The Battle of Neighborhoods

Applied Data Science Capstone Project

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Introduction

- Pune is the second largest city in the Indian state of Maharashtra, after Mumbai.

- The educational and economic ecosystem of the city attracts a young and vibrant metropolitan crowd.

- An Italian restaurant chain wants to open an Italian restaurant at an optimal location near to the city center.

- In this project, our objective is to find and recommend a few optimal locations for our stakeholders to open an Italian restaurant in Pune city, India.

Business Problem

The business problem here is to generate a few most promising neighborhoods in Pune to open an Italian restaurant based on some defined criterias. There are three important criterias regarding neighborhood locations:

- The locations should not already be crowded with restaurants.
- There should not be any Italian restaurants in the vicinity.
- The locations should be as close to the city center as possible.

Problem Statement

Using data science techniques find optimal neighborhood locations based on the defined criterias. Collect, explore and analyze neighborhood locations and restaurants data to answer following four questions:

1. How many restaurants are present in a radius of 6 km around the city center?
2. How many of the identified restaurants are Italian restaurants?
3. What are the locations within 2.5 km area with no more than two restaurants in a radius of 250 meters and without Italian restaurants in a radius of 400 meters?
4. What are the final 15 location recommendations with addresses?

Data

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

1. Number of existing restaurants in the neighborhood (any type of restaurant)
2. Number of and distance to Italian restaurants in the neighborhood, if any
3. Distance of neighborhood from city center

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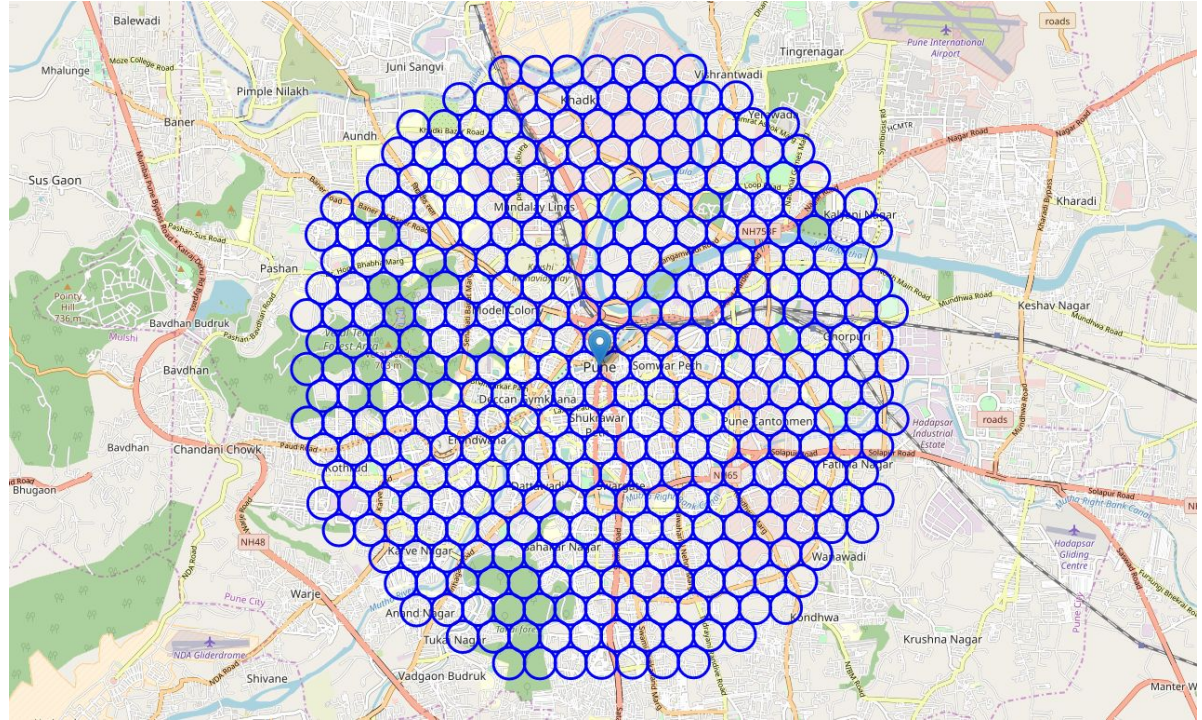
Data Source

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 the *GeoPy* python library.
- **Number of restaurants and their type and location in every neighborhood** will be obtained using *Foursquare API*
- **Coordinate of Pune center** will be obtained using *GeoPy* python library.

Grid of neighborhood area candidates

Grid of 364 equally spaced neighborhood area candidates with a radius of 300m and within 6 km radius around Pune city center.
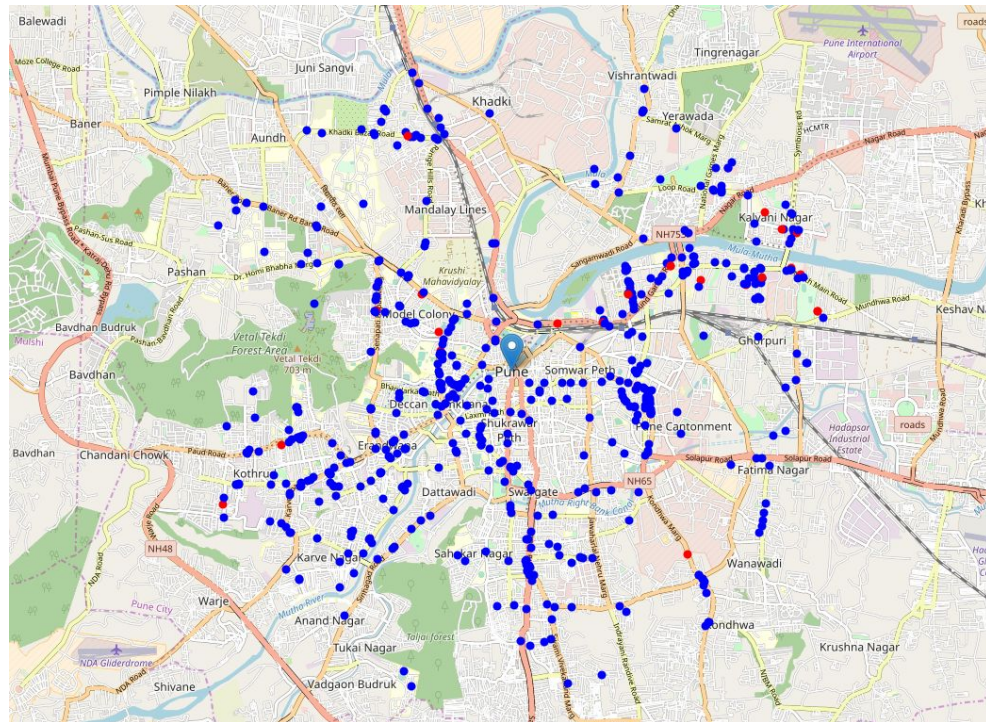
List of neighborhood candidate areas

List of candidate areas with address, latitude, longitude, UTM x and y coordinate locations and distance from the Pune city center.

	Address	Latitude	Longitude	X	Y	Distance from center
0	Sinhagad College Wadgaon Campus, Sinhgad Cante...	18.469675	73.837752	377284.452392	2.042544e+06	5992.495307
1	Tukai Nagar, Pune, 411001	18.469709	73.843434	377884.452392	2.042544e+06	5840.376700
2	Sahakar Nagar, Pune, 411001	18.469744	73.849116	378484.452392	2.042544e+06	5747.173218
3	Sahakar Nagar, Pune, 411001	18.469778	73.854797	379084.452392	2.042544e+06	5715.767665
4	KK Market, KK Market road, Sahakar Nagar, Pune...	18.469813	73.860479	379684.452392	2.042544e+06	5747.173218
5	Sahakar Nagar, Pune, 411001	18.469847	73.866161	380284.452392	2.042544e+06	5840.376700
6	Kondhwa, Pune, 411018	18.469881	73.871843	380884.452392	2.042544e+06	5992.495307
7	Prosperity Society, Tukai Nagar, Pune, 411001	18.474317	73.829198	376384.452392	2.043064e+06	5855.766389
8	Prosperity Society, Tukai Nagar, Pune, 411001	18.474352	73.834879	376984.452392	2.043064e+06	5604.462508
9	Prosperity Society, Tukai Nagar, Pune, 411001	18.474387	73.840561	377584.452392	2.043064e+06	5408.326913

Map of collected restaurants

Map of all collected restaurants within radius of 6 km around Pune city center in blue color with Italian restaurants in red color.
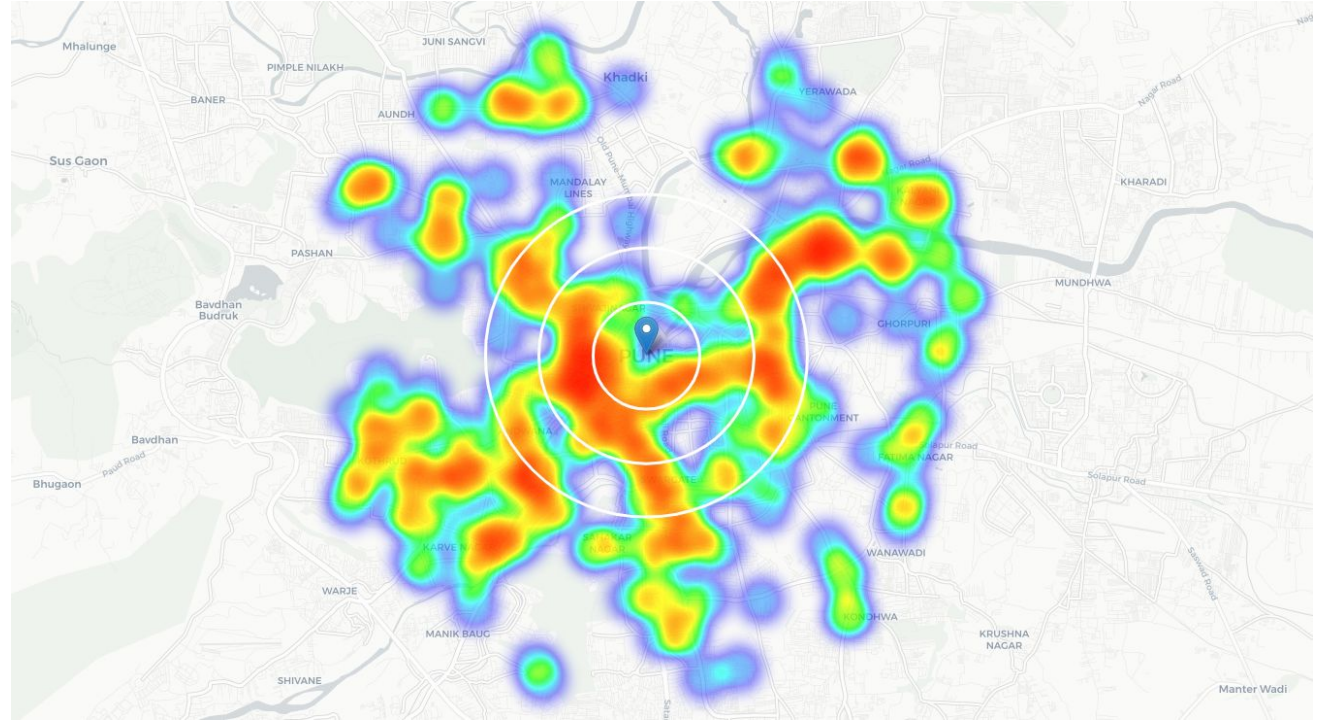
Methodology

The four steps data analysis methodology:

1. **Data collection and preparation**: location and type of every restaurant within a radius of 6 km from Pune city center.
2. **Data analysis**: calculate 'restaurant density' and use heatmaps to identify a few promising areas close to the center.
3. **Clustering**: cluster promising locations into 15 clusters using k-means.
4. **Results**: final 15 promising good recommendations with addresses.

Recommendations are starting point for final 'street level' exploration and search for the optimal venue location by stakeholders.
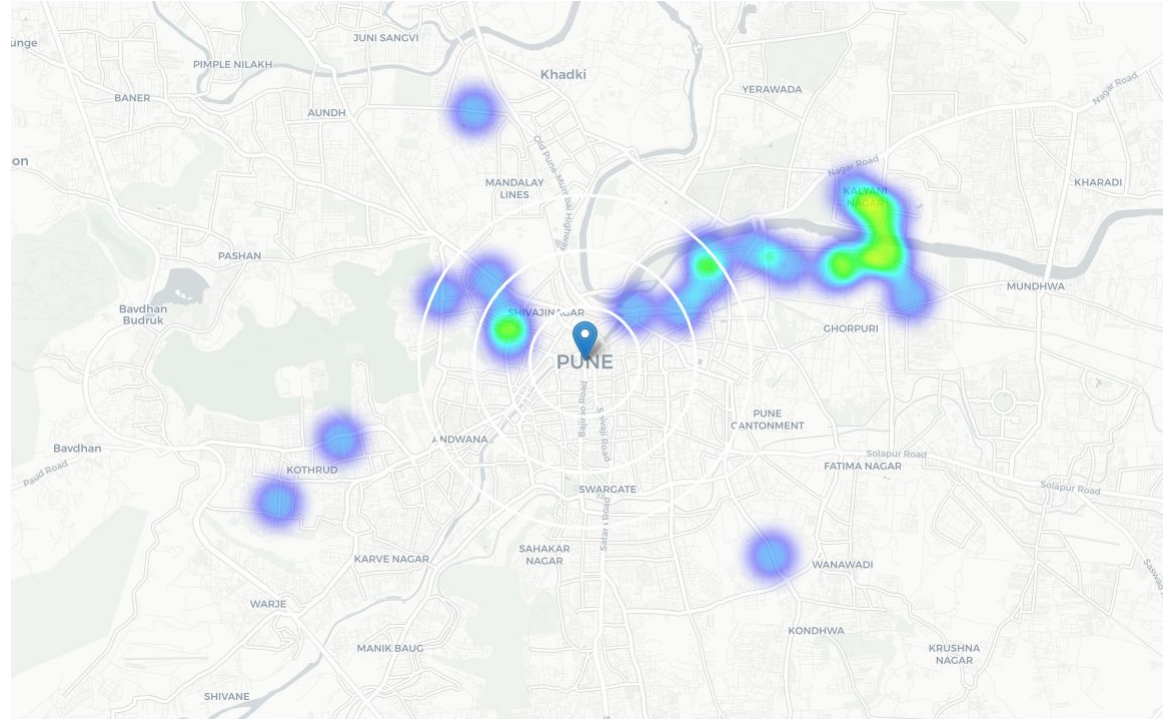
Heatmap of density of restaurants within 6 km

Heatmap of density of restaurants with circles indicating distance of 1 km, 2 km and 3 km from the Pune city center.

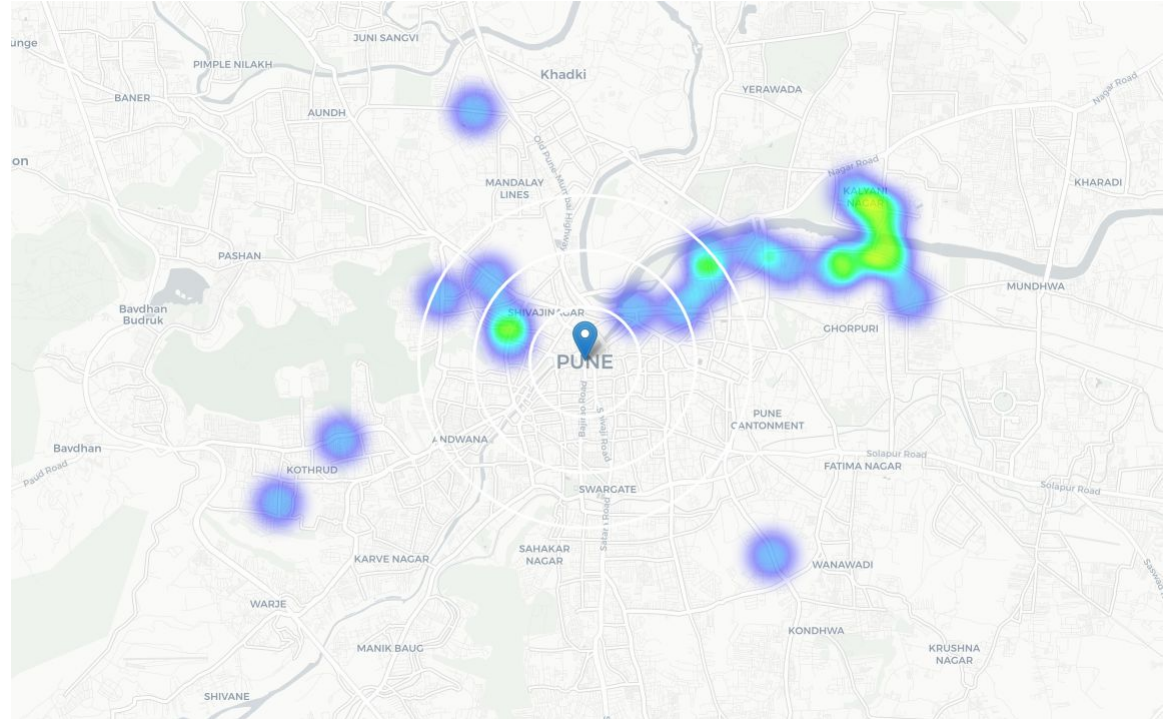# Heatmap of density of Italian restaurants within 6 km

Heatmap of density of **Italian** restaurants with circles indicating distance of 1 km, 2 km and 3 km from the Pune city center.

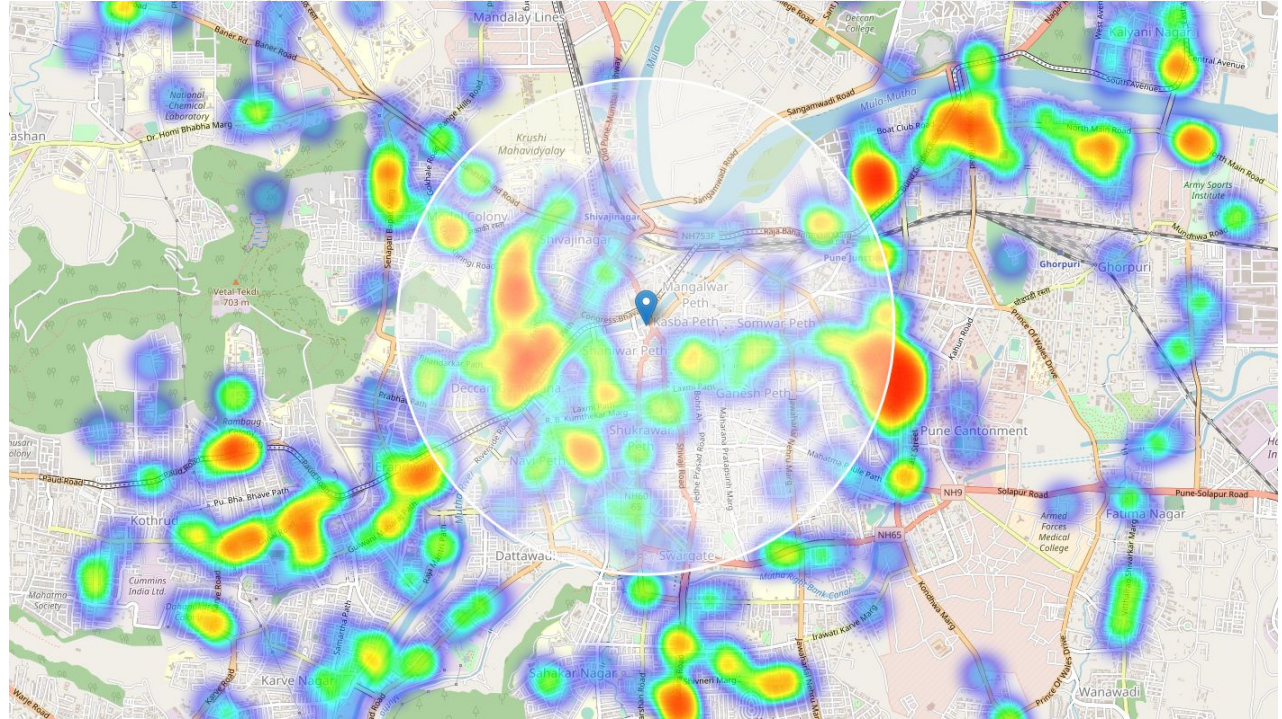# Heatmap of density of Italian restaurants within 6 km

Heatmap of density of **Italian** restaurants.

Low Italian restaurant density positions: *north*, *south*, *south-east* and *south-west* from the city center.

Heatmap of density of restaurants within 2.5 km area

Heatmap of density
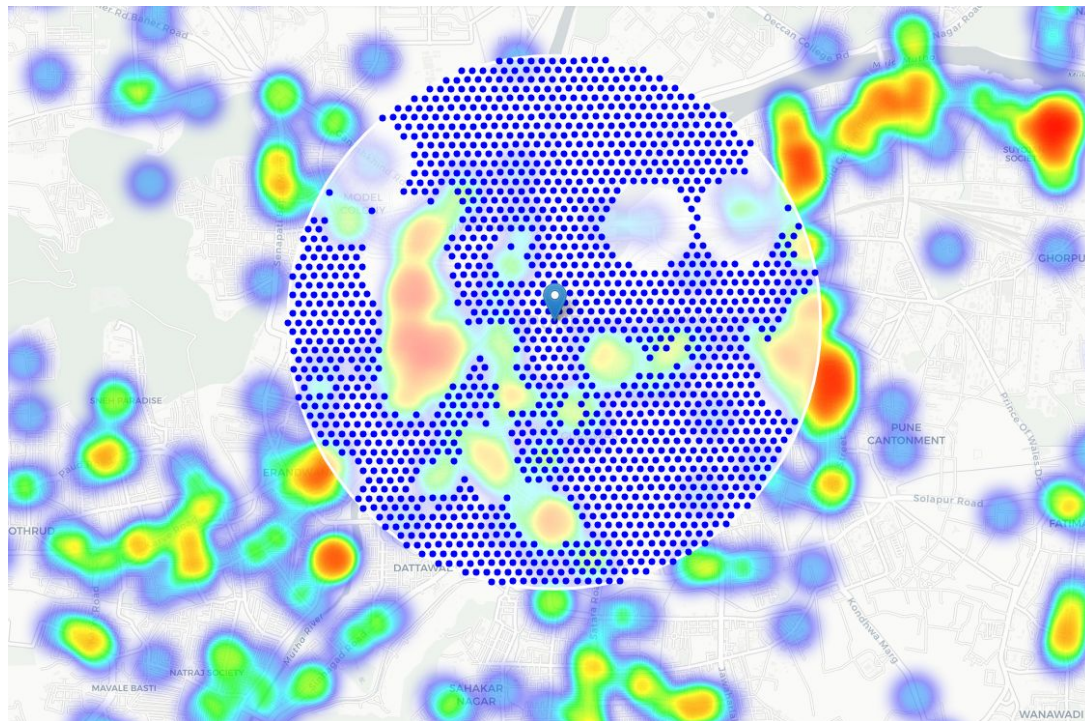of restaurants within
2.5 km.

Filtered candidate locations within 2.5 km

Total 1635 filtered locations with no more than two restaurants in radius of 250 m, and no Italian restaurants in radius of 400 m (first 10 rows):

	Latitude	Longitude	X	Y	Restaurants nearby	Distance to Italian restaurant
0	18.498834	73.854131	379034.452392	2.045760e+06	3	3191.948781
1	18.498840	73.855078	379134.452392	2.045760e+06	3	3234.294842
2	18.499585	73.848916	378484.452392	2.045846e+06	0	2924.506242
3	18.499591	73.849864	378584.452392	2.045846e+06	0	2952.094658
4	18.499597	73.850811	378684.452392	2.045846e+06	0	2982.782086
5	18.499602	73.851758	378784.452392	2.045846e+06	0	3016.473948
6	18.499608	73.852705	378884.452392	2.045846e+06	1	3053.070780
7	18.499614	73.853652	378984.452392	2.045846e+06	2	3092.469449
8	18.499620	73.854599	379084.452392	2.045846e+06	2	3134.564307
9	18.499625	73.855546	379184.452392	2.045846e+06	2	3179.248261

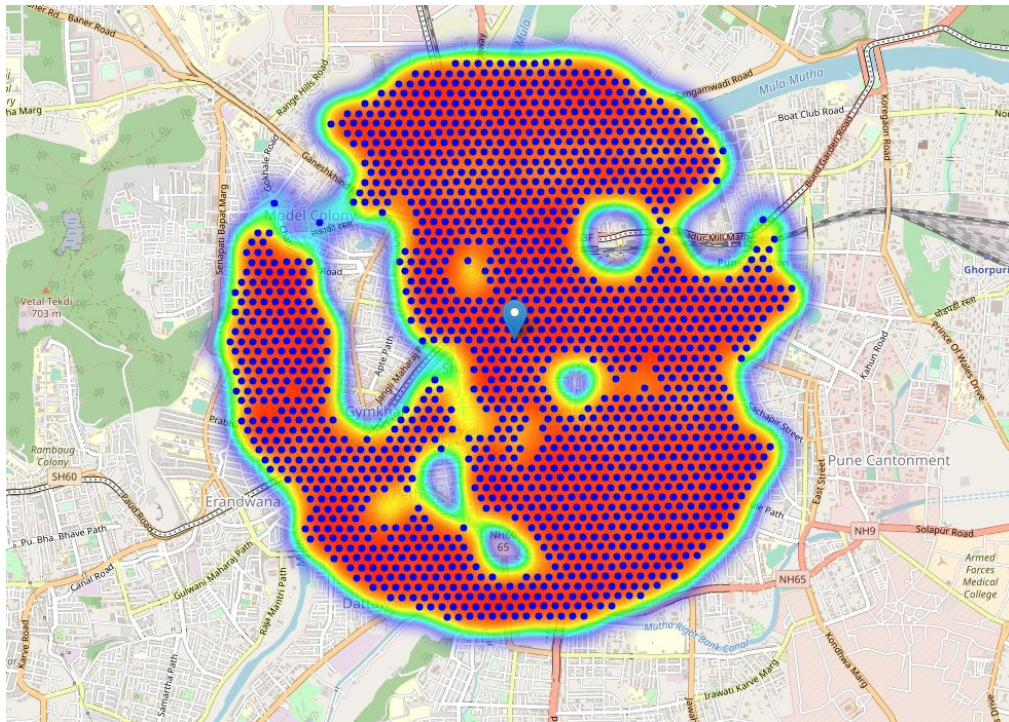# Map of filtered candidate locations within 2.5 km

Map of all filtered 1635 candidate locations with no more than two restaurants nearby and with no Italian restaurants within 400 meters.

Heatmap of all good locations within 2.5 km

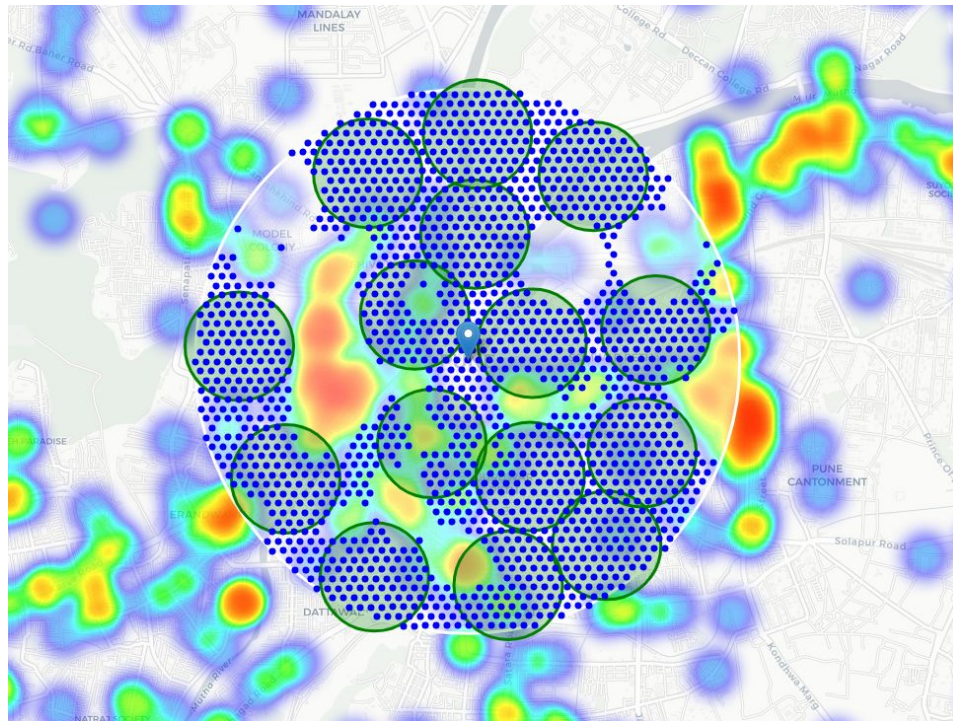Heatmap of all good 1635 locations.

Zones with low number of restaurants in vicinity, and no Italian restaurants at all nearby.

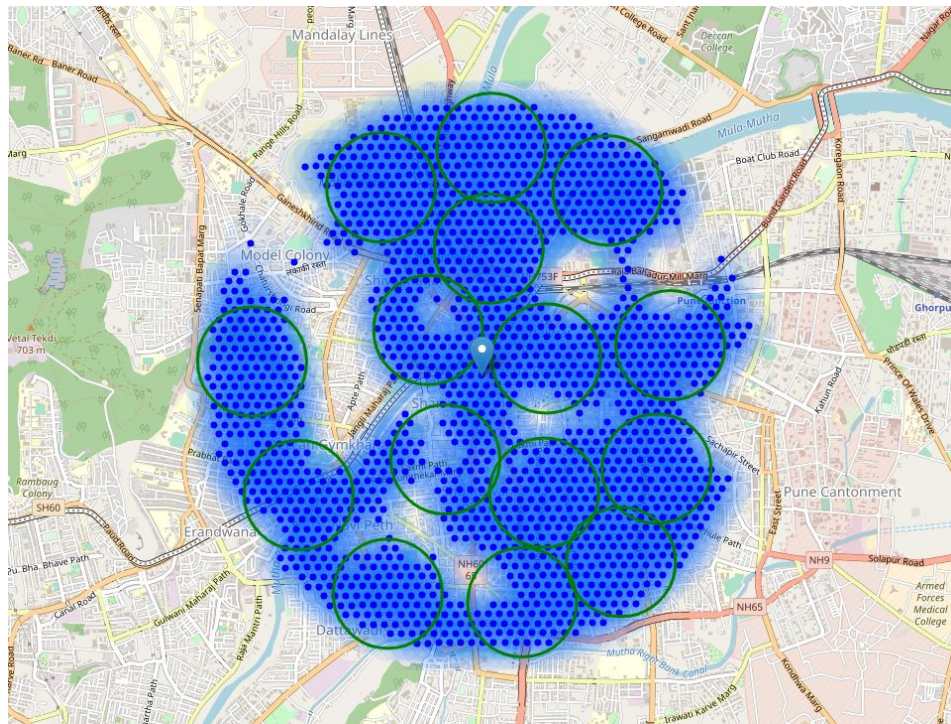# Heatmap of 15 clusters of good locations

Using a non-supervised machine learning technique ***k*-means clustering** to cluster promising good locations into 15 clusters.

Cluster centers are placed in the middle of the zones 'rich' with location candidates.

Shaded map of 15 clustered zones

Zones on a city map without a heatmap, using shaded areas to indicate our promising good 15 clusters.

Results

Based on our data analysis, we found answers to all four questions defined in our problem statement:

1. Total 552 restaurants present in a radius of 6 km around Pune city center.
2. Total 24 Italian restaurants, 4.35% of all restaurants.
3. Total 1635 locations with no more than two restaurants nearby and with no Italian restaurants within 2.5 km area.
4. The final list of 15 recommended locations with addresses. (see next slide)
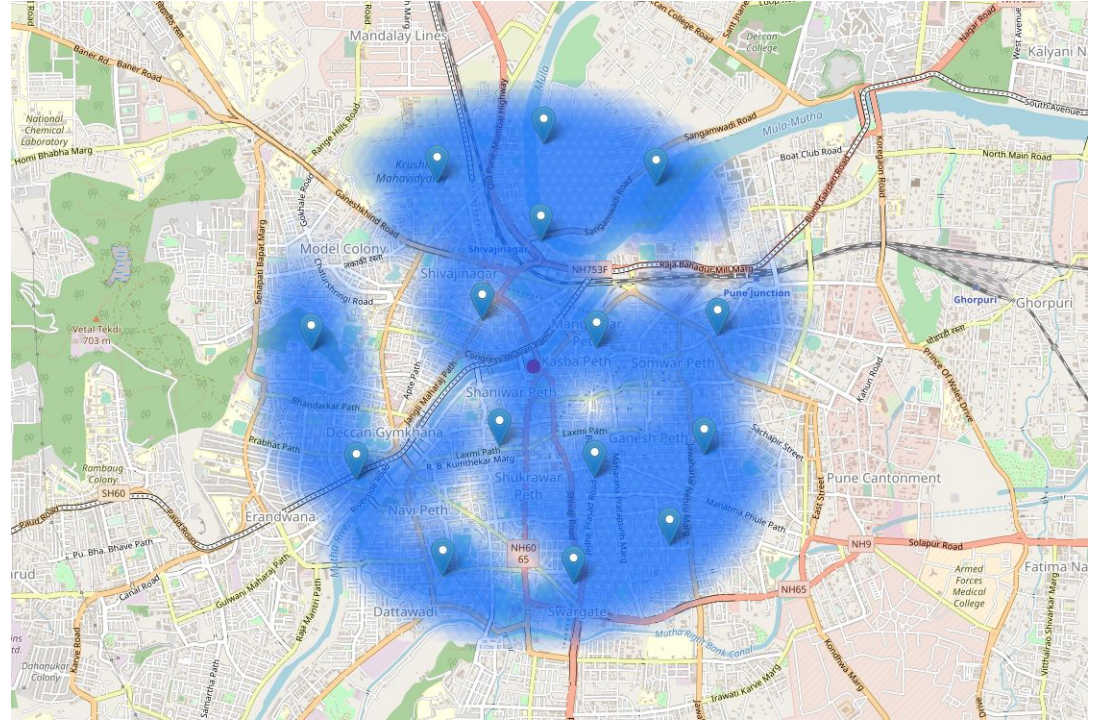
Final recommendations of 15 good locations

Sl. No.	Recommended Location Address	Distance from Pune city center
1.	Mokshagundam Vishweshvarayya Flyover, Shivajinagar, Pune	1.2 km
2.	Hamalwada Parking, Bhat Bol, Narayan Peth, Pune	0.8 km
3.	Swargate, Pune	2.1 km
4.	Timber Market, Ganesh Peth, Pune	2.1 km
5.	Abasaheb Garware College, Karve Road, Deccan Gymkhana, Pune	2.0 km
6.	Krushi Mahavidyalay, Ganeshkhind Road, Model Colony, Pune	1.9 km
7.	Ganesh Peth, Pune	1.8 km
8.	Shivajinagar, Pune	2.1 km

Sl. No.	Recommended Location Address	Distance from Pune city center
9.	Sangamwadi Road, Mangalwar Peth, Pune,	2.0 km
10.	Madhavrao Peshve Marg, Dattawadi, Pune	2.1 km
11.	Shivajinagar, Pune	0.6 km
12.	Mangalwar Peth, Pune	0.6 km
13.	Guruwar Peth, Pune	1.2 km
14.	Sneh Paradise, Deccan Gymkhana, Pune	2.1 km
15.	Somwar Peth, Pune	1.8 km

Map of final 15 recommended locations

15 recommended locations on the map of Pune city center.

Discussion

- Good number of restaurants in Pune - 552 in a radius of 6 km around Pune.

- Highest concentration of restaurants in north-east and north-west regions.

- Total 1635 locations with no more than two restaurants nearby and with no Italian restaurants within 2.5 km area.

- 15 clustered zones with greatest number of location candidate.

- Recommended zones should be considered only as a starting point for more detailed analysis

Conclusion

- We identified and recommended 15 promising good areas close to the Pune city 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 Italian restaurant.
- Final decision on optimal restaurant location will be made by stakeholders based on specific characteristics of neighborhoods and locations in every recommended zone, considering additional factors like attractiveness, noise level, proximity to major roads, real estate availability, social and economic dynamics of every neighborhood etc.