Capstone Project - The Battle of the Neighborhoods (Week 2)

Applied Data Science Capstone by IBM/Coursera

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Introduction: Business Problem

In this project we will try to find an optimal location for a gym. Specifically, this report will be aimed at those interested in opening a gym specializing in Pilates in Paris, France.
Since there are many gyms in Paris, we will try to detect locations that are not already crowded with gyms.
We are also particularly interested in areas without Pilates gyms nearby.
We also prefer locations as close to the city center as possible, assuming that the first two conditions are met.
We will use our data science powers to generate some of the most promising neighborhoods based on this criterion.
The advantages of each area will then be clearly expressed so that the best possible final location can be chosen by those interested.

Data

Based on the definition of our problem, the factors that will influence our decision are
- number of gyms in the neighborhood (any type of gym)
- number and distance of Pilates gyms in the neighborhood, if any
- distance from the neighbourhood to the city centre

We decided to use a grid of regularly spaced places, centered in the center of the city, to define our neighborhoods.
The following data sources will be needed to extract/generate the required information:

- the centers of the candidate areas will be algorithmically generated and the approximate addresses of the centers of those areas will be obtained using the OpenCage Reverse geocoding API
- The number of gyms and their type and location in each neighborhood will be obtained using the API Foursquare.ç
- The coordinate of the center of Paris will be obtained using OpenCage Geocoding API from the known location of Paris (Champs-Elysees)

Neighborhood Candidates

We will create the latitude and longitude coordinates for the centroids of our candidate neighborhoods.
We will create a grid of cells covering our area of interest which is approximately 12x12 kilometers centered in the center of the city of Paris.
Let's first find the latitude and longitude of the center of Paris, using a specific and known address and the OpenCage geocoding API.

Coordinate of Campos Elíseos, Paris, Francia: [48.8706149, 2.3049928]

We will then create a grid of area candidates, equally spaced, centered around the city center and within ~6km of Champs Elysees. Our neighborhoods will be defined as circular areas with a radius of 300 meters, so our neighborhood centers will be 600 meters away.
To calculate distances accurately we will need to create our grid of places in the 2D Cartesian coordinate system which allows us to calculate distances in meters (not in degrees of latitude/longitude).
We will then project those coordinates back in degrees of latitude/longitude to be shown on the Folium map.
So we will create functions to convert between the spherical coordinate system WGS84 (degrees of latitude/longitude) and the Cartesian coordinate system UTM (X/Y coordinates in meters).

Coordinate transformation check

Paris center longitude=2.3049928, latitude=48.8706149
Paris center UTM X=-429871.02921360545, Y=5491266.10414692
Paris center longitude=2.3049928000000017, latitude=48.87061489999999

We will create a hexagonal grid of cells: we compensate every two rows and adjust the vertical space of the rows so that the center of each cell is equally distant from all its neighbors.

364 candidate neighborhood centers generated.

Let's look at the data we have so far: location of the city center and the centers of the candidate neighborhoods:
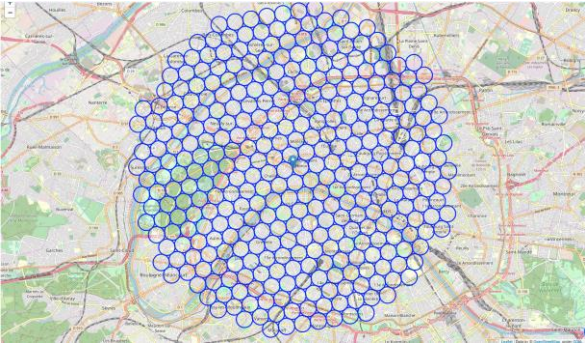
OK, now we have the coordinates of the centers of the neighborhoods/areas to be evaluated, equally spaced (the distance from each point to its neighbors is exactly the same) and within ~6km of 'Champs Elysees'.
We will use the OpenCageData API to get the approximate directions of those places.

Reverse geocoding check

Address of [48.8706149, 2.3049928] is: 68 Avenue des Champs-Élysées, 75008 Paris, France

Obtaining location addresses:

 ['27 Boulevard Jules Ferry, 75011 Paris',
 '146 Rue Saint-Maur, 75011 Paris',
 'Bâtiment 7, Rue des Couronnes, 75020 Paris',
 'Hippodrome de Longchamp, Route des Tribunes, 75016 Paris',
 "Avenue de l'Hippodrome, 75016 Paris",
 'Route de la Vierge aux Berceaux, 75016 Paris',
 'Lac Inférieur, Boulevard Périphérique Extérieur, 75016 Paris',
 '2 Rue Ernest Hébert, 75016 Paris',
 '17 Rue de Siam, 75116 Paris',
 '37 Avenue Georges Mandel, 75116 Paris',
 '10 Rue de Magdebourg, 75116 Paris',
 '14 Avenue du Président Wilson, 75016 Paris',
 '26 Rue Jean Goujon, 75008 Paris',
 'Jardins des Champs-Élysées, Avenue du Général Eisenhower, 75008 Paris',
 'Automobile Club de France, Place de la Concorde, 75008 Paris',
 '4 Rue des Capucines, 75001 Paris',
 '6 Rue Ménars, 75002 Paris',
 '18 Rue Saint-Fiacre, 75002 Paris',
 "20 Passage de l'Industrie, 75010 Paris",
 '6 Rue Legouvé, 75010 Paris']

Let's put all this in a Pandas data frame.

	Address	Latitude	Longitude	X	Y	Distance_from_center
0	10 Rue Raymond David, 92240 Malakoff	48.817776	2.293957	-431671.029214	5.485550e+06	5992.495307
1	8 Rue Renault, 92240 Malakoff	48.818669	2.301930	-431071.029214	5.485550e+06	5840.376700
2	64 Avenue Pierre Brossolette, 92240 Montrouge	48.819562	2.309903	-430471.029214	5.485550e+06	5747.173218
3	1 Rue du 11 Novembre, 92120 Montrouge	48.820454	2.317877	-429871.029214	5.485550e+06	5715.767665
4	3 Avenue de la Porte d'Orléans, 75014 Paris	48.821346	2.325852	-429271.029214	5.485550e+06	5747.173218
5	9 Rue du Parc de Montsouris, 75014 Paris	48.822237	2.333827	-428671.029214	5.485550e+06	5840.376700
6	43 Rue de l'Amiral Mouchez, 75014 Paris	48.823127	2.341802	-428071.029214	5.485550e+06	5992.495307
7	55 Avenue du Général de Gaulle, 92130 Issy-les...	48.820994	2.280825	-432571.029214	5.486070e+06	5855.766389
8	22BIS Rue Sadi Carnot, 92170 Vanves	48.821889	2.288798	-431971.029214	5.486070e+06	5604.462508
9	74 Rue Jean Bleuzen, 92170 Vanves	48.822782	2.296772	-431371.029214	5.486070e+06	5408.326913

Foursquare

Now that we have our placement candidates, we will use API Foursquare to get information on the gyms in each neighborhood.
We are interested in locations in the 'fitness' category, but only those that are suitable gyms - golf, curling, basketball, etc. are not direct competitors, so we don't worry about them.
Therefore, we will include in our list only those places that have a 'gym' in the name of the category, and we will make sure to detect and include all the subcategories of the specific 'Pilates gym' category, as we need information about the specialized Pilates gyms in the neighborhood.

Obtaining venues around candidate locations: . . . .
Total number of gyms: 656
Total number of Pilates gyms: 11
Percentage of Pilates gyms: 1.68%
Average number of gyms in neighborhood: 1.565934065934066

List of all gyms

('4e9011fa61afcfde29b67301', 'Fushan Kwoon', 48.82011084414003, 2.2920888100896346, '11 rue Ernest Laval, 92170 Vanves', 311, False, -431763.7626481827, 5485832.169380279)
('5cec026d33e118002c763d35', 'Keep Cool', 48.82104, 2.304697, '68 avenue Pierre Larousse, 92240 Malakoff', 293, False, -430824.0954698052, 5485778.635643852)
('4c0cad9fb1b676b03b6ddf86', 'Fitness Malakoff', 48.818007, 2.308301, 'France', 209, False, -430617.43556097185, 5485397.98839793)
('4e917df849013919db3a70cf', 'Gym Suédoise Montrouge', 48.82031749307568, 2.3207645008551174, '25 BIS AVENUE DE LA REPUBLIQUE, 92120 MONTROUGE', 212, False, -429662.4158350044, 5485499.458341408)
('4e9c08804901d3b0b787ba5b', 'Fitness Center EverGreen', 48.82296709735948, 2.316257333039831, 'Gabriel Péri, 92120 Montrouge', 303, False, -429942.37279510556, 5485848.784962585)
('4d48a23a4a6d8eecfb2d212d', 'Institut du Judo', 48.82248396274017, 2.316344976425171, '21 Avenue Porte de Châtillon, 75014 Paris', 252, False, -429945.02842260944, 5485794.183639092)
('5122620ae4b027096c32d203', 'Club Med Gym - Sanofi', 48.81901133961309, 2.3282755533463946, '9 Bd Romain Rolland, 75014 Paris', 314, False, -429137.50446841714, 5485261.771672926)
('5085a92fe4b0b1ead2b8f07a', 'Paris Taekwondo Elite', 48.82126357368282, 2.323440723986733, '27 boulevard Jourdan, 75014 Paris', 176, False, -429448.9213214482, 5485571.108240705)
('4e5fa74f52b171e17dbbda1d', 'Nordique France', 48.823645, 2.323203, 'Paris', 273, False, -429421.64728171646, 5485837.836713018)
('4d84df3450913704082e895b', 'Gymnase Doisneau', 48.821611626626236, 2.3345374628838442, 'France', 86, False, -428630.7420677282, 5485472.304988544)
...
Total: 656

List of Pilates Gyms

('4cae0dff8c48a093db68712c', 'Europe Pilates Center', 48.840701, 2.241564, 'Rue de paris, Boulogne-Billancourt', 211, True, -435070.5364915617, 5488741.314092849)
('4d7e7724e7e1721e05f9e00b', 'Boulogne Pilates', 48.84017831336912, 2.244182825088501, '53 rue de Paris, Boulogne-Billancourt', 215, True, -434888.9409796109, 5488650.782350457)
('596e18676f0aa2051e0f7286', 'Paris Pilates', 48.850909, 2.311139, '32 Avenue Duquesne, 75007 Paris', 282, True, -429792.07690998726, 5489007.2182700895)
('55fbd27b498eb3a5d322d6ca', 'Pilates by Jenn', 48.8521319, 2.293601599999988, '15 Rue George Bernard Shaw, 75015 Paris', 344, True, -431051.0198145197, 5489360.182554285)
('4f9e47e6e4b0a3d1dda5319b', 'Cours Pilates @ HQ', 48.857326724621785, 2.2911603705649974, '3 avenue octave gréard, 75007 Paris', 350, True, -431131.73830055806, 5489965.8782646945)
('5a100503a6ec983a4a97a183', 'Reformation Pilates', 48.86518, 2.359946, '175 Rue du Temple, 75003 Paris', 240, True, -425957.34254639165, 5489984.25962068)
('500e99e3e4b02345771d167e', 'Keana Pilates', 48.868812183737795, 2.3250430945917753, '11 Rue Du Chevalier Saint Georges', 239, True, -428439.81577301386, 5490818.030485942)
('5d1a1748a24dd70023e0ed0b', 'Ze Art Studios', 48.87036, 2.3413446, '17 rue saint-marc, 75002 Paris', 346, True, -427219.62934649526, 5490787.814565842)
('530253d011d2035304d47a68', 'Pilates privee', 48.87223753566504, 2.302564072089421, '5 Rue Lamennais', 339, True, -430017.9869323266, 5491475.947289139)
('548624c9498e19bef47cc0fa', 'Le Studio du 17ème - Pilates', 48.88192765861766, 2.303942441940307, '28 rue Cardinet, 75017 Paris', 319, True, -429735.11621097894, 5492532.152658249)
...
Total: 11

Gyms around location

Gyms around location 101:
Gyms around location 102: Front de Seine - Squash & Fitness, Blue Fitness Eiffel, Gym Suedoise keller, Gym Suedoise Beaugrenelle C3B, Piscine René et André Mourlon
Gyms around location 103: Neoness Paris La Motte-Picquet, Neoness Paris La Motte-Picquet
Gyms around location 104: Health City, Centre Aquabike La Motte Picquet, Fitness First Motte-Picquet
Gyms around location 105:
Gyms around location 106: Centre Aquasvelt, Paris Pilates
Gyms around location 107: Champion Spirit Paris
Gyms around location 108: Corebody
Gyms around location 109: La Villa SG FC, De Rose, Bandha Yoga
Gyms around location 110: Hyperion Coaching, Autrement Zen

Let's see on the map all the gyms collected in our area of interest and let's also show the Pilates gyms in different colors.
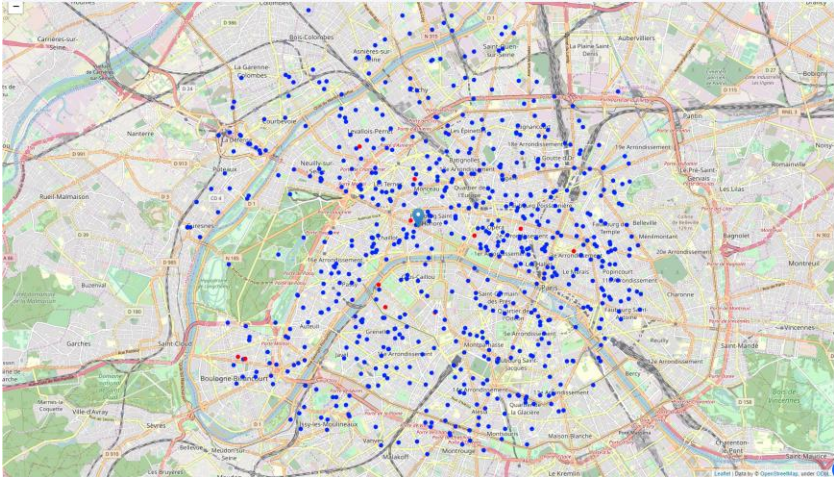
Now we have all the gyms in the area a few kilometers from Champs Elysees, and we know which are the Pilates gyms.
We also know exactly which gyms are located in the vicinity of each candidate center in the neighborhood.
This concludes the data collection phase
We are now ready to use this data for analysis and produce gym report on the optimal locations for a new Pilates gym!

Methodology

In this project we will direct our efforts to detect areas of Paris that have a low density of gyms, particularly those with a low number of gyms specializing in Pilates. We will limit our analysis to an area of ~6km around the city center.

* In the first step we have collected the necessary data: location and type (category) of each gym within 6km of the centre of Paris (Champs-Elysées). We have also identified the gyms that specialize in Pilates (according to the Foursquare categorization).
* The second step of our analysis will be to calculate and explore the "gym density" in different areas of Paris - we will use heat maps to identify some promising areas near the center with a low number of gyms in general (and no Pilates specialized gym nearby) and focus our attention on those areas.
* In the third and final step we will focus on the most promising areas and within them we will create clusters of locations that meet some basic requirements established in the discussion with the stakeholders: we will take into consideration locations with no more than two gyms within a 250 meter radius, and we want locations without Pilates gyms within a 400 meter radius.

We will present a map of all these locations, but we will also create clusters (using k-means clustering) of these locations to identify general areas/neighborhoods/directions that should be a starting point for the final "street level" exploration and the stakeholders' search for the optimal location of the premises.

Analysis

Let's do some basic explanatory data analysis and derive some additional information from our raw data.
First, let's count the number of gyms in each candidate area:

Average number of gyms in every area with radius=300m: 1.565934065934066

	Address	Latitude	Longitude	X	Y	Distance_from_center	Gyms_in_area
0	10 Rue Raymond David, 92240 Malakoff	48.817776	2.293957	-431671.029214	5.485550e+06	5992.495307	1
1	8 Rue Renault, 92240 Malakoff	48.818669	2.301930	-431071.029214	5.485550e+06	5840.376700	0
2	64 Avenue Pierre Brossolette, 92240 Montrouge	48.819562	2.309903	-430471.029214	5.485550e+06	5747.173218	1
3	1 Rue du 11 Novembre, 92120 Montrouge	48.820454	2.317877	-429871.029214	5.485550e+06	5715.767665	2
4	3 Avenue de la Porte d'Orléans, 75014 Paris	48.821346	2.325852	-429271.029214	5.485550e+06	5747.173218	1
5	9 Rue du Parc de Montsouris, 75014 Paris	48.822237	2.333827	-428671.029214	5.485550e+06	5840.376700	2
6	43 Rue de l'Amiral Mouchez, 75014 Paris	48.823127	2.341802	-428071.029214	5.485550e+06	5992.495307	1
7	55 Avenue du Général de Gaulle, 92130 Issy-les...	48.820994	2.280825	-432571.029214	5.486070e+06	5855.766389	0
8	22BIS Rue Sadi Carnot, 92170 Vanves	48.821889	2.288798	-431971.029214	5.486070e+06	5604.462508	1
9	74 Rue Jean Bleuzen, 92170 Vanves	48.822782	2.296772	-431371.029214	5.486070e+06	5408.326913	1

Now let's calculate the distance to the nearest Pilates gym from each candidate center in the area (not just the ones within 300m - we want the distance to the nearest one, no matter how far away it is).

	Address	Latitude	Longitude	X	Y	Distance From center	Gyms_in_area	Distance_toPilates_gym
0	10 Rue Raymond David, 92240 Malakoff	48.817776	2.293957	-431671.029214	5.485550e+06	5992.495307	1	3859.966159
1	8 Rue Renault, 92240 Malakoff	48.818669	2.301930	-431071.029214	5.485550e+06	5840.376700	0	3685.885334
2	64 Avenue Pierre Brossolette, 92240 Montrouge	48.819562	2.309903	-430471.029214	5.485550e+06	5747.173218	1	3522.926046
3	1 Rue du 11 Novembre, 92120 Montrouge	48.820454	2.317877	-429871.029214	5.485550e+06	5715.767665	2	3457.783273
4	3 Avenue de la Porte d'Orléans, 75014 Paris	48.821346	2.325852	-429271.029214	5.485550e+06	5747.173218	1	3495.929404
5	9 Rue du Parc de Montsouris, 75014 Paris	48.822237	2.333827	-428671.029214	5.485550e+06	5840.376700	2	3634.113322
6	43 Rue de l'Amiral Mouchez, 75014 Paris	48.823127	2.341802	-428071.029214	5.485550e+06	5992.495307	1	3861.610658
7	55 Avenue du Général de Gaulle, 92130 Issy-les...	48.820994	2.280825	-432571.029214	5.486070e+06	5855.766389	0	3468.919382
8	22BIS Rue Sadi Carnot, 92170 Vanves	48.821889	2.288798	-431971.029214	5.486070e+06	5604.462508	1	3416.436185
9	74 Rue Jean Bleuzen, 92170 Vanves	48.822782	2.296772	-431371.029214	5.486070e+06	5408.326913	1	3305.756333

Average distance to closest Pilates gym from each area center: 2032.1648678573972

So on average a Pilates gym can be found within ~2km of each candidate's downtown area. That's pretty close, so we have to filter our areas carefully!
We will create a map showing the heat/density map of the gyms and try to extract some meaningful information from that.
In addition, we will show the boundaries of the neighborhoods/districts of Paris on our map and some circles indicating the distance of 1, 2 and 3 km from the Champs-Elysées.

It seems that some of the low-density gyms closer to the city center are located south, southeast and east of the Champs Elysees.
Let's create another heat map showing heat/density map of Pilates gyms only.
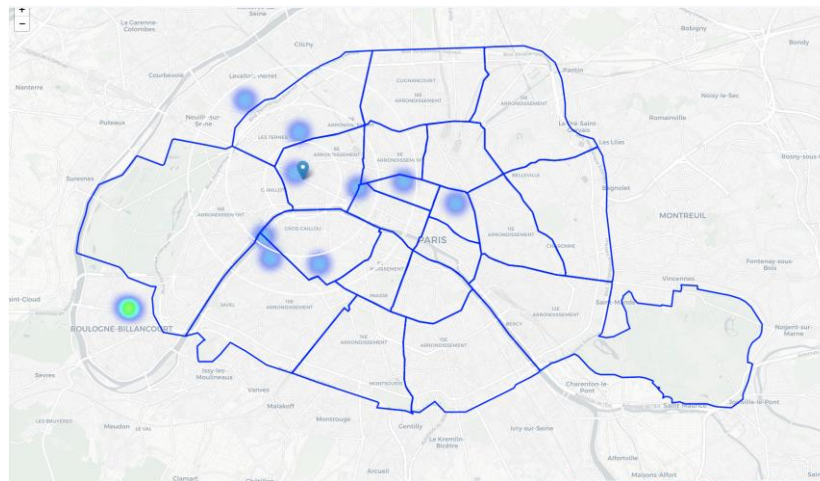
This map is not so 'hot' (Pilates gyms represent a subset of ~1% of all gyms in Paris) but it also indicates a higher density of existing Pilates gyms directly north and west of the Champs-Elysées, with the closest low-density Pilates gym bags located east, southeast and south of the city center.
Based on this, we will now focus our analysis on the southwest, south, southeast and east areas of central Paris - we will move the center of our area of interest and reduce its size to have a radius of 2.5km. This places our location candidates in the municipalities of "Pont Du Carrouser" and "The Eiffel Tower" (another potentially interesting municipality is "Montparnasse", with a high density of gyms to the northeast of the city centre, however, this municipality is less interesting for those interested as it is mainly residential and less busy).

Pont Du Carrouser and The Eiffel Tower
Travel guide reviews and popular websites often mention "Pont Du Carrouser" and "The Eiffel Tower" as beautiful, interesting, culturally rich, hip and cool French neighborhoods popular with locals and loved by the French.

* "Bold and brazen, the creative people, places and spaces of Pont Du Carrouser could challenge your paradigm": Day life, Art, Natural, Fashion, Loved by the French, Great traffic.

* "Pont Du Carrouser has long been revered for its diverse cultural life and as part of Paris where alternative lifestyles have flourished. The vision of the glamorous and sandy nature of Paris often evokes scenes from this neighborhood, where cultures, movements and artistic radiance adorn the walls of the buildings and fill the air.

* Full of clubs, light food and art galleries, The Eiffel Tower is the ideal place for the young and trendy in Paris"

* "Imagine an upside-down art gallery and you'll start to imagine The Eiffel Tower. Individual walls are not canvases for creative works, entire buildings are canvases. This zealously expressive Parisian neighborhood renounces social norms "Tags: Artistic, Day Life, Fashion, Restaurants, Tourist, Shopping, High Traffic, Loved by Parisians.

*As anyone from The Eiffel Tower will tell you, this district is not only the coolest in Paris, but the most modern place in the entire universe. The Eiffel Tower has long been famous for its diverse cultural life, its experimental alternative lifestyles and the powerful spell it casts over young people throughout Paris.

Popular with tourists, alternative and bohemian, but booming and fashionable, relatively close to the city centre and well connected, these districts seem to warrant further analysis.

Let's define a new, narrower region of interest, which will include parts of Pont Du Carrouser and The Eiffel Tower with low population density, closer to the Champs-Elysées.
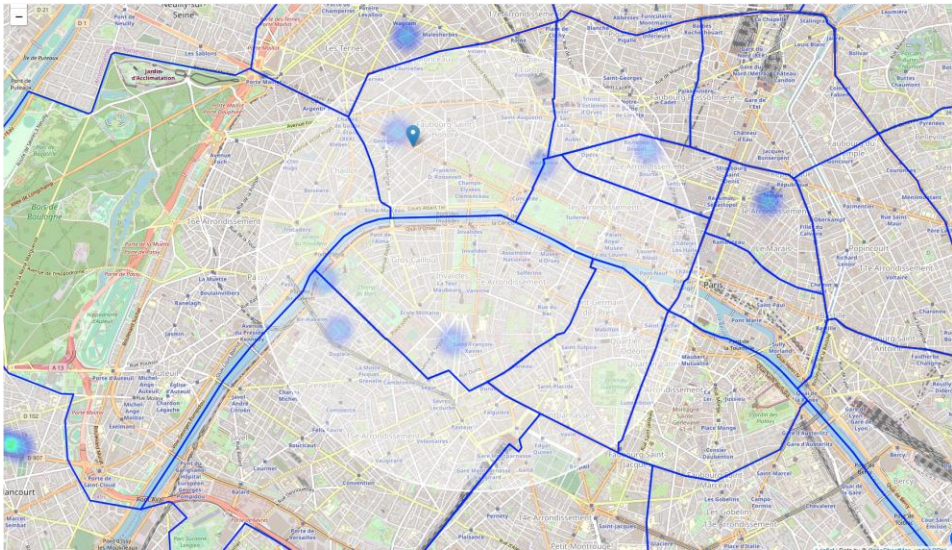
This covers very well all the low density pockets of gyms at "Pont Du Carrouser" and "The Eiffel Tower" closest to the center of Paris.

We will also create a new and denser network of location restricted candidates to our new region of interest (let's make our location candidates 100m away).

2261 candidate neighborhood centers generated.

Let's calculate two very important things for each location candidate: number of gyms in the vicinity (we will use a radius of 250 meters) and distance to the nearest Pilates gym.

Generating data on location candidates... done.

	Latitude	Longitude	X	Y	Gyms_nearby	Distance_to_Pilates_gym
0	48.836181	2.319996	-429421.029214	5.487266e+06	3	1780.212005
1	48.836329	2.321325	-429321.029214	5.487266e+06	4	1803.708491
2	48.836123	2.312489	-429971.029214	5.487353e+06	1	1664.161201
3	48.836272	2.313818	-429871.029214	5.487353e+06	0	1656.394290
4	48.836420	2.315148	-429771.029214	5.487353e+06	1	1654.645455
5	48.836569	2.316477	-429671.029214	5.487353e+06	1	1658.933731
6	48.836718	2.317807	-429571.029214	5.487353e+06	4	1669.212587
7	48.836866	2.319136	-429471.029214	5.487353e+06	4	1685.372422
8	48.837015	2.320466	-429371.029214	5.487353e+06	2	1707.246245
9	48.837164	2.321795	-429271.029214	5.487353e+06	1	1734.617906

Let's filter those locations: we are only interested in locations with no more than two gyms within 250 meters, and no Pilates gyms within 400 meters.

Locations with no more than two gyms nearby: 1700
Locations with no Pilates gyms within 400m: 1941
Locations with both conditions met: 1478

Let's see how this looks on a map.
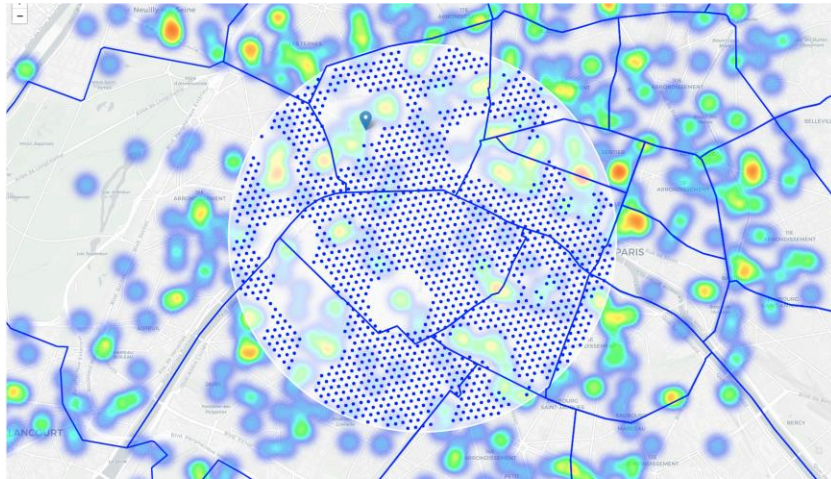
Now we have a lot of places quite close to "Champs Elysees" (mainly in Faubourg Pont Du Carrouser, The Eiffel Tower and in the southeast corner), and we know that each of those places has no more than two gyms within a 250 meter radius, and no Pilates specialized gym is within 400 meters. Any of these locations is a potential candidate for a new Pilates Gym, at least on the basis of nearby competition.

Let's show those good locations in the form of a heat map:
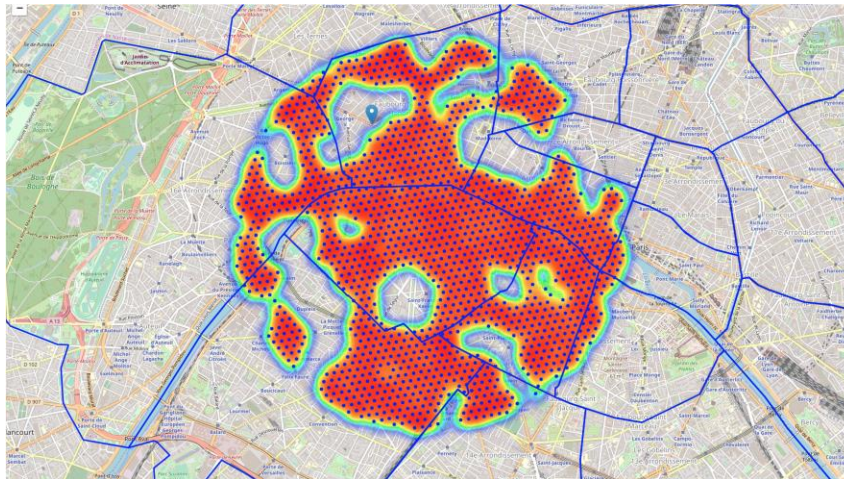
What we have now is a clear indication of areas with a low number of gyms in the vicinity, and not Pilates gyms at all.
Let's now cluster those locations to create area centers that contain good locations. Those areas, their centers and addresses will be the final result of our analysis.
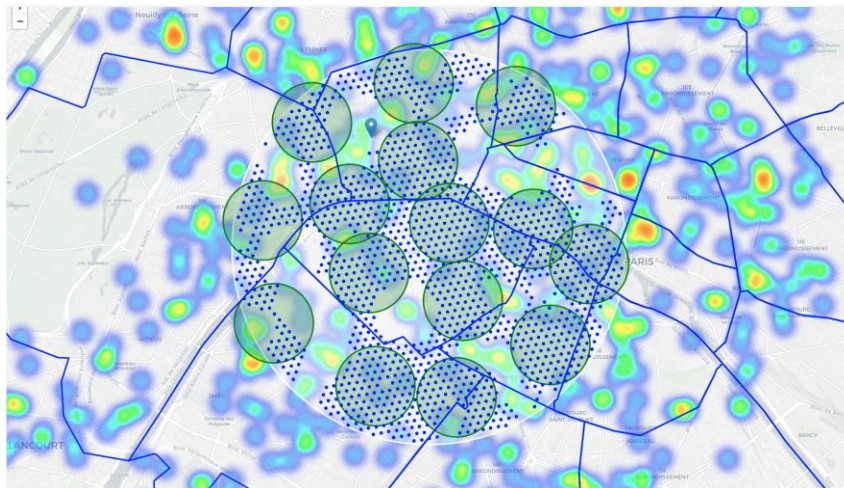
Our clusters represent groupings of most candidate locations and the cluster centres are located in the middle of "location rich" areas.
The addresses of these cluster centers will be a good starting point for exploring neighborhoods to find the best possible location based on neighborhood specifications.

Let's look at these zones on a city map without heatmap, using shaded areas to indicate our clusters:
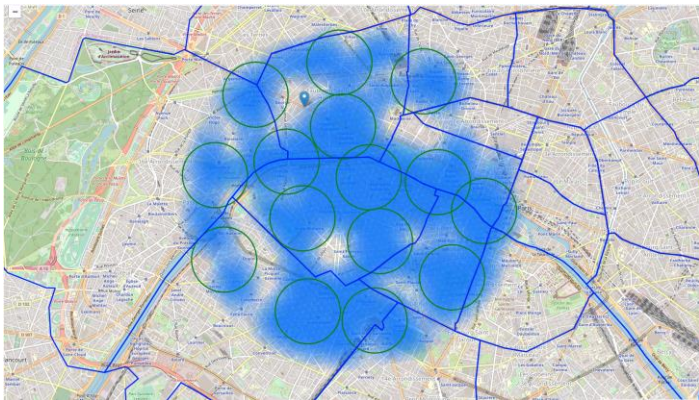
Let's approach the candidate areas on pont du carrouser:

...and the candidate areas in The Eiffel Tower:

Finally, we will reverse the geocode of the centres of the candidate areas to obtain the addresses that can be presented to those interested.
==
Addresses of centers of areas recommended for further analysis
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Address	Distance
56 Avenue Bosquet, 75007 Paris	=> 1.7km from Paris
Hôtel de Cassini, Rue de Babylone, 75007 Paris	=> 2.4km from Paris
39 Rue Blomet, 75015 Paris	=> 3.2km from Paris
Square de Berlin, Avenue des Champs-Élysées, 75008 Paris	=> 0.7km from Paris
BNP Paribas, 20 Rue de Harlay, 75001 Paris	=> 3.2km from Paris
6b Rue de Presbourg, 75016 Paris	=> 0.8km from Paris
12 Place Raoul Dautry, 75015 Paris	=> 3.5km from Paris
40 Rue Vineuse, 75116 Paris	=> 1.7km from Paris
12 Quai François Mitterrand, 75001 Paris	=> 2.4km from Paris
43 Rue Saint-Charles, 75015 Paris	=> 2.7km from Paris
90 Rue de Provence, 75009 Paris	=> 1.9km from Paris
24 Avenue de Messine, 75008 Paris	=> 0.9km from Paris
Pont de l'Alma, 75007 Paris	=> 0.9km from Paris
126 Rue de l'Université, 75007 Paris	=> 1.5km from Paris
17bis Rue de Vaugirard, 75006 Paris	=> 3.5km from Paris

This concludes our analysis. We have created 15 addresses that represent area centers containing places with a low number of gyms and no Pilates gym nearby, all areas are quite close to the city center (all within 4 km of Champs Elysees, and about half of them within 2 km of Champs Elysees). Although the areas are shown on a map with a radius of ~500 meters (green circles), their shape is actually very irregular and their centers/directions should be considered only as a starting point for exploring the neighborhoods in the area for possible gym locations. Most of the areas are located in the districts of pont du carrouser and The Eiffel Tower, which we have identified as interesting due to their popularity with tourists, quite close to the city centre and well connected by public transport.
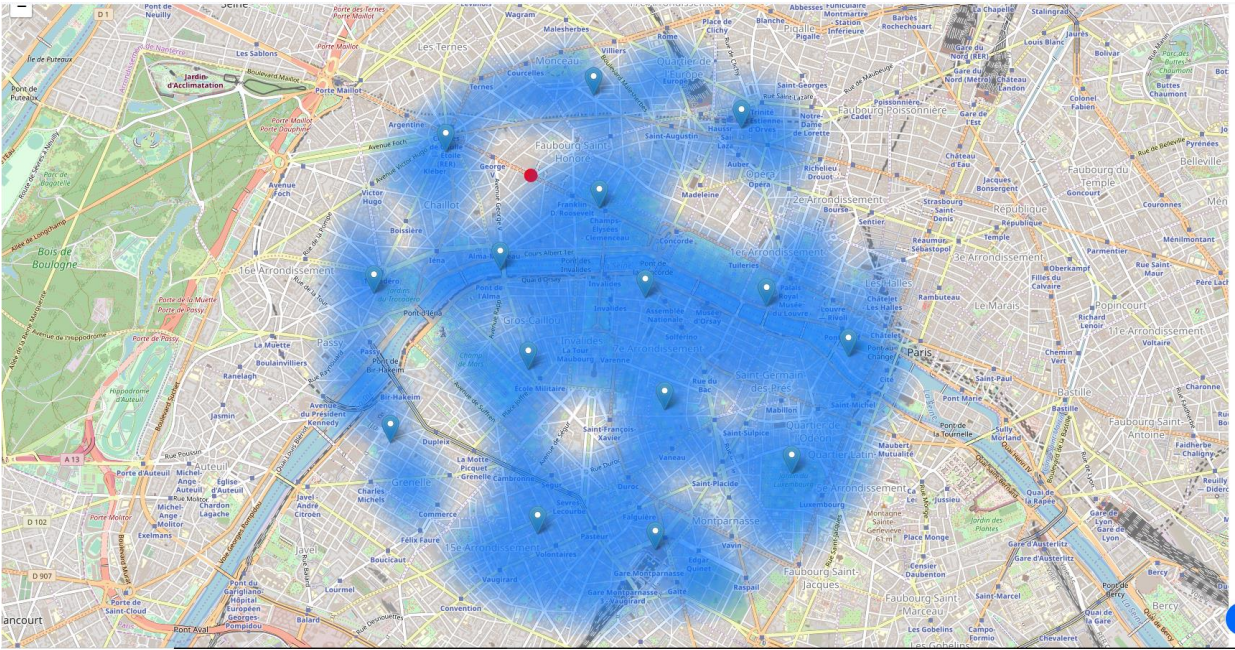
Results and Discussion

Our analysis shows that, although there are a large number of gyms in Paris (~2000 in our initial area of interest which was 12x12km around the Champs-Elysées), there are pockets of low density gyms fairly close to the city centre. The highest concentration of gyms was detected to the north and west of the Champs Elysées, so we focused our attention on the southern, southeastern and eastern areas, which correspond to the municipalities of pont du carrouser, The Eiffel Tower. Another municipality was identified as potentially interesting (Beselle, northeast of the Champs Elysées), but our attention was focused on pont du carrouser and The Eiffel Tower which offer a combination of popularity among tourists, proximity to the city centre, strong socio-economic dynamics and a number of low-density gym pockets.

After directing our attention to this narrower area of interest (covering approx. 5x5km southeast of the Elysian fields) we first created a dense network of location candidates (spaced at 100m apart); those locations were then filtered out so that those with more than two gyms within a 250m radius and those with a Pilates gym closer to 400m were eliminated.

These locations were then grouped together to create areas of interest containing the highest number of candidate locations. The centre addresses of these areas were also generated using reverse geocoding to be used as markers/starting points for more detailed local analysis based on other factors.

The result is 15 areas that contain the greatest number of possible locations for new gyms based on the number and distance of existing locations - both gyms in general and Pilates gyms in particular. This, of course, does not imply that these areas are actually optimal locations for a new gym. The purpose of this analysis was to provide information only on areas close to the centre of Paris but which are not crowded with existing gyms (particularly dedicated to Pilates) - it is entirely possible that there is a very good reason for the small number of gyms in any one of these areas, reasons which would make them unsuitable for a new gym regardless of the lack of competition in the area. Therefore, the recommended areas should be considered only as a starting point for a more detailed analysis that could result in a location that not only has no nearby competition, but also takes into account other factors and meets all other relevant conditions.

Conclusion

The purpose of this project was to identify areas of Paris near the center with a low number of gyms (particularly Pilates Gyms) in order to help stakeholders narrow down the search for an optimal location for a new Pilates Gym. In calculating the distribution of gym density from Foursquare data, we first identified the general districts that warrant further analysis (pont du carrouser and The Eiffel Tower), and then generated a large collection of locations that meet some basic requirements with respect to existing nearby gyms. These locations were then grouped together to create major areas of interest (containing the largest number of potential locations) and addresses of these area centers were created to be used as starting points for final exploration by stakeholders.

The final decision on the optimal location of the fitness centers will be made by the stakeholders based on the specific characteristics of the neighborhoods and the locations in each recommended area, taking into account additional factors such as the attractiveness of each location (proximity to the park or water), noise levels/ proximity to major roads, availability of real estate, prices, social and economic dynamics of each neighborhood, etc.
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