Ranking hotels by the number of top attraction around them

IBM Data Science Professional Certificate Specialization Capstone Project

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Introduction

Description of the Problem

Finding the best hotel for a short stay might be tricky. On one hand, one wants to stay in a nice place, on the other, wishes to experience the local culture as much as possible.

Following report explores the feasibility of locating the best possible hotel within range of as many local attractions as possible. For the sake of the exercise the top 25 hotels in the city of Prague in Czech Republic are used.

Target audience:

- End users: with a bit of technical knowledge the approach can be utilized to identify the hotel in the city of ones choice.
- Investors: the approach can be implemented in any travel-related app

Description of the Data

The Foursquare API is used to fetch all required data:

- The list of categories supported by Foursquare. (Endpoint: categories)
- The list of the most popular local attractions in a given city. (Endpoint: explore)
- The list of the most popular hotels amongst Foursqaure users. (Endpoint: search)
- The list of the most popular local attracation around the listed hotels. (Endpoint: search)

The categories IDs from the list of categories can be used in the further API calls to Foursquare to filter results correctly.

The list of the most popular local attractions in a given city is the first of two main datasets.

The list of the most popular hotels is joined with the lists of the most popular attractions around each of them. This creates the second of two main datasets.

The main datasets are then used to to rank the hotels by the number of the top attractions around them.

Report Organization

This report is structured in the following way:

- Methodology: one finds there details about the datasets
- Results: one finds there the data analysis with visualisations
- Discussion and Conclusion: one finds there the overview of the results

Methodology

Following section describes in the details the datasets utilized in the report.

For fetching the data a python library "requests" is used. And for storing and manipulating the data - Pandas library.

Following global variables are defined for the HTTP requests: CLIENT_ID, CLIENT_SECRET, VERSION< DEFAULT_NEAR

The categories

The endpoint *categories* returns a hierarchical list of Foursquare categories, full API reference can be found here https://developer.foursquare.com/docs/api/venues/categories (https://developer.foursquare.com/docs/api/venues/categories)

The endpoint returns a JSON response and each category level is stored in an array named *category*.

The tree structure is converted to the table format containing the ID for category, the full path, and each level name.

Fetching and parsing the data

```
Shape of the dataframe (833, 5)
```

The first 10 rows:

Out[5]:

	Category Id	Category Path	Category Level 1	Category Level 2	Category Level 3
0	4d4b7104d754a06370d81259	Arts & Entertainment	Arts & Entertainment		
1	56aa371be4b08b9a8d5734db	Arts & Entertainment - Amphitheater	Arts & Entertainment	Amphitheater	
2	4fceea171983d5d06c3e9823	Arts & Entertainment - Aquarium	Arts & Entertainment	Aquarium	
3	4bf58dd8d48988d1e1931735	Arts & Entertainment - Arcade	Arts & Entertainment	Arcade	
4	4bf58dd8d48988d1e2931735	Arts & Entertainment - Art Gallery	Arts & Entertainment	Art Gallery	
5	4bf58dd8d48988d1e4931735	Arts & Entertainment - Bowling Alley	Arts & Entertainment	Bowling Alley	
6	4bf58dd8d48988d17c941735	Arts & Entertainment - Casino	Arts & Entertainment	Casino	
7	52e81612bcbc57f1066b79e7	Arts & Entertainment - Circus	Arts & Entertainment	Circus	
8	4bf58dd8d48988d18e941735	Arts & Entertainment - Comedy Club	Arts & Entertainment	Comedy Club	
9	5032792091d4c4b30a586d5c	Arts & Entertainment - Concert Hall	Arts & Entertainment	Concert Hall	

Quick inspection of the data shows that there are 833 categories and the categories structure is fetched correctly.

Identification of Hotel category ID

This is the only analysis made on the categories datasets as no other is required.

Categories containing word "Hotel" in the path:

Out[6]:

	Category Id	Category Path	Category Level 1	Category Level 2	Category Level 3
384	4bf58dd8d48988d1d5941735	Nightlife Spot - Bar - Hotel Bar	Nightlife Spot	Bar	Hotel Bar
802	4bf58dd8d48988d1fa931735	Travel & Transport - Hotel	Travel & Transport	Hotel	
803	4bf58dd8d48988d1f8931735	Travel & Transport - Hotel - Bed & Breakfast	Travel & Transport	Hotel	Bed & Breakfast
804	4f4530a74b9074f6e4fb0100	Travel & Transport - Hotel - Boarding House	Travel & Transport	Hotel	Boarding House
805	4bf58dd8d48988d1ee931735	Travel & Transport - Hotel - Hostel	Travel & Transport	Hotel	Hostel
806	4bf58dd8d48988d132951735	Travel & Transport - Hotel - Hotel Pool	Travel & Transport	Hotel	Hotel Pool
807	5bae9231bedf3950379f89cb	Travel & Transport - Hotel - Inn	Travel & Transport	Hotel	Inn
808	4bf58dd8d48988d1fb931735	Travel & Transport - Hotel - Motel	Travel & Transport	Hotel	Motel
809	4bf58dd8d48988d12f951735	Travel & Transport - Hotel - Resort	Travel & Transport	Hotel	Resort
810	56aa371be4b08b9a8d5734e1	Travel & Transport - Hotel - Vacation Rental	Travel & Transport	Hotel	Vacation Rental

As the search results shows there are multiple matching tuples: there is a seperate category for hotel bar and multiple different types of hotels and their facilities.

However, the entry in the 2nd row is the one the most interesting as it is the general *Hotel* category

Out[7]:

	Category Id	Category Path	Category Level 1	Category Level 2	Category Level 3
802	4bf58dd8d48988d1fa931735	Travel & Transport - Hotel	Travel & Transport	Hotel	

The most popular local attractions

The endpoint *explore* is used to fetch the data, full API reference cen be found here: https://developer.foursquare.com/docs/api/venues/explore (https://developer.foursquare.com/docs/api/venues/explore)

The endpoint returns a JSON response with object *groups* containing an array *items* with the list of recommended places.

The data which is the most interesting is:

- Venue ID
- Venue Name
- Venue Location: Latitude and Longitude
- Venue Category

This list is the list of *the most popular local attracation in the city*.

Fetching and parsing the data

```
Shape of the dataframe (100, 5)
```

The first 10 rows:

Out[10]:

	Venue Id	Venue Name	Venue Latitude	Venue Longitude	Venue Category
0	4adcda9ff964a520654d21e3	Stromovka	50.105098	14.421840	Park
1	4c5ed6b67735c9b617ca9272	Havlíčkovy sady (Grébovka)	50.068765	14.443674	Park
2	4b78047af964a5203bb22ee3	Letenské sady	50.096275	14.414406	Park
3	4affd3cdf964a5201c3a22e3	Vyšehrad	50.064095	14.419387	Castle
4	51c23e25498e8ef76e18c2c6	Vyhlídka Riegrovy sady	50.079692	14.440136	Scenic Lookout
5	5311ae7311d2b14c76832d24	Naše maso	50.090763	14.426960	Butcher
6	4b464feef964a520451d26e3	Kampa	50.083981	14.407711	Park
7	4bd473f46798ef3be09c618d	Vyhlídková cesta	50.085683	14.391567	Scenic Lookout
8	539842a2498ee08ed9e0b8ce	Mozzarellart	50.065568	14.439399	Cheese Shop
9	4adcdaa0f964a5209a4d21e3	Riegrovy sady	50.080498	14.441271	Park

Quick inspection of the created dataframe shows that the top 100 local attractions were fetched correctly. Each record contains the ID, the attraction Name and Category, and the GPS coordinates.

The most popular hotels

The endpoint *search* is used to fetch the data, full API reference cen be found here: https://developer.foursquare.com/docs/api/venues/search (https://developer.foursquare.com/docs/api/venues/search)

The endpoint returns a JSON response with an array *venues*.

The data which is the most interesting is:

- Hotel ID
- Hotel Name
- Hotel Location: Latitude and Longitude

This list is the list of *the most popular hotels*.

Fetching and parsing the data

List of top hotels:

Out[12]:

	Hotel Id	Hotel Name	Hotel Latitude	Hotel Longitude
0	4adcda9af964a520544c21e3	InterContinental Prague	50.091498	14.418660
1	4adcda9af964a5201e4c21e3	Hilton Prague	50.093326	14.439827
2	5c29b324c876c8002c2e181a	Pension U Čejpů	50.042537	14.439099
3	4adcda9af964a520104c21e3	Hotel International Prague	50.109227	14.393567
4	4baccb7ef964a520da0c3be3	Park Inn Hotel Prague	50.068067	14.418326
5	4adcda9af964a5202b4c21e3	Krystal Praha	50.093888	14.341170
6	4bd0fbac20cd9960319b2e9e	ibis Praha Malá Strana	50.072277	14.400727
7	4bdeeef2fe0e62b537100606	PLUS Prague Hostel	50.109367	14.451095
8	4bd0fbb220cd9960389b2e9e	Courtyard Prague Airport	50.106560	14.269609
9	5b486ba2666116002c231866	Mama Shelter	50.102394	14.431907
10	4adcda9bf964a5206d4c21e3	Hotel Josef	50.089958	14.425959
11	4bc8f38f762beee162bc3d38	Hotel Don Giovanni Prague	50.078649	14.475701
12	56e3fbfe498e069c58721350	Marriott Prague	50.088136	14.431245
13	59be43a80c9f31433b23418c	Hotel Grandium Prague	50.082160	14.429408
14	4afa73f8f964a520e51722e3	President Hotel	50.092627	14.419600
15	4bbde176593fef3b15f10356	Hotel Golf	50.067510	14.344676
16	4c3eb2f3b8b4be9abb8accef	Holiday Inn Prague Congress Centre	50.061213	14.427136
17	4adcda9af964a5206b4c21e3	Four Seasons Hotel Prague (Hotel Four Seasons ...	50.087665	14.414450
18	4adcda9af964a520204c21e3	Occidental Praha	50.043463	14.439222
19	4adcda9af964a520404c21e3	Panorama Hotel Prague	50.049091	14.437925
20	4bc5e5f56c26b713d1e7ebf3	angelo by Vienna House Prague	50.070564	14.401837
21	4b0f7f01f964a520ba6223e3	Czech Inn	50.071860	14.446652
22	4bcd56c40687ef3b4fcee0cc	Grand Majestic Plaza	50.090354	14.430538
23	4bdebff56316d13afbb7a011	ibis Praha Old Town	50.089456	14.430903
24	579d0e32498e13267828248c	Dancing House Hotel	50.075506	14.414191

Inspection of the data frame shows that 10 top hotels were fetched correctly and the hotels IDs, names and locations are available.

The most popular local attracation around the most popular hotels

The endpoint *explore* is used to fetch the data, full API reference cen be found here: https://developer.foursquare.com/docs/api/venues/explore (https://developer.foursquare.com/docs/api/venues/explore)

This endpoint has been previously described for *the most popular attractions*. The difference here is that the HTTP call is made repeatedly for each hotel of *the most popular hotels* list.

Fetching and parsing the data

```
Shape of the dataframe (1233, 7)
```

The first 10 rows:

Out[15]:

	Hotel Id	Hotel Name	Venue Id	Venue Name	
0	4adcda9af964a520544c21e3	InterContinental Prague	56aa3cca498e65a06469bda1	COS	5
1	4adcda9af964a520544c21e3	InterContinental Prague	4baa48a8f964a520025b3ae3	Mansson Danish Bakery & Café	5
2	4adcda9af964a520544c21e3	InterContinental Prague	4b604b10f964a52009de29e3	La Veranda	5
3	4adcda9af964a520544c21e3	InterContinental Prague	54058355498eb7b4830c6802	Public Interest	5
4	4adcda9af964a520544c21e3	InterContinental Prague	54f7836f498ec71694f873dc	L'Fleur Bar	5
5	4adcda9af964a520544c21e3	InterContinental Prague	4ea68cc60cd61af179e820a6	Dolce&Gabbana	5
6	4adcda9af964a520544c21e3	InterContinental Prague	4db6ed13cda1c57c828d673c	Galerie Rudolfinum	5
7	4adcda9af964a520544c21e3	InterContinental Prague	4adcda9bf964a520af4c21e3	Bugsy's Bar	5
8	4adcda9af964a520544c21e3	InterContinental Prague	4b39b9a5f964a520b95e25e3	Pastacaffé Tonino Lamborghini	5
9	4adcda9af964a520544c21e3	InterContinental Prague	4b890763f964a520f71832e3	Prada	5

The last 10 rows:

Out[16]:

	Hotel Id	Hotel Name	Venue Id	Venue Name	Venue Latitude
1223	579d0e32498e13267828248c	Dancing House Hotel	5ac521d792e7a9178809864b	Tonkin	50.074596
1224	579d0e32498e13267828248c	Dancing House Hotel	4b804499f964a5209d6230e3	Palác Žofín	50.079032
1225	579d0e32498e13267828248c	Dancing House Hotel	4c1426edb7b9c928baecaa37	Groove Bar	50.080499
1226	579d0e32498e13267828248c	Dancing House Hotel	4b6f1d2df964a520ebdd2ce3	La Casa de la Havana vieja	50.080495
1227	579d0e32498e13267828248c	Dancing House Hotel	517b846ce4b0347e198bdbe5	Brewbar Náplavka	50.070176
1228	579d0e32498e13267828248c	Dancing House Hotel	539f2926498ef1b1c9e66f6b	Funky Bee cocktail bar & lounge	50.078412
1229	579d0e32498e13267828248c	Dancing House Hotel	51422216e4b0bab05a383dd1	Železná koule - Hardstyle Gym	50.079750
1230	579d0e32498e13267828248c	Dancing House Hotel	4d8b74035ecdf04d9a0bd48a	Döner Kebab Can Bey	50.075673
1231	579d0e32498e13267828248c	Dancing House Hotel	5238702e11d2b81d38a1d358	Herní klub RE-LOAD	50.076999
1232	579d0e32498e13267828248c	Dancing House Hotel	57ae5949498ef7c5f507e8fc	Hostel Cosmopole	50.078717

Quick look at the data shows that 1000 records are correctly present, as 10 hotels times 100 attractions gives that number. There is hotel and attracation details available in each tuple.

Results

Following sections described the data analysis made on the data sets including descsriptive statistics, geospatial visualisation, model training, or plotting.

Python libraries like folium, pandas or scikit-learn are extremely useful in tasks as such.

Prague's top attractions

The number of unique top attractions categories is: 53

Those categories are: Park, Castle, Scenic Lookout, Butcher, Cheese Shop, Nature Preserve, Bridge, Zoo, Church, Paper / Office Supplies Store, Zoo Exhibit, Wine Bar, Plaza, Café, Hotel, Cocktail Bar, Steakhouse, Coffee Shop, Garden, Forest, Theater, Theme Park Ride / Attraction, Wine Shop, Indie Movie Theater, Bakery, Noodle House, Asian Restaurant, Gourmet Shop, Beer Bar, Ice Cream Shop, Movie Theater, Pool, Cosmetics Shop, Athletics & Sports, Island, Indie Theater, Art Gallery, Italian Restaurant, Farmers Market, Vietnamese Restaurant, Exhibit, Hot Dog Joint, Bistro, Performing Arts Venue, Sushi Restaurant, Sandwich Place, French Restaurant, Restaurant, Dance Studio, Burger Joint, Bar, Pizza Place, Monument / Landmark

It is quite clearly visible that the following categories are least touristts attractions and hence the two subsets will be threat separately further on:

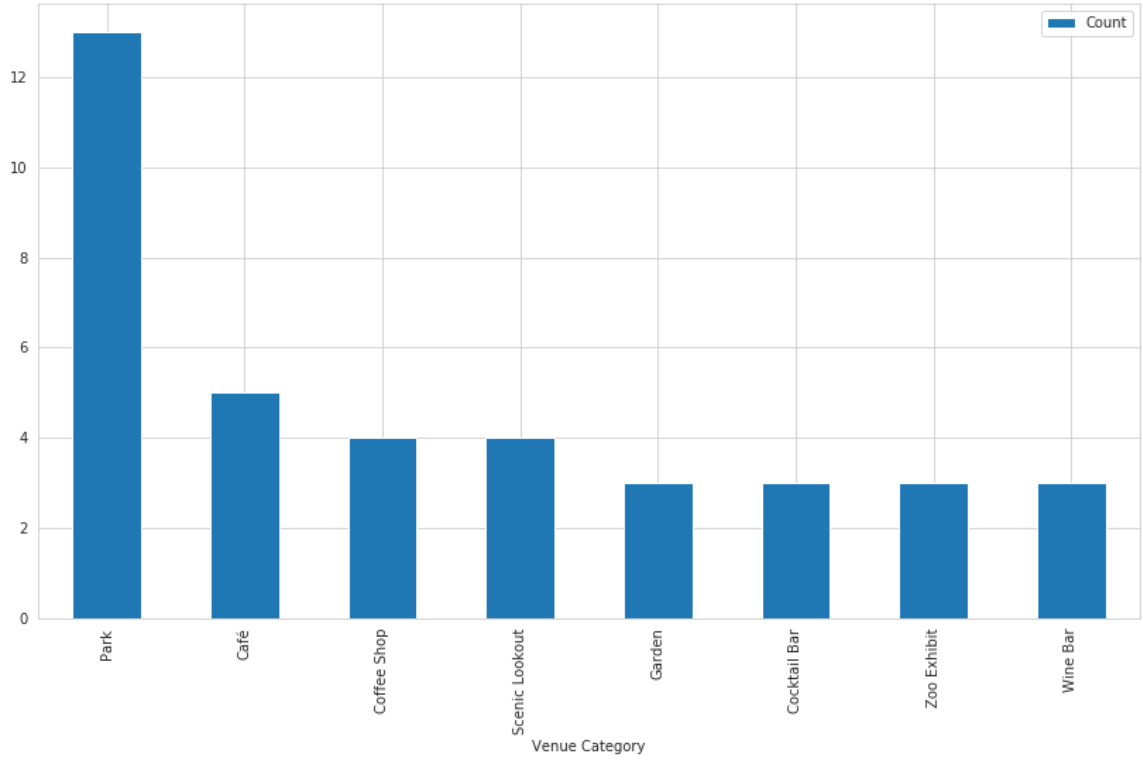
- Butcher
- Paper / Office Supplies Store
- Hotel
- Gourmet Shop
- Cosmetics Shop
- Farmers Market
- Dance Studio

That gives 90 tourists attractions out of 100

The most populat categories of attractions are as shows the following plot

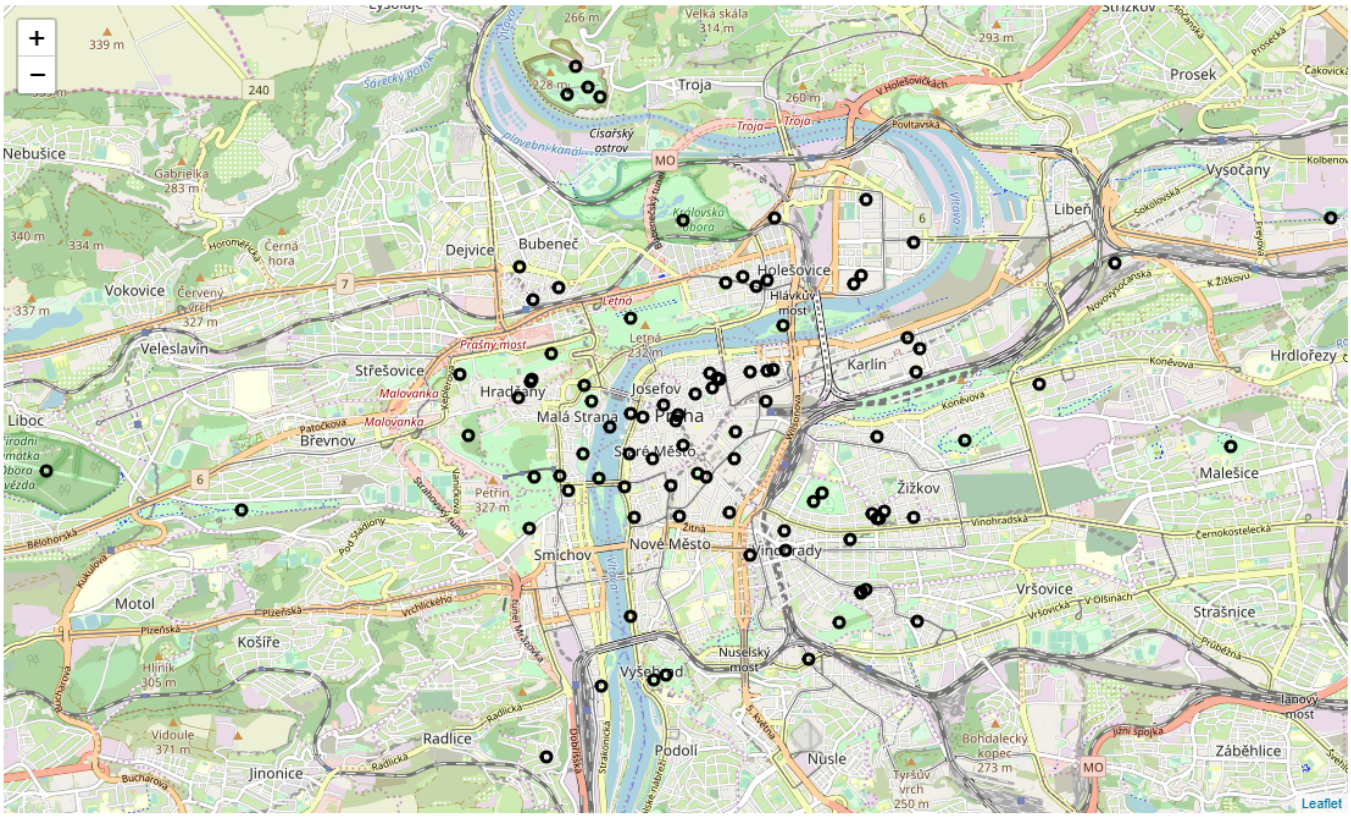
Out[28]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f82719a5dd8>
```



Following map presents all top 100 attraction in Prague. In black presented are tourist attractions, and in green non-tourists attractions.

In further analysis only tourists attractions are used.

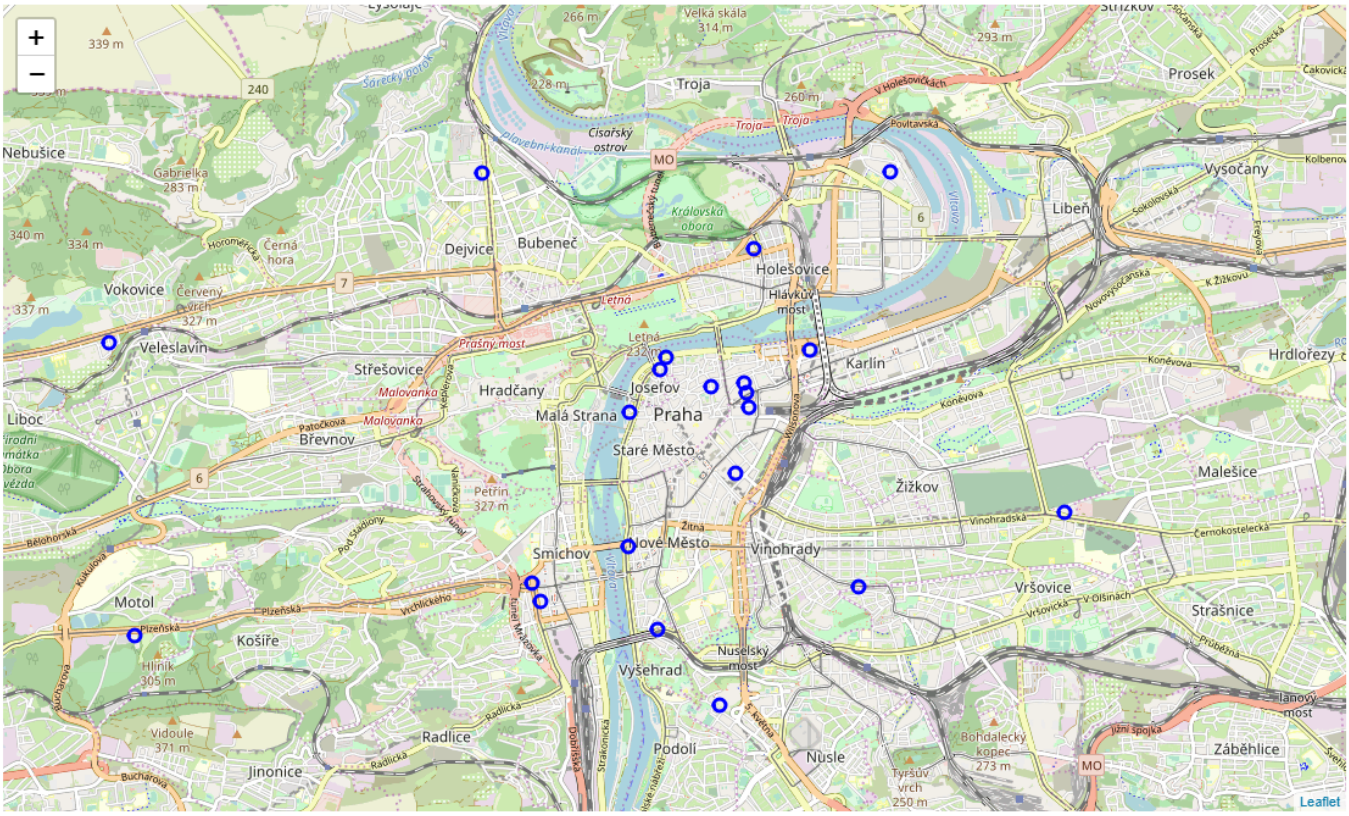


Prague's top hotels

Following map presents location of top 25 hotels in Prague, Czech Republic amongst the Foursquare users.

It is clearly visible that about half of the top hotels are located in the Old Town, but surprisingly other half is located all around the ctiy, and the 1/3 on the outskirts.

Hotels in the outskirts might suggest the existance of some kind of business centres located there, however that is out-of-scope of this report.



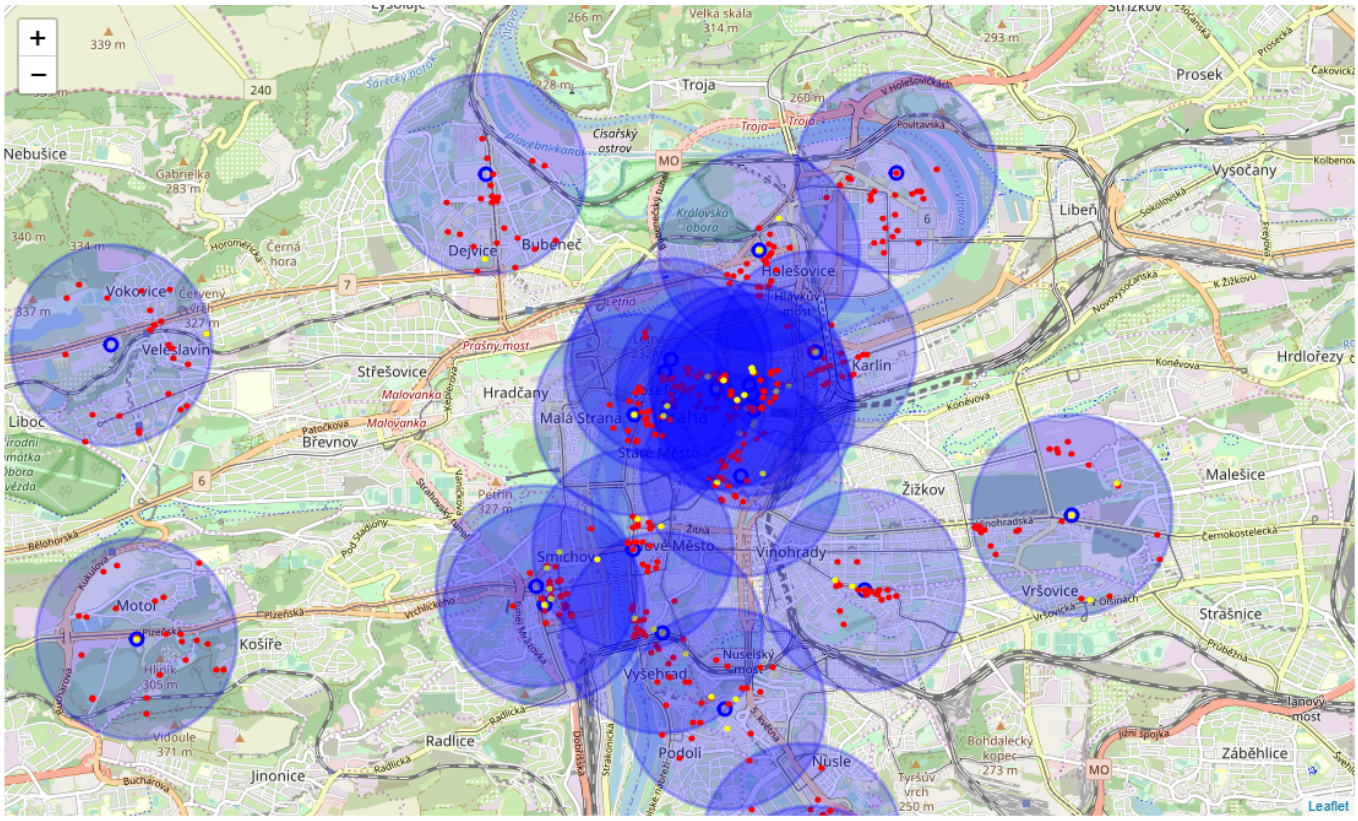
Attractions around top hotels

Following map presents locaions of top 25 Prague's hotels and the top attractions around them. In red marked are the tourists attractions, and in yellow non-tourists places.

There are quite a few non-tourists places, but there are mainly places worth to be visited by tourists.

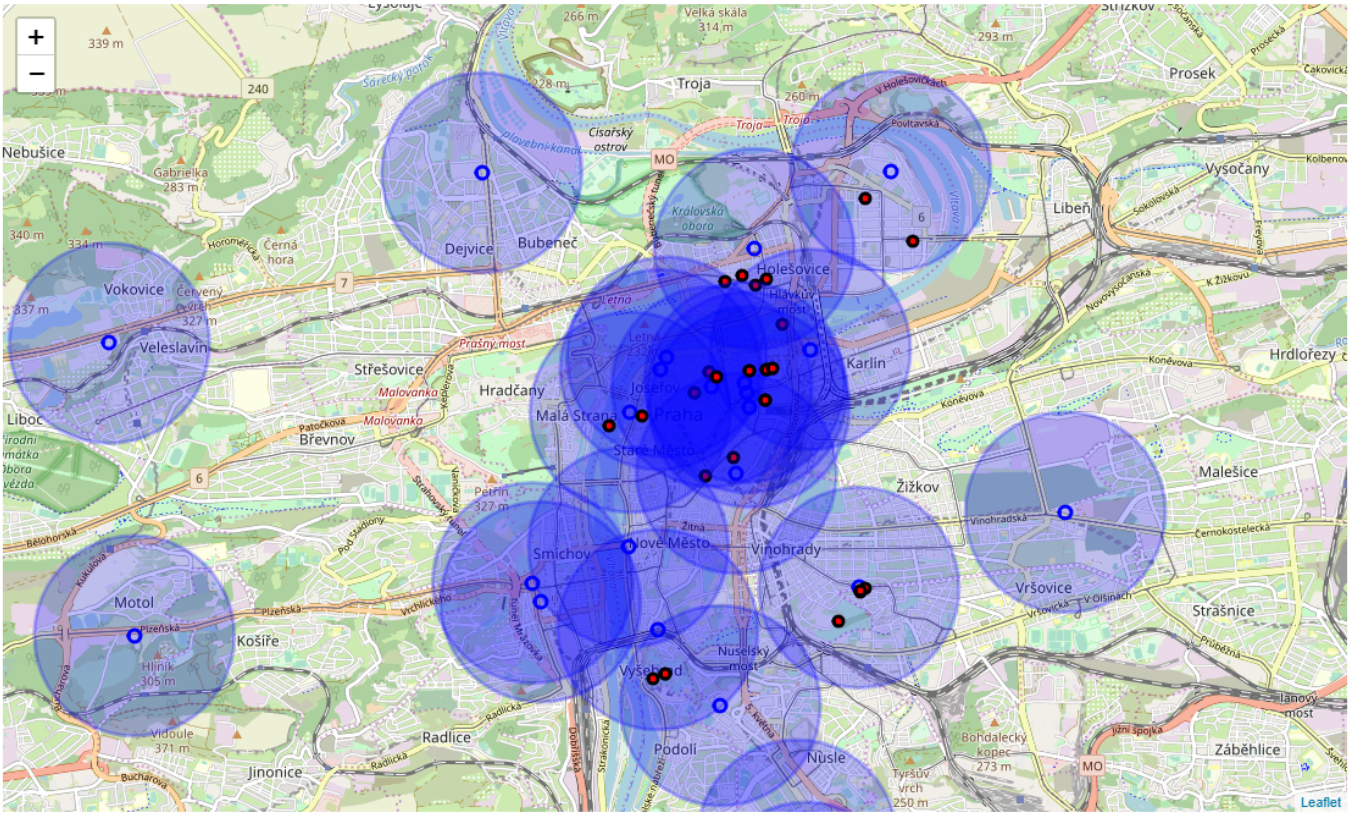
Many hotels, especially in the Old Town, share the attractions because of close distance to each other.

At this stage initial findings suggest that the best place to stay will be the Old Town (which is not that surprising).



Top attractions around top hotels

Inspecting and visualising the top attractions out of attractions near hotels brings first surprise! Only a few of attractions around hotels are in top 100 Prague's attractions. This is visible on the following map.



`Hotels have between 1 and 6 top attractions`

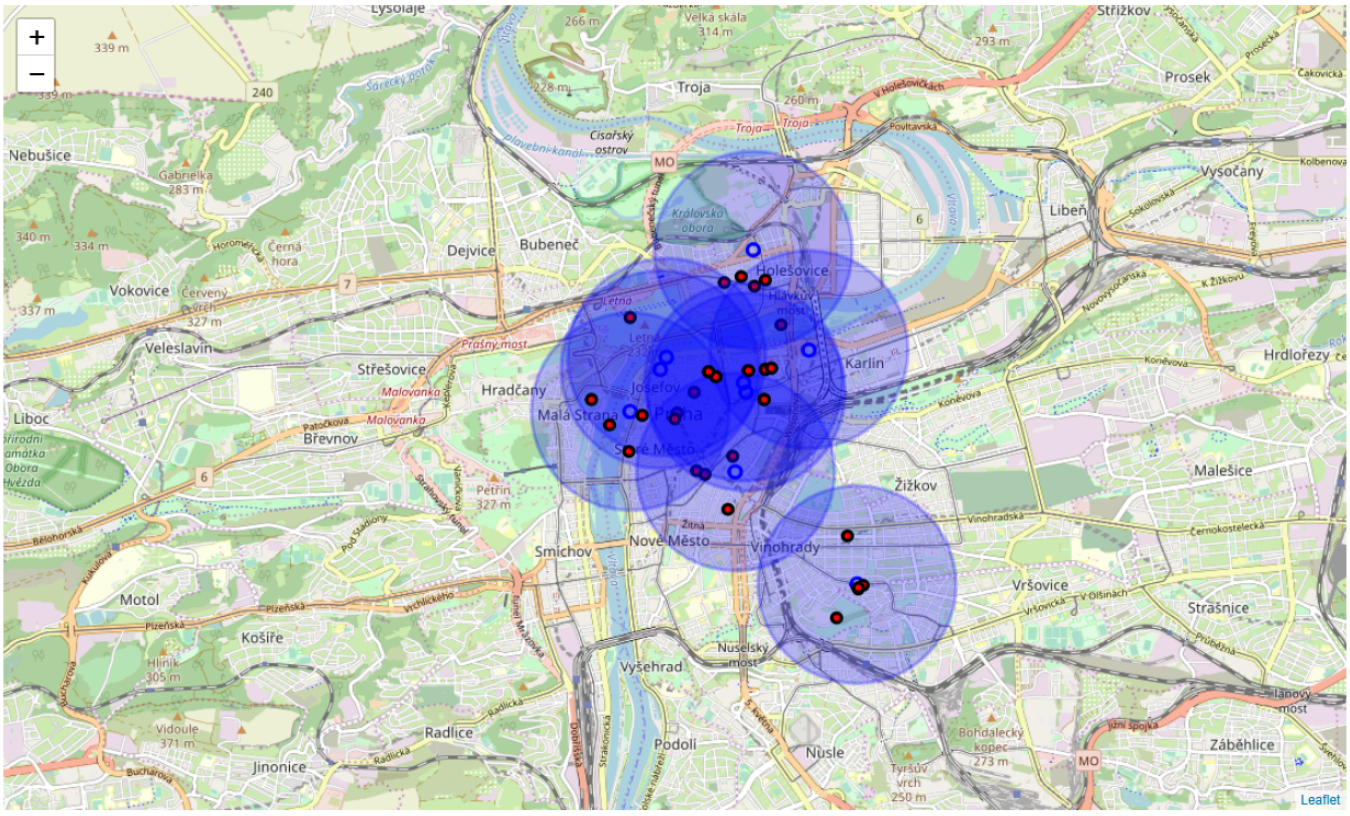
Let's remove the hotels with less than 4 top attractions. The result presents as follows

Out[37]:

	Hotel Name	Count
3	Grand Majestic Plaza	6
0	Czech Inn	5
2	Four Seasons Hotel Prague (Hotel Four Seasons ...	5
15	ibis Praha Old Town	5
4	Hilton Prague	4
6	Hotel Grandium Prague	4
8	InterContinental Prague	4
9	Mama Shelter	4
13	President Hotel	4

There are only 9 those hotels.

Those top hotels and attractions around them are presented on the following map.



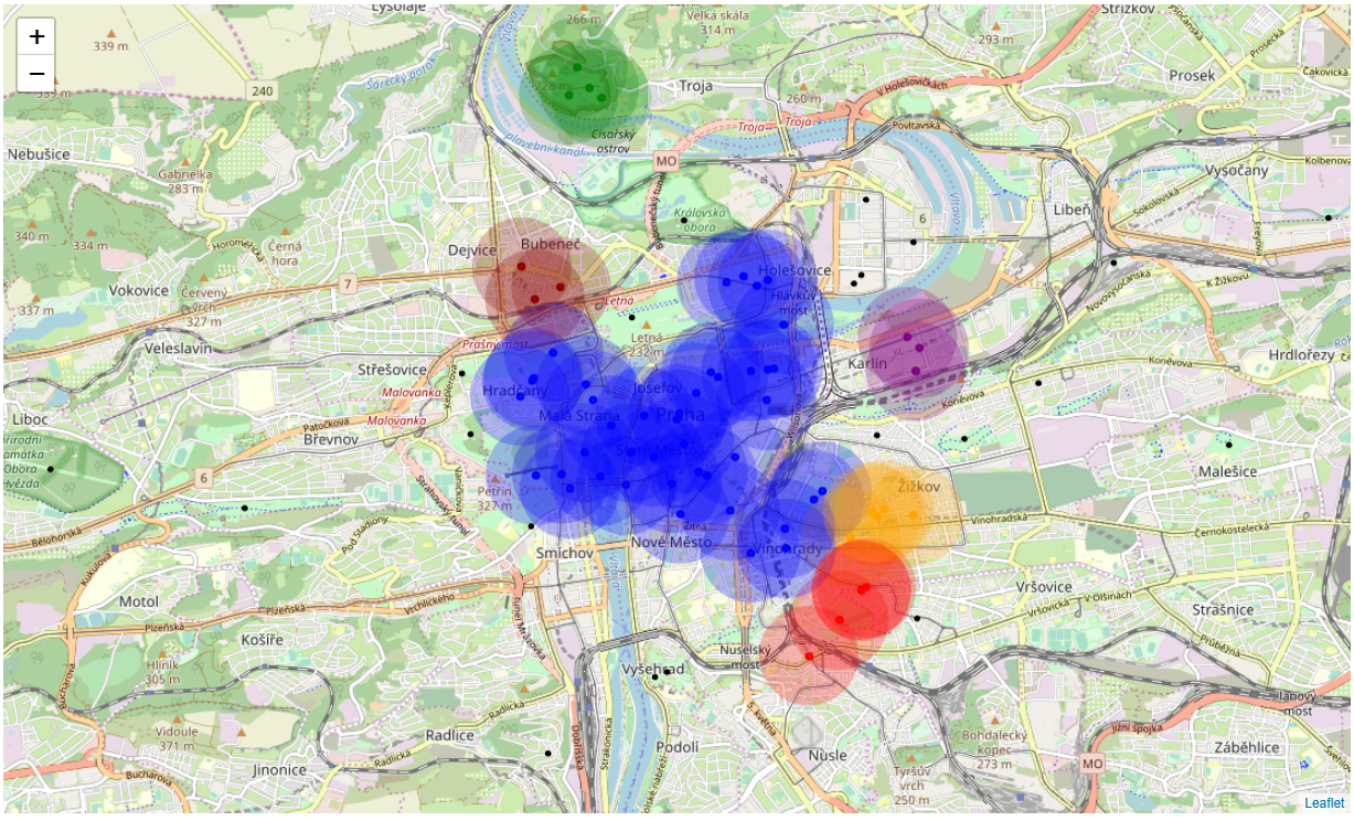
Clustering top tourists attractions

To get some more context and data for comparison, let's cluster the top Prague's attraction in order to identify the best tourists areas.

The DBSCAN method from sci-kit learn library is one of the methods of such analysis.

The results of clustering shows the following map.

It is clearly visible that the most of attractions is located in the cluster consisting of Old Town, Hradcany and Holesovice. All of those locations are the popular tourists places.



Discussion

The aim of this report is to assess the feasibility of locating the best possible hotel within range of as many local attractions as possible. The attractions which, as defined during data analysis, are the most popuplar tourists venues. For the sake of the exercise hotels and attractions of Prague in Czech Republic are used.

The report analises and shows on the map the top 25 hotels and top attractions around them. The most surpising finding is that the top attractions around the hotel match the global Prague top attraction only in a small fraction.

Because of that fact one cannot ultimately select the best hotel based on the approach but defintelly take it as sugestion.

To support this claim, the report shows also clustered Prague's top attractions. And when it is not shown on a single map, one can easily check that the biggeset attraction clusters corresponds to the radius of the top selected hotels.

Conclussion

The results of the the investigated approach are far from the ideal. There is defintelly a lot of space for improvement in all stages of analysis: starting from the data collection, through methodology, ending on the clustering method. However, I conclude the overall approach to be correct.

Possible approaches to improve the results are:

- Modify Foursquare API call to return straigh away only venues interesting for tourists.
- Rank hotels by calculating how many Prague's' top attractions are around them.
- Investigate different clustering methods.