradouro de Monsanto", "Miradouro da Torre de Belém" or "Experiência Pilar 7" have a much-reduced number of venues nearby, so this would be good spots to open a restaurant, with less competition. In such places, Coffee Spots and Vegetarian Food would be good options, since restaurants of this category are not present in this locations.

For a tourist aiming to explore the city's viewpoints, Cluster 2 is constituted by a large number of Viewpoints and Venues near each other, so this would be a great area to explore, with lots of different categories of restaurants.