

Location of new hospital in Zagreb

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Introduction

In past two weeks as can be seen in media, Zagreb had an earthquake and lot of Zagreb hospitals were damaged during this earthquake.¹² Even newborn babies were on morning cold in hospital yard. The main issue is that most of this hospital were built during late 19th and at the beginning of 20th Century. Next to this, most of hospitals are in city center. So many patients from suburb do not have hospitals In their district.

¹ https://en.wikipedia.org/wiki/2020_Zagreb_earthquake

² <https://www.independent.co.uk/news/world/europe/croatia-earthquake-today-zagreb-coronavirus-lockdown-maternity-hospital-a9416911.html>

Use of data

For this case I will use data from Wikipedia, where we can see Zagreb districts data in 2011. Next to this, I will use Foursquare data for geo locations of hospitals.

Here we can see data frame with latitude and longitude.

	District	size(km²)	Population -2011	Latitude	Longitude
0	Donji grad (Lower town)	3	37.024	45.808340	15.969490
1	Gornji Grad-Medveščak (Upper town-Medveščak)	10	30.962	45.814710	15.973380
2	Trnje	7	42.282	45.801168	15.977048
3	Maksimir	14	48.902	45.833312	16.010151
4	Peščenica – Žitnjak	35	56.487	45.787527	16.045939
5	Novi Zagreb – istok (New Zagreb-East)	17	59.055	45.759520	16.007969
6	Novi Zagreb – zapad (New Zagreb-West)	63	58.103	45.760738	15.921552
7	Trešnjevka – sjever (Trešnjevka-North)	6	55.425	45.801677	15.940319
8	Trešnjevka – jug (Trešnjevka-South)	10	66.674	45.786266	15.922941
9	Črnomerec	24	38.546	45.782765	15.937838
10	Gornja Dubrava (Upper Dubrava)	40	61.841	45.864777	16.056851
11	Donja Dubrava (Lower Dubrava)	11	36.363	45.822390	16.050730
12	Stenjevec	12	51.390	45.800612	15.879435
13	Podsused – Vrapče	36	45.759	45.834528	15.868742
14	Podsljeme	60	19.165	45.888748	15.984549
15	Sesvete	165	70.009	45.828537	16.110122
16	Brezovica	127	12.030	45.727649	15.911798

The map displays the city of Zagreb and its immediate surroundings. Twelve blue pins indicate the locations of police stations. The pins are distributed across the city, with a higher concentration in the central and northern parts. The map also shows major roads, green spaces, and surrounding municipalities.

Since, we need to visualize current location of hospitals we will use Foursquare. Commands that were used can be seen below.

```
#define Login data for Foursquare
CLIENT_ID = "XXXXXXXXXXXXX" # your Foursquare ID
CLIENT_SECRET = "XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX" # your Foursquare Secret
VERSION = "20180604"
LIMIT = 30
print("Your credentials:")
print('CLIENT_ID:' + CLIENT_ID)
print('CLIENT_SECRET:' + CLIENT_SECRET)

Your credentials:
CLIENT_ID: 8221A5AC9PMHTSAQ3PPRTYXATHJRSKHQM3SESUSIDSHQBG0
CLIENT_SECRET: 00WFAH318VUI2GZ2LCVTNYODEMSEBHTGHUKGTGF4145RAF0

#import additional modules
from pandas.io.json import json_normalize

#since there was few results with 'hospital' as search_query word, we use croatian word bolnica
# we use geo data of Zagreb central square
search_query = 'bolnica'
radius = 20000
latitude = 45.813032
longitude = 15.977165

#define url for query
url = "https://api.foursquare.com/v2/venues/search?client_id={}&client_secret={}&l={},{}&v={}&q={}&r={}&limit={}".format(CLIENT_ID, CLIENT_SECRET, latitude, longitude, VERSION, search_query, radius, LIMIT)
url

7): 'https://api.foursquare.com/v2/venues/search?client_id=XXXXXXXXXXXX&client_secret=XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX&l=45.813032,15.977165&v=20180604&q=bolnica&r=20000&limit=30'
```

After the query we will get json data which need to be trimmed for next steps. Below can be seen first data frame which is from json data.

	id	name	location.state	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	location.lng	location.address	location.lat	l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After filtering this data, we create new data frame with necessary columns.

Out[24]:

	name	location.state	location.address	location.lat	location.lng
0	Psihijatrijska bolnica za djecu i mladez	Grad Zagreb	Kukuljeviceva 11	45.814630	15.963653
1	Klinička bolnica Merkur	Grad Zagreb	Zajčeva 19	45.820840	15.997930
2	Bolnica za plucne bolesti	NaN	NaN	45.829766	15.981899
3	Specijalna bolnica Goljak	Grad Zagreb	Goljak 2	45.818942	15.963958
4	Bolnica Runjaninova	Grad Zagreb	Runjaninova 4	45.804951	15.969430
5	KBC Zagreb (Petrova bolnica)	Grad Zagreb	Petrova 13	45.815381	15.993247
6	Ortopedija Salata - bolnica	NaN	NaN	45.820071	15.983979
7	Napu\u0161tena Vojna Bolnica	Grad Zagreb	vla\u0161ka	45.813908	15.989718
8	Dan D Vojna bolnica	NaN	NaN	45.814664	15.989551
9	Veterinarska bolnica Hospivet	Grad Zagreb	NaN	45.794555	15.933313
10	Psihijatrijska bolnica Vrap\u0107e	Grad Zagreb	Bolni\u0107ka 23	45.814980	15.901643
11	Specijalna Bolnica Podobnik	Grad Zagreb	Sveti Duh 112	45.824963	15.939414
12	Zarazna bolnica F.Mihaljevic	Grad Zagreb	Mirogojska	45.830219	15.981030
13	Djeca bolnica Srebrnjak	Grad Zagreb	Srebrnjak 100	45.825073	15.993065
14	Bolnica sv. Duh	NaN	NaN	45.800286	15.915221
15	Klini\u0107ka bolnica Sveti Duh	Grad Zagreb	Sveti Duh 64	45.820000	15.938892
16	Klinika za dje\u0107je bolesti Zagreb	Grad Zagreb	Vjekoslava Klai\u0107a 16	45.809527	15.964489
17	Sveucili\u0161na Bolnica	Grad Zagreb	NaN	45.771301	15.923028
18	Specijalna bolnica Aksis	Grad Zagreb	Petrovaradinska 1	45.796130	15.908646
19	KBC Sestre Milosrdnice (Vinogradska)	Grad Zagreb	Vinogradska cesta 29	45.815108	15.952849
20	Psihijatrijska bolnica Sv. Ivan	Grad Zagreb	Jankomir 11	45.805321	15.877102
21	Klini\u0107ka bolnica Dubrava	NaN	NaN	45.882944	16.015643
22	Klinika za plućne bolesti Jordanovac	Grad Zagreb	Jordanovac 104	45.825591	16.002947
23	KB Dubrava	Grad Zagreb	Avenija Gojka \u0160u\u0161ka 6	45.833911	16.034674
24	opca bolnica bjelovar oftalmologija	NaN	NaN	45.788990	16.190350
25	Spec. Bolnica Za Rehabilitaciju	Krapinsko-Zagorska \u017dupanija	NaN	45.976218	15.935971

Since there was lot of data which is inaccurate, and does not refer to real world state, some of hospitals were deleted manually. Finally we get data frame which is reference to real state.

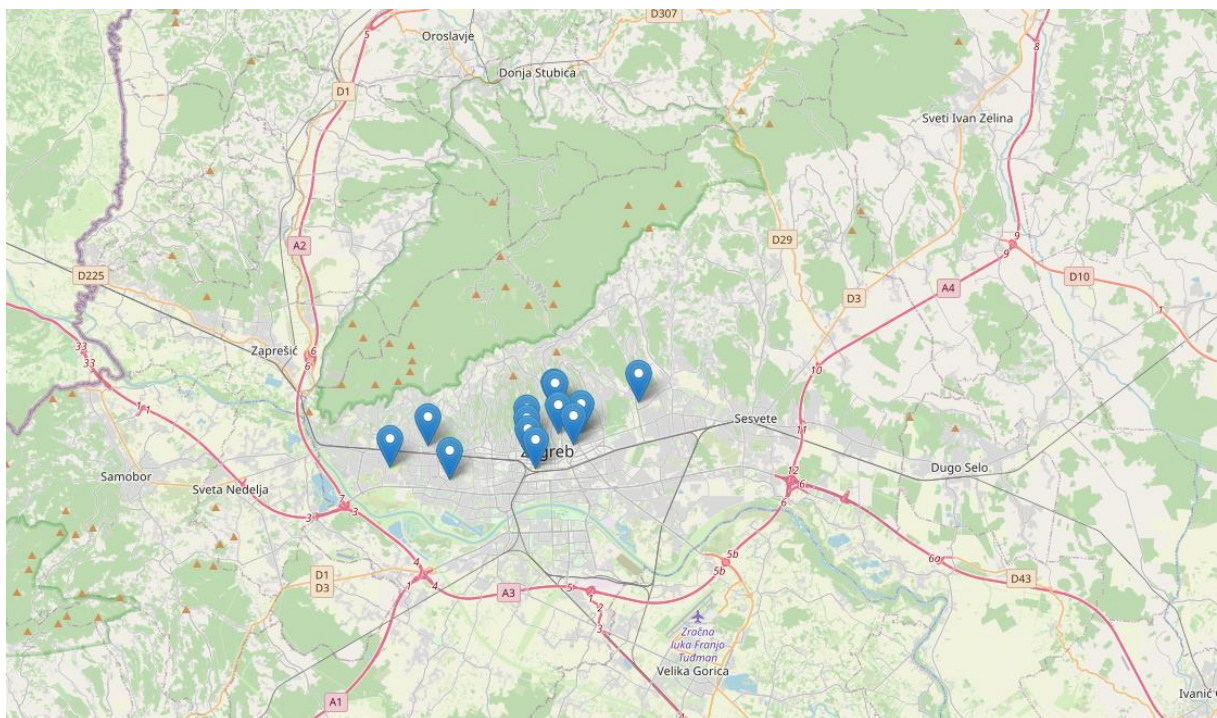
```
In [26]: zg_hospitals
```

Out[26]:

	name	location.state	location.address	location.lat	location.lng
0	Psihijatrijska bolnica za djecu i mladez	Grad Zagreb	Kukuljeviceva 11	45.814630	15.963653
1	Klinička bolnica Merkur	Grad Zagreb	Zajčeva 19	45.820840	15.997930
2	Bolnica za plucne bolesti	NaN	NaN	45.829766	15.981899
3	Specijalna bolnica Goljak	Grad Zagreb	Goljak 2	45.818942	15.963958
4	Bolnica Runjaninova	Grad Zagreb	Runjaninova 4	45.804951	15.969430
5	KBC Zagreb (Petrova bolnica)	Grad Zagreb	Petrova 13	45.815381	15.993247
6	Ortopedija Salata - bolnica	NaN	NaN	45.820071	15.983979
10	Psihijatrijska bolnica Vrapče	Grad Zagreb	Bolnička 23	45.814980	15.901643
11	Specijalna Bolnica Podobnik	Grad Zagreb	Sveti Duh 112	45.824963	15.939414
12	Zarazna bolnica F.Mihaljevic	Grad Zagreb	Mirogojska	45.830219	15.981030
14	Bolnica sv. Duh	NaN	NaN	45.800286	15.915221
16	Klinika za dječje bolesti Zagreb	Grad Zagreb	Vjekoslava Klaića 16	45.809527	15.964489
20	Psihijatrijska bolnica Sv. Ivan	Grad Zagreb	Jankomir 11	45.805321	15.877102
23	KB Dubrava	Grad Zagreb	Avenija Gojka Šuška 6	45.833911	16.034674

```
In [27]: folium.folium
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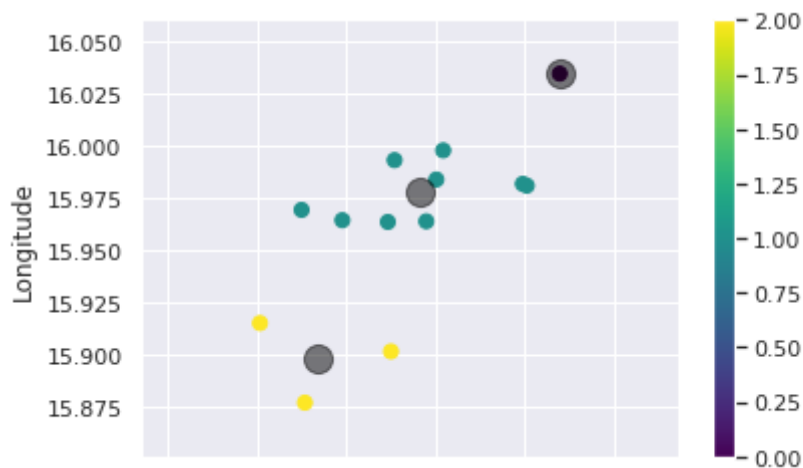
After we are done with trimming data, there is also provided folium map with current locations of hospitals.



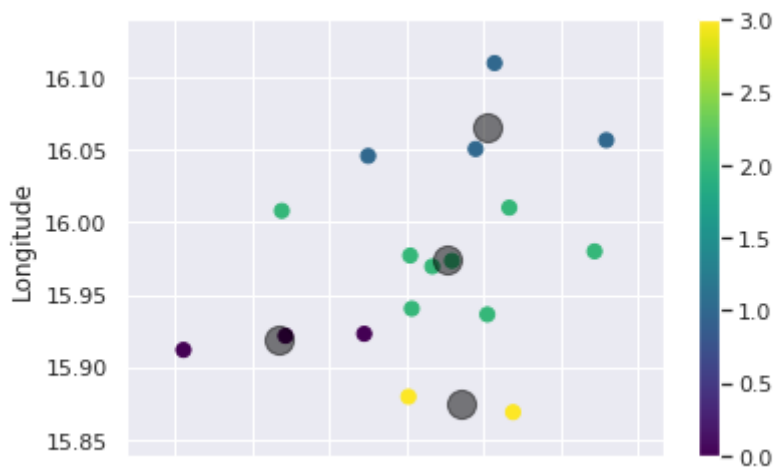
Using SKM model to visualize clusters were are hospitals and districts

Since we begin project with statement that most of Zagreb hospitals are located in one place, that can be viewed using SKM model and Elbow curve method for number of clusters. Since there are two datasets, one with hospitals and other with districts. Below is shown visualization of these two different datasets.

Hospitals



Districts



Conclusion

As can be seen, most of the hospitals were built in City center and most of them are very close to each other. This is the reason why all of them were damaged in earthquake. Problem is that there is only one hospital in eastern part of city, and three in western. In addition to that, two of these three are Psychiatric hospitals. So, the best way to overcome this is to build new hospital which will be in south-western part of city. Since most of citizens live there.