

REPORT



Capstone Project - The Battle of Neighborhoods (Week 2)

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Table of content

Introduction	Page 3
Data	Page 4
Methodology	Page 8
Analysis	Page 9
Results	Page 17
Conclusion	Page 18

Introduction

In this project I will try to find an optimal location for a Chinese restaurant in my country. Specifically, this report will be targeted to stakeholders interested in opening an **Chinese restaurant** in **Budapest**, Hungary.

Since there are lots of fast food restaurants in Budapest I will try to detect **locations that are not already crowded with restaurants**. We are also particularly interested in **areas with no Chinese restaurants in vicinity**. We would also prefer locations **as close to city center as possible**, assuming that first two conditions are met.

Advantages of each area will then be clearly expressed so that best possible final location can be chosen by stakeholders.

Data

Based on definition of our problem, factors that will influence our decision are:

number of existing restaurants in the neighborhood (any type of restaurant)

number of and distance to Chinese restaurants in the neighborhood, if any

distance of neighborhood from city center

We decided to use regularly spaced grid of locations, centered around city center, to define our neighborhoods.

Following data sources will be needed to extract/generate the required information:

centers of candidate areas will be generated algorithmically and approximate addresses of centers of those areas will be obtained using Google Maps API reverse geocoding

number of restaurants and their type and location in every neighborhood will be obtained using Foursquare API

coordinate of Budapest center will be obtained using Google Maps API geocoding of well known Budapest location

Let's create latitude & longitude coordinates for centroids of our candidate neighborhoods. We will create a grid of cells covering our area of interest which is approx. 10x10 kilometers centered around Budapest city center.

Let's first find the latitude & longitude of Budapest city center, using specific, well known address and Google Maps geocoding API

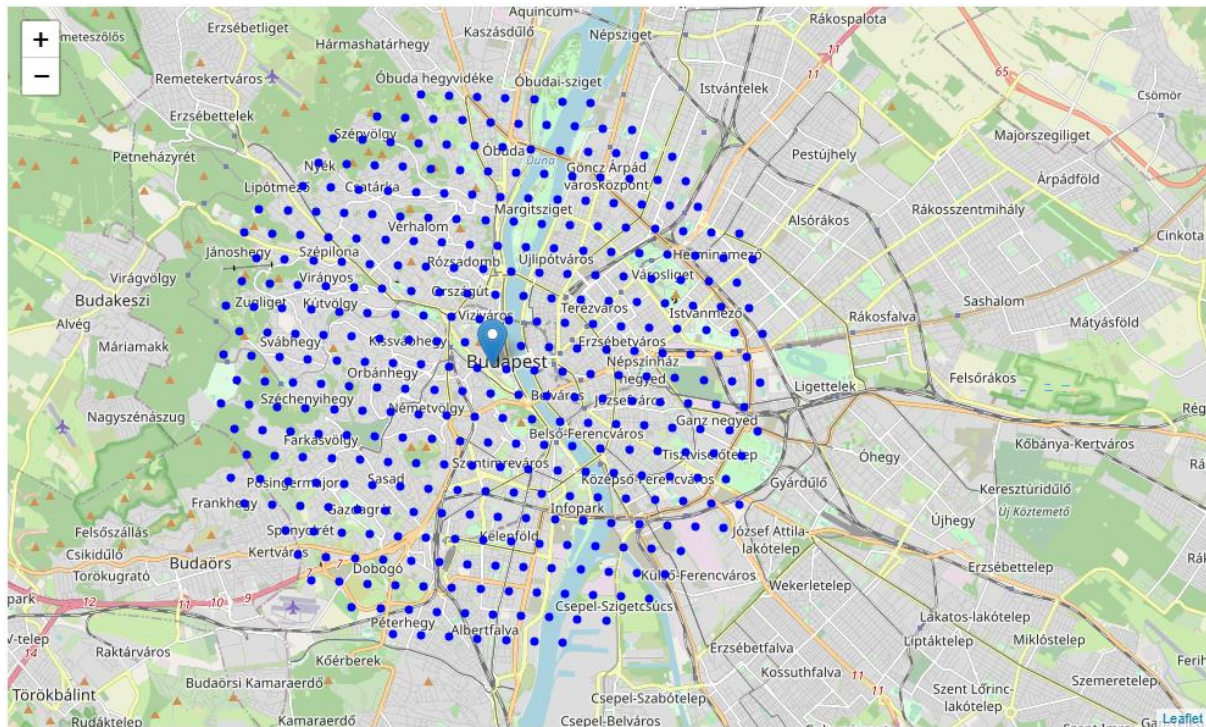
Coordinate of Palota, Budapest, Hungary: [47.4969189, 19.0361941]

Budapest center longitude=19.0361941, latitude=47.4969189

Budapest center UTM X=803975.6742963139, Y=5268287.058729421

Budapest center longitude=19.036194100000003, latitude=47.496918899999999

364 candidate neighborhood centers generated.



1. figure: 364 candidate neighborhood centers generated.

Address of [47.4969189, 19.0361941] is: Budapest, 1014 Budapest, Budavári Palota F épület, 1013 Hungary

List of adresses:

'Budapest, Vajda Péter u. 2, 1089 Hungary',
 'Budapest, Vajda Péter u. 8, 1089 Hungary',
 'Budapest, Kőbányai út 41, 1101 Hungary',
 'Budapest, Sötétvágás utca, 1121 Hungary',
 'Budapest, Hegyhát út 16, 1121 Hungary',
 'Budapest, Agancs út 17, 1121 Hungary',
 'Budapest, Széchenyi-emplék út 12b, 1121 Hungary',
 'Budapest, Hangya u. 42, 1121 Hungary',
 'Budapest, Tamási Áron u. 30, 1124 Hungary',
 'Budapest, Németvölgyi út 53c, 1124 Hungary',
 'Budapest, Kiss János altábornagy u. 33a, 1126 Hungary',
 'Budapest, Avar u. 5a, 1123 Hungary',
 'Budapest, Lisznyai u. 27, 1016 Hungary',
 'Budapest, Attila út 11, 1013 Hungary',
 'Budapest, Március 15. tér, 1056 Hungary',
 'Budapest, Henszlmann Imre u. 5, 1053 Hungary',
 'Budapest, Horánszky u. 21, 1085 Hungary',
 'Budapest, Őr u. 3, 1084 Hungary',
 'Budapest, Magdolna u. 22, 1086 Hungary',
 'Budapest, Orczy tér 1., 1087 Hungary'

	Address	Latitude	Longitude	X	Y	Distance from center
0	Budapest, Bedő u. 9, 1112 Hungary	47.446452	19.008445	802175.674296	5.262571e+06	5992.495307
1	Budapest, Murányi u. 14, 1221 Hungary	47.446174	19.016384	802775.674296	5.262571e+06	5840.376700
2	Budapest, Kubikos u. 3, 1116 Hungary	47.445895	19.024323	803375.674296	5.262571e+06	5747.173218
3	Budapest, Verbéna u. 53, 1116 Hungary	47.445616	19.032262	803975.674296	5.262571e+06	5715.767665
4	Budapest, Gyékényes u. 15, 1116 Hungary	47.445336	19.040200	804575.674296	5.262571e+06	5747.173218
5	Budapest, Hunyadi János út 8, 1117 Hungary	47.445056	19.048139	805175.674296	5.262571e+06	5840.376700
6	Budapest, Szikratávíró u. 12-14, 1211 Hungary	47.444774	19.056077	805775.674296	5.262571e+06	5992.495307
7	Budapest, Egér út, 1112 Hungary	47.451533	18.996890	801275.674296	5.263091e+06	5855.766389
8	Budapest, Repülőtéri út 6, 1112 Hungary	47.451255	19.004830	801875.674296	5.263091e+06	5604.462508
9	Budapest, Ütköző sor 12, 1112 Hungary	47.450977	19.012770	802475.674296	5.263091e+06	5408.326913

Total number of restaurants: 1195

Total number of Chines restaurants: 107

Percentage of Chines restaurants: 8.95%

Average number of restaurants in neighborhood: 2.9148351648351647

Restaurants around location:

Restaurants around location 101: Talponálló kifőzde

Restaurants around location 102: Kakukkfészek

Restaurants around location 103:

Restaurants around location 104: Bécsiszelet Vendéglő

Restaurants around location 105: Mermel étterem, Kuriózum Café

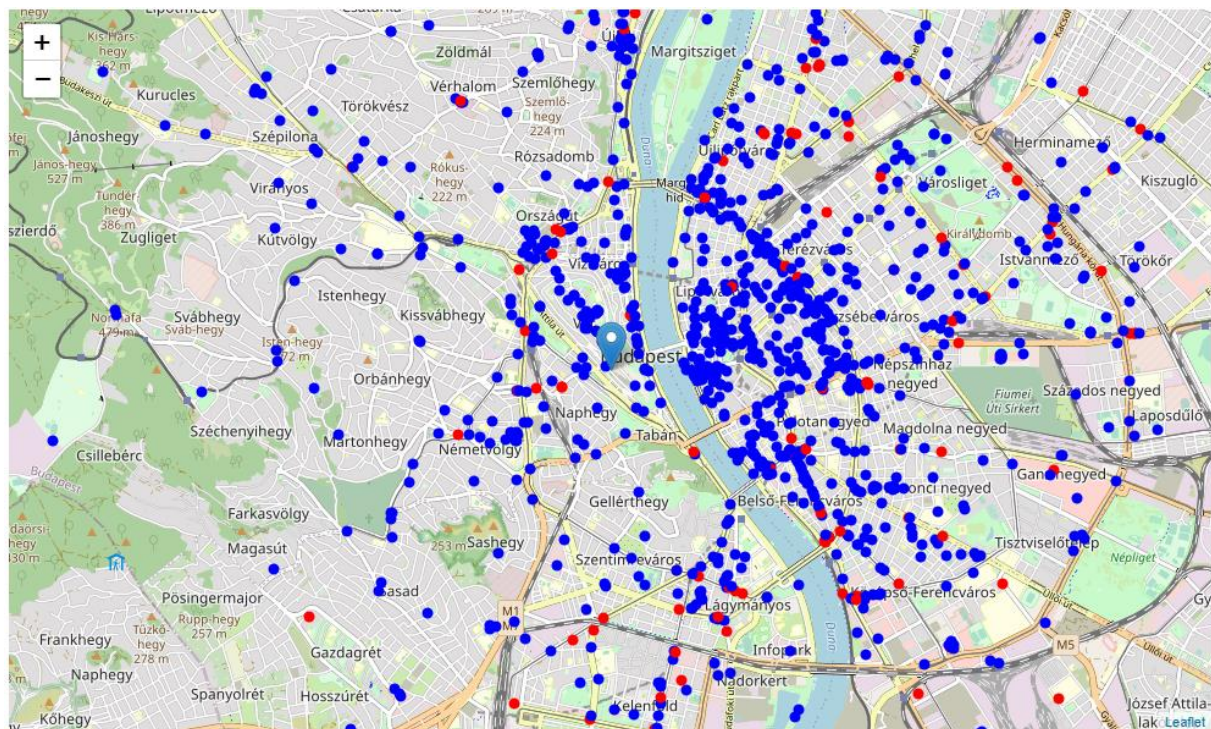
Restaurants around location 106: Hemingway Étterem, Kisvigadó, Montenegroi Gurman, Family Restaurant Kifőzde, Gyros Büfé, Corner Falatozó

Restaurants around location 107: Deli's Vegán Bisztró, Eker Gyros Török Étterem, Las Vegans, Bueno by Il Treno, Istanbul Kebabs Non-Stop, Madárfészek gyorsétterem és kávézó, Madárfészek Kínai Gyorsétterem, Döner kebab

Restaurants around location 108: Gyros, El Vandom salátabár, Pho 74, Íz-lelő Étkezdé, Ganesha Vega, Stoczek Menza, Bercsényi Kisvendéglő, Rondo Gyorsétterem és Kávézó, Ji Li Kínai Büfé

Restaurants around location 109: A38 Étterem

Restaurants around location 110: Saloniki Gyros Taverna, Wok Express, Hange Restaurant (Hange Étterem), Lele Kínai Gyorsbüfé, Adames Salátabár, Pho Ha Noi, Zorba Gyros, Haller Étterem



2. figure: Restaurants (Blue) and Chinies restaurants (Red)

Now we have all the restaurants in area within few kilometers from Budapest Palota , and we know which ones are Chines restaurants! We also know which restaurants exactly are in vicinity of every neighborhood candidate center.

This concludes the data gathering phase - we're now ready to use this data for analysis to produce the report on optimal locations for a new Chines restaurant!

Methodology

In this project we will direct our efforts on detecting areas of Budapest that have low restaurant density, particularly those with low number of Chines restaurants. We will limit our analysis to area ~6km around city center.

In first step we have collected the required data: location and type (category) of every restaurant within 6km from Budapest center (Budapest Palota). We have also identified Chines restaurants (according to Foursquare categorization).

Second step in our analysis will be calculation and exploration of 'restaurant density' across different areas of Budapest - we will use heatmaps to identify a few promising areas close to center with low number of restaurants in general (and no Chines restaurants in vicinity) and focus our attention on those areas.

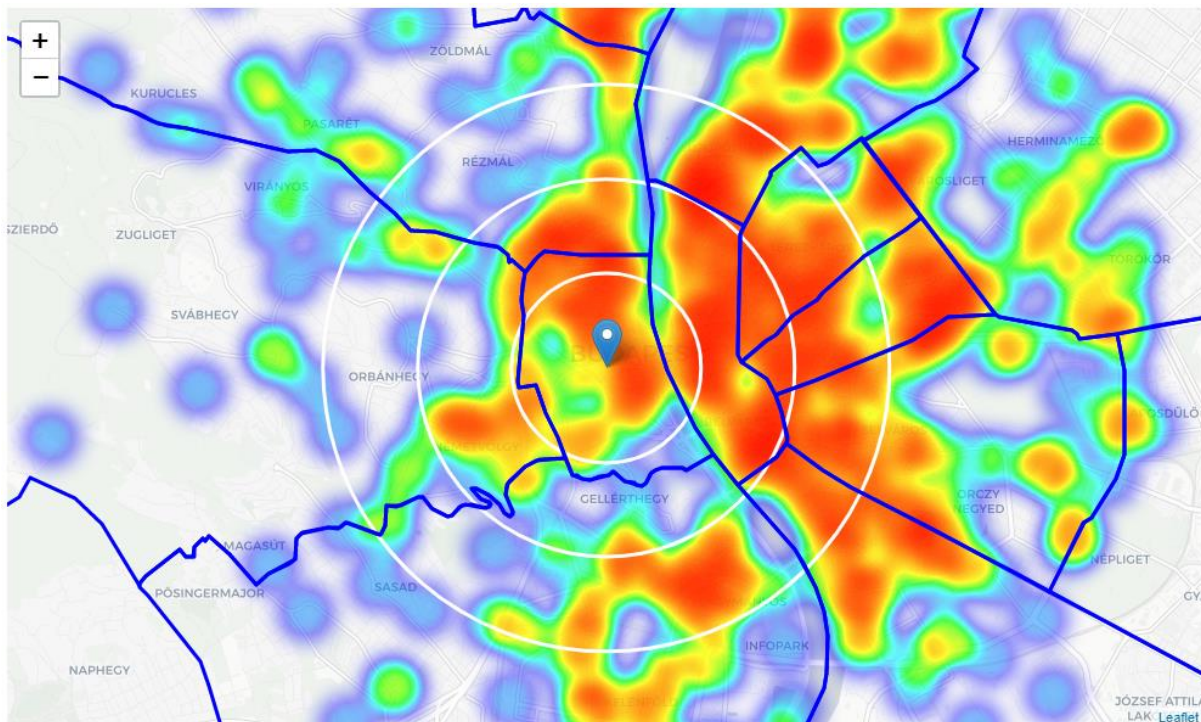
In third and final step we will focus on most promising areas and within those create clusters of locations that meet some basic requirements established in discussion with stakeholders: we will take into consideration locations with no more than two restaurants in radius of 250 meters, and we want locations without Chines restaurants in radius of 400 meters. We will present map of all such locations but also create clusters (using k-means clustering) of those locations to identify general zones / neighborhoods / addresses which should be a starting point for final 'street level' exploration and search for optimal venue location by stakeholders.

Analysis

Average number of restaurants in every area with radius=300m: 2.9148351648351647

	Address	Latitude	Longitude	X	Y	Distance from center	Restaurants in area	Distance to Chines restaurant
0	Budapest, Bedő u. 9, 1112 Hungary	47.446452	19.008445	802175.674296	5.262571e+06	5992.495307	1	2359.869269
1	Budapest, Murányi u. 14, 1221 Hungary	47.446174	19.016384	802775.674296	5.262571e+06	5840.376700	0	2185.008229
2	Budapest, Kubikos u. 3, 1116 Hungary	47.445895	19.024323	803375.674296	5.262571e+06	5747.173218	2	2106.120963
3	Budapest, Verbéna u. 53, 1116 Hungary	47.445616	19.032262	803975.674296	5.262571e+06	5715.767665	0	2028.496656
4	Budapest, Gyékényes u. 15, 1116 Hungary	47.445336	19.040200	804575.674296	5.262571e+06	5747.173218	0	1877.045510
5	Budapest, Hunyadi János út 8, 1117 Hungary	47.445056	19.048139	805175.674296	5.262571e+06	5840.376700	0	1709.825404
6	Budapest, Szikratávíró u. 12-14, 1211 Hungary	47.444774	19.056077	805775.674296	5.262571e+06	5992.495307	0	1744.622016
7	Budapest, Egér út, 1112 Hungary	47.451533	18.996890	801275.674296	5.263091e+06	5855.766389	0	2463.528471
8	Budapest, Repülőtéri út 6, 1112 Hungary	47.451255	19.004830	801875.674296	5.263091e+06	5604.462508	0	2065.682449
9	Budapest, Ütköző sor 12, 1112 Hungary	47.450977	19.012770	802475.674296	5.263091e+06	5408.326913	0	1764.177422

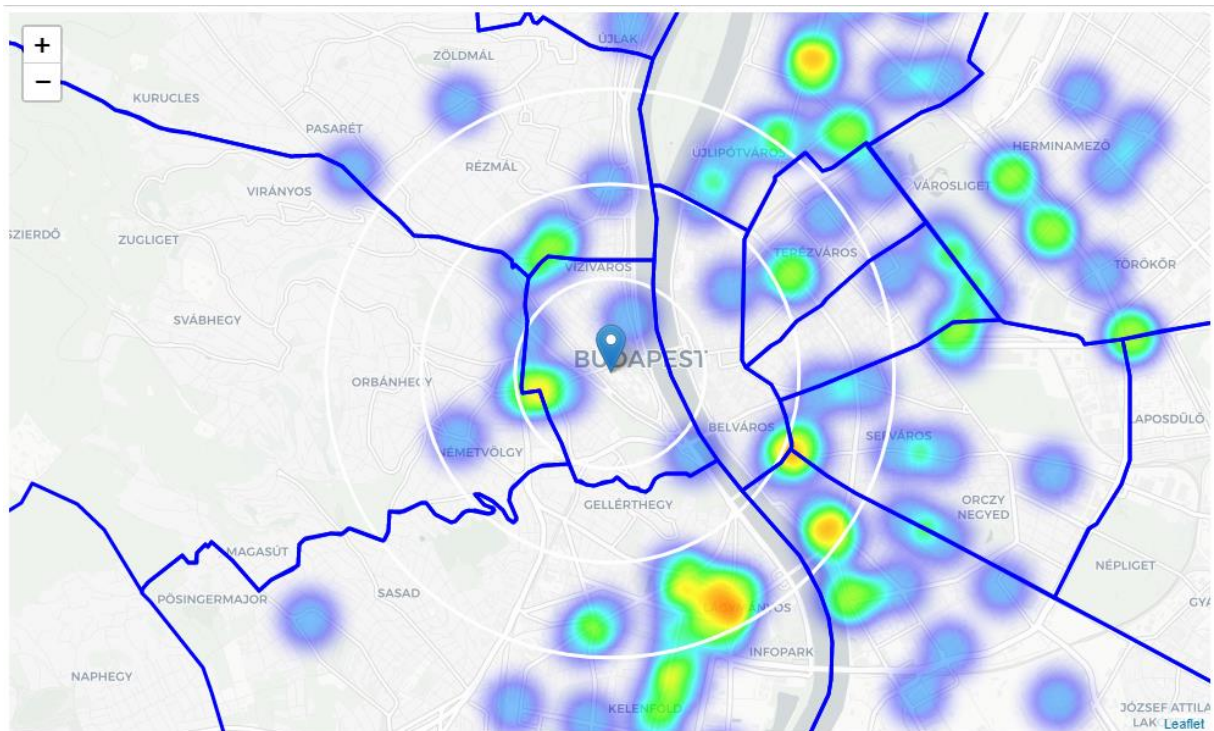
Average distance to closest Chines restaurant from each area center: 906.6730769768445



3. figure: Heat map

Looks like a few pockets of low restaurant density closest to city center can be found south, south-east and east from Budapest palota.

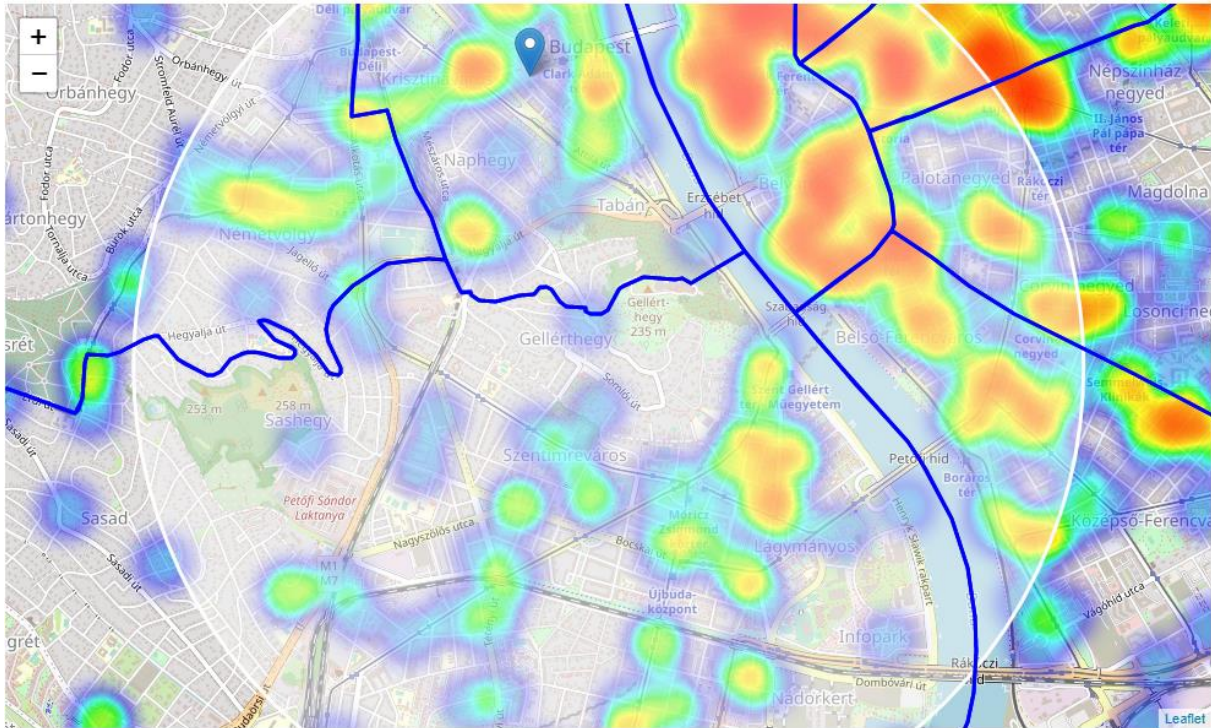
Let's create another heatmap map showing heatmap/density of Chines restaurants only.



4. figure: Low Chines density

This map is not so 'hot' (Chines restaurants represent a subset of ~15% of all restaurants in Budapest) but it also indicates higher density of existing Chines restaurants directly north and west from Budapest Palota, with closest pockets of low Chines restaurant density positioned east, south-east and south from city center.

Based on this we will now focus our analysis on areas south-west, south, south-east and east from Budapest center - we will move the center of our area of interest and reduce it's size to have a radius of 2.5km.



5. figure: Budapest center area

Let's also create new, more dense grid of location candidates restricted to our new region of interest (let's make our location candidates 100m appart).

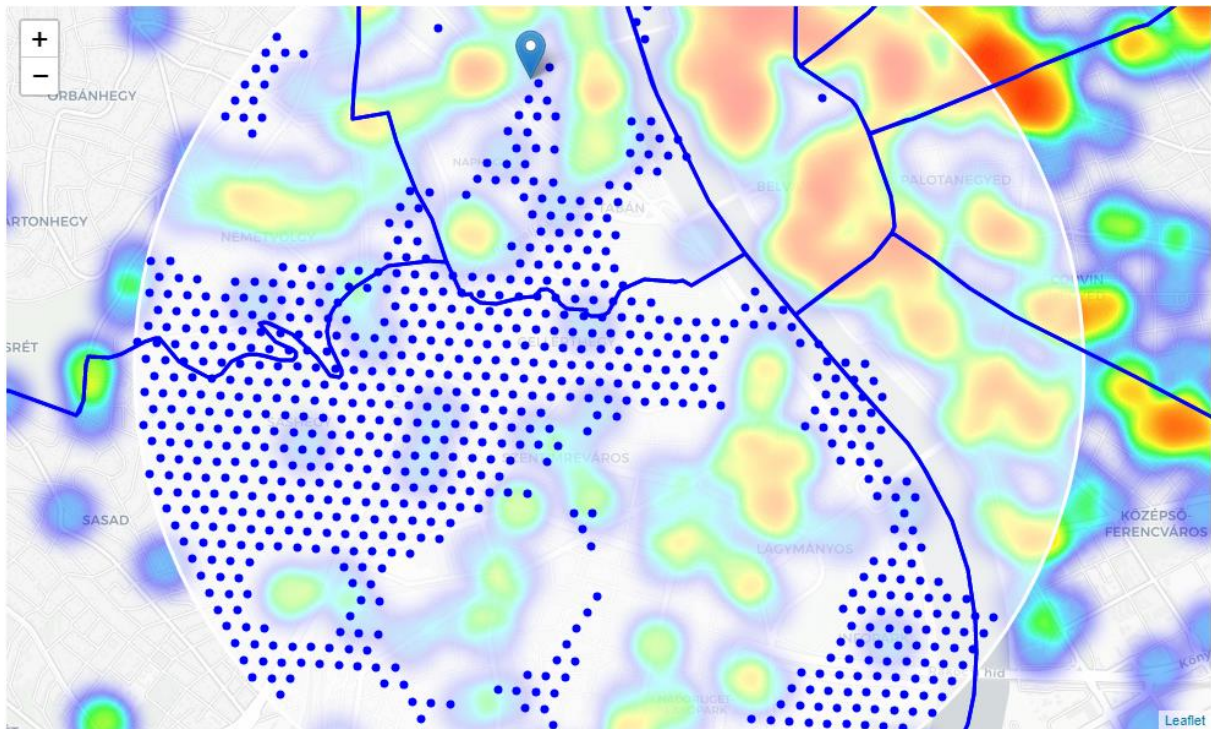
2261 candidate neighborhood centers generated.

	Latitude	Longitude	X	Y	Restaurants nearby	Distance to Italian restaurant
0	47.460806	19.039397	804425.674296	5.264287e+06	1	326.094580
1	47.460759	19.040720	804525.674296	5.264287e+06	1	269.646272
2	47.461840	19.032177	803875.674296	5.264374e+06	1	235.723218
3	47.461794	19.033500	803975.674296	5.264374e+06	1	228.197936
4	47.461747	19.034824	804075.674296	5.264374e+06	0	261.883868
5	47.461700	19.036147	804175.674296	5.264374e+06	0	324.178997
6	47.461654	19.037471	804275.674296	5.264374e+06	0	399.747275
7	47.461607	19.038795	804375.674296	5.264374e+06	0	310.111788
8	47.461560	19.040118	804475.674296	5.264374e+06	2	229.217710
9	47.461513	19.041442	804575.674296	5.264374e+06	4	170.035867

Locations with no more than two restaurants nearby: 1180

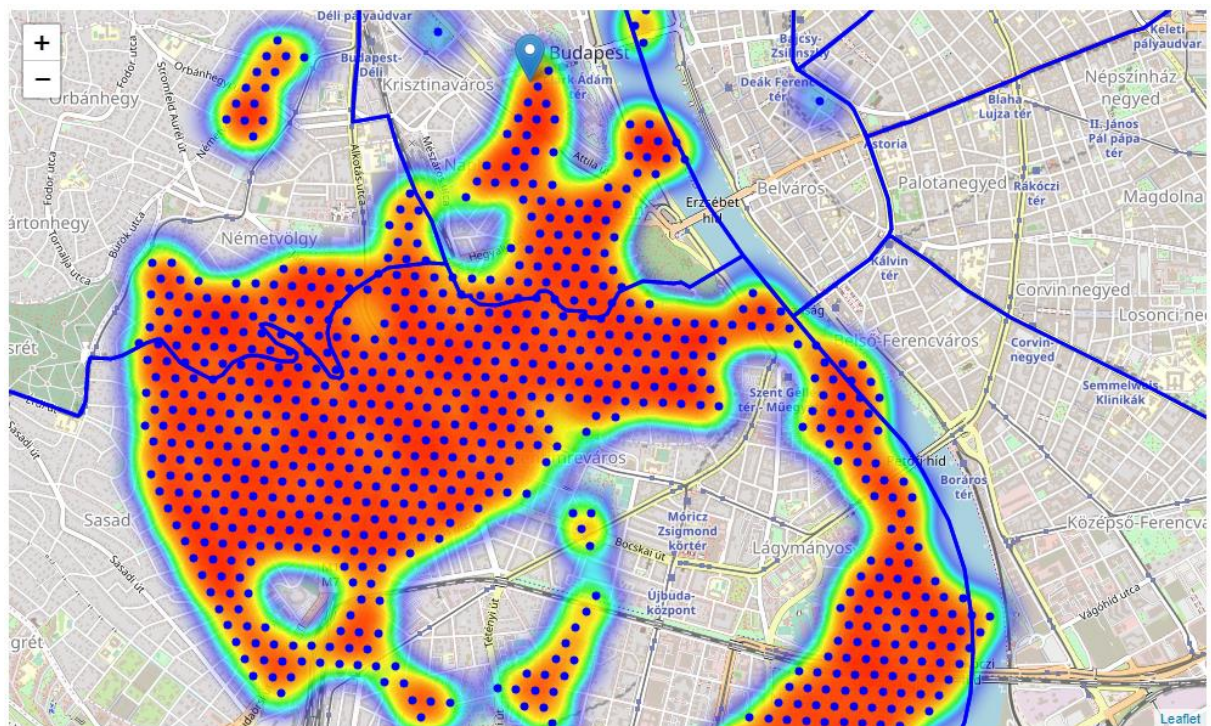
Locations with no Chines restaurants within 400m: 1151

Locations with both conditions met: 755



6. figure: Close to Budapest Palota

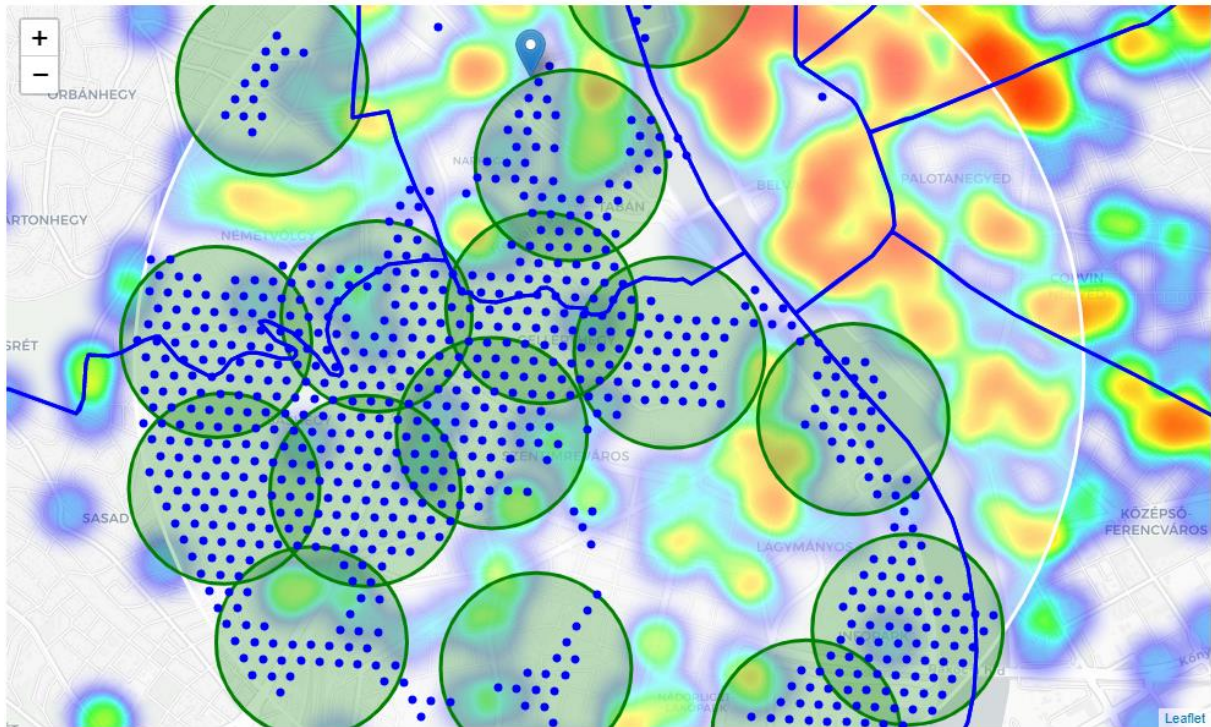
Looking good. We now have a bunch of locations fairly close to Budapest Palota, and we know that each of those locations has no more than two restaurants in radius of 250m, and no Chinese restaurant closer than 400m. Any of those locations is a potential candidate for a new Chinese restaurant, at least based on nearby competition.



7. Figure: Good location heatmap

What we have now is a clear indication of zones with low number of restaurants in vicinity, and no Chinese restaurants at all nearby.

Let us now cluster those locations to create centers of zones containing good locations. Those zones, their centers and addresses will be the final result of our analysis.



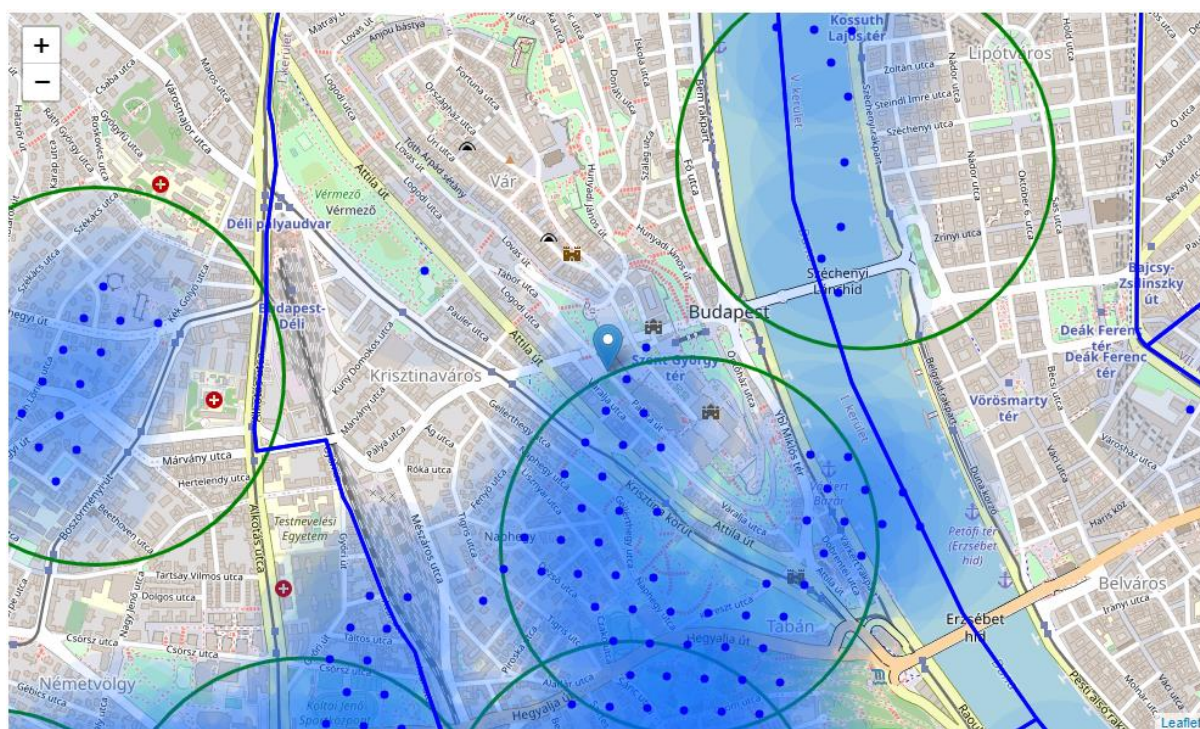
8. figure: Clusters with rich middle zone

My clusters represent groupings of most of the candidate locations and cluster centers are placed nicely in the middle of the zones 'rich' with location candidates.

Addresses of those cluster centers will be a good starting point for exploring the neighborhoods to find the best possible location based on neighborhood specifics.



9. figure: Clusters without heatmap



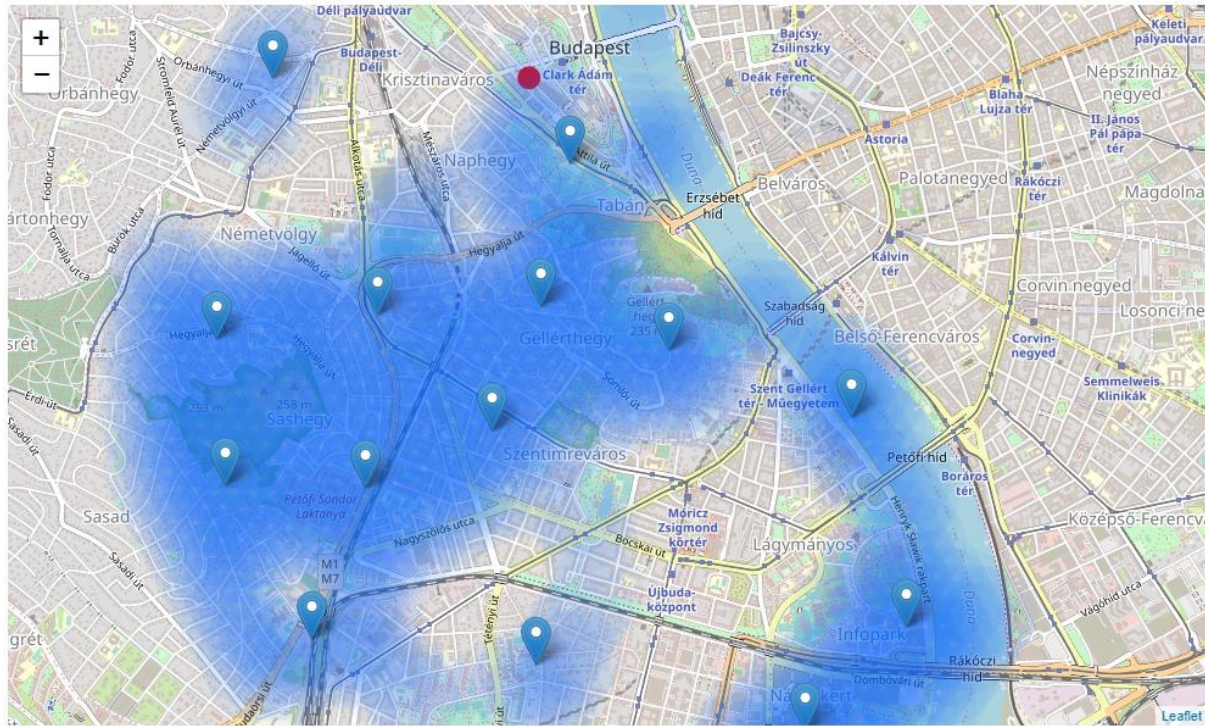
11. figure: Closest view to Budapest Palota

Finally, let's reverse geocode those candidate area centers to get the addresses which can be presented to stakeholders.

Addresses of centers of areas recommended for further analysis

Budapest, Krisztina krt. 101, 1016 Hungary	=> 0.5km from Palota
Budapest, Budaörsi út 22, fsz 4, 1118 Hungary	=> 1.5km from Palota
Budapest, Pázmány Péter stny. 37, 1117 Hungary	=> 3.5km from Palota
Budapest, Budaörsi út 62, 1118 Hungary	=> 3.2km from Palota
Budapest, 1644+600 FKM Jobb parti szelvény XI/121. sz. raszter, 1111 Hungary	=> 2.5km from Palota
Budapest, Dayka Gábor u. 29, 1112 Hungary	=> 2.7km from Palota
Budapest, Sasfiók u. 3, 1124 Hungary	=> 2.2km from Palota
Budapest, Tarcali u. 14, 1113 Hungary	=> 1.9km from Palota
Budapest, Számadó u. 10, 1118 Hungary	=> 1.2km from Palota
Budapest, Fejér Lipót u. 25, 1119 Hungary	=> 3.1km from Palota
Budapest, Németsölgyi út 13, 1126 Hungary	=> 1.4km from Palota
Budapest, Hauszmann Alajos u. 11, 1116 Hungary	=> 3.8km from Palota
Budapest, Rezeda u. 9, 1118 Hungary	=> 1.6km from Palota
Budapest, Budaörsi út 51, 1118 Hungary	=> 2.3km from Palota
Budapest, Akadémia u. 6, 1054 Hungary	=> 0.9km from Palota

This concludes our analysis. We have created 15 addresses representing centers of zones containing locations with low number of restaurants and no Chinese restaurants nearby, all zones being fairly close to city center (all less than 4km from Budapest Palota, and about half of those less than 2km from Palota). Although zones are shown on map with a radius of ~500 meters (green circles), their shape is actually very irregular and their centers/addresses should be considered only as a starting point for exploring area neighborhoods in search for potential restaurant locations. Most of the zones are located in, which we have identified as interesting due to being popular with tourists, fairly close to city center and well connected by public transport.



12. figure: Result

Results

Our analysis shows that although there is a great number of restaurants in Budapest (~2000 in our initial area of interest which was 12x12km around Palota), there are pockets of low restaurant density fairly close to city center. Highest concentration of restaurants was detected north and west from Palota, so we focused our attention to areas south, south-east and east, corresponding to boroughs Vár, kastély and south-east corner of central Palace borough. Another borough was identified as potentially interesting (Kalkr Ádám square, north-east from Palota), but our attention was focused on Vár and Palota which offer a combination of popularity among tourists, closeness to city center, strong socio-economic dynamics and a number of pockets of low restaurant density.

After directing our attention to this more narrow area of interest (covering approx. 5x5km south-east from Palota) we first created a dense grid of location candidates (spaced 100m appart); those locations were then filtered so that those with more than two restaurants in radius of 250m and those with an Chines restaurant closer than 400m were removed.

Those location candidates were then clustered to create zones of interest which contain greatest number of location candidates. Addresses of centers of those zones were also generated using reverse geocoding to be used as markers/starting points for more detailed local analysis based on other factors.

Result of all this is 15 zones containing largest number of potential new restaurant locations based on number of and distance to existing venues - both restaurants in general and Chinese restaurants particularly. This, of course, does not imply that those zones are actually optimal locations for a new restaurant! Purpose of this analysis was to only provide info on areas close to Budapest center but not crowded with existing restaurants (particularly Chinese) - it is entirely possible that there is a very good reason for small number of restaurants in any of those areas, reasons which would make them unsuitable for a new restaurant regardless of lack of competition in the area. Recommended zones should therefore be considered only as a starting point for more detailed analysis which could eventually result in location which has not only no nearby competition but also other factors taken into account and all other relevant conditions met.

Conclusion

Purpose of this project was to identify Budapest areas close to center with low number of restaurants (particularly Italian restaurants) in order to aid stakeholders in narrowing down the search for optimal location for a new Chinese restaurant. By calculating restaurant density distribution from Foursquare data we have first identified general boroughs that justify further analysis (Vár and Kastély), and then generated extensive collection of locations which satisfy some basic requirements regarding existing nearby restaurants. Clustering of those locations was then performed in order to create major zones of interest (containing greatest number of potential locations) and addresses of those zone centers were created to be used as starting points for final exploration by stakeholders.

Final decision on optimal restaurant location will be made by stakeholders based on specific characteristics of neighborhoods and locations in every recommended zone, taking into consideration additional factors like attractiveness of each location (proximity to park or water), levels of noise / proximity to major roads, real estate availability, prices, social and economic dynamics of every neighborhood etc.

This project prepared by based on the example project. Thank you for your review!