Applied Data Science Capstone Project

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This is my final project for the IBM Data Science Professional Certificate program, submitted in the course "Applied Data Science Capstone" on Coursera. The project is peer-reviewed. The objective of the project is to come up with a creative idea to leverage the Foursquare location data to explore or compare neighbourhoods or cities. Alternatively, to come up with a problem that can be solved by using the Foursquare location data.

Contents

1. Introduction

1.A. Business Problem

Project Goal
My project is devoted to exploring and segmenting elementary schools in Tel Aviv (a major city located in the center of Israel), based on their proximity to other venues that are of particular interest to the client. The project aims to provide clients, who wish to live in close proximity to a school, with data concerning other venues in the area, in order to assist them in understanding and narrowing down their choices and eventually deciding where to rent an apartment.

Background
I was inspired to create this project by a friend of mine, who is interested in moving with his family to the city of Tel Aviv. My friend, who currently lives in a suburban area, works in Tel Aviv and spends hours each day in traffic. He and his wife have decided to move to the city, sell their car and travel mainly by foot or, if necessary, public transportation. While he works in Tel Aviv, my friend is unfamiliar with most of its neighbourhoods and needs my advice on the best area to search for an apartment.
Despite Tel Aviv being my hometown, I soon realized how easily one could become overwhelmed when approaching such a decision. Tel Aviv is Israel's second most populous city, with approximately 450,000 residents. It is the financial capital of Israel, with the largest economy per capita in the Middle East. It hosts countless venues, including numerous schools and education venues. Its many neighborhoods differ greatly and provide for a wide variety of living environments.
My friend and his wife have no special financial limitations, as their employers subsidize their rent. However, they have a rather **long list of preferences**, as they do not wish to rely on private transportation and are looking for the most suitable environment to raise their two children. They have a six-year-old boy about to attend elementary school and a baby girl. They also have a dog. They wish to live in an area in which many venues are at a walking distance, which they consider to be approximately 500 meters. They are looking for a child-friendly environment, preferably a neighborhood with a relatively young demographic and many families with children.
The most fundamental requirement, as far as my friend and his wife are concerned, is that they want to rent a place adjacent to a elementary school. However, they would also like to live nearby a day care for toddlers; a playground for toddlers; a kindergarten; green areas; a dog garden; a pizzeria and ice cream parlor for their weekly "family tradition" and, preferably, a neighborhood bar (or pub), so that they could go on dates and easily return home quickly in case of an emergency. Additionally, my friend's background is somewhat traditional. He thus strongly prefers not to expose his children to shady places such as strip clubs and would rather live far away from such places.
As indicated above, one of my friend's main concerns is education. In Israel, there are different types of schools (public/private; Jewish/non-Jewish; secular/religious) and the education a student receives may differ greatly based on the school in which he or she are enrolled. My friend, for instance, wants to send his son to a public, Jewish, secular school, and does not know which schools in Tel Aviv fit these criteria. The Israeli Board of Education publishes this data. It is important to note that the Board of Education also provides data on the quality of each school (test scores, etc.), however, when I attempted to integrate this data I realized that it was partial and outdated (last updated in 2017). I consulted the "client" (i.e., my friend) and he asked that I discard this data, as he is currently less interested in the quality of the school and more focused on finding a neighborhood that would meet the holistic needs of his family.
My project was originally intended to help my friend find a suitable place for him to live, by addressing his specific needs. However, the parameters he has set for me are not so unique;

many of my friends consider similar parameters when deciding where to live and it will be easy to adapt this analysis to fit different parameters. I believe that this project could assist them in making informed decisions on their living situations. Thus, while I initially planned to choose a project in the field of finance, designed for a business-oriented target audience, I decided that it would be preferable to focus on a concrete problem designed to help an actual client, rather than on an abstract problem designed for theoretical clients. In so doing, I aspire to create a project that has real practical value, without compromising the main objective of the assignment, which is demonstrating my skillset using location data. Therefore, the objective of my project is to explore and segment schools in Tel Aviv, based on the parameters that the client has set for me. The project is designed so that the client receives the relevant data on each cluster, thus allowing him to understand his possibilities, narrow down his choices and reach an informed decision independently.

1.B. Target Audience – the clients

My project was designed for a specific client - my friend, who is a 32 year old male, married with 2 children and a pet dog. This is a middle class family that intends to move to the city of Tel Aviv. However, the target audience for this project is far wider, and includes young families that wish to live in Tel Aviv, in close proximaty to an elementary school and in a child and familiy-friendly environment.

The Client's Particular Interest
The client's main particular interest is the proximaty to elementary schools. These schools must abide by several specific parameters:

- State (public); ownership: city.
- Stream of education: Jewish
- Type of education: regular (secular)

There are additional parameters that are of particular interest to the client, as listed bellow. He wishes to live in a walking distance from these venues, which he considers to be 500 meters. The client strongly prefers there to be a large variety of these venues of interest in close proximaty (for example, there is great advantage in a wide variety of kindergartens and daycares, as many may have long waiting lists):

- Kindergartens (see specific parameters listed above for elementary schools)
- Playgrounds with at least one facility for toddlers (mostly interested in the number of playground facilities available nearby)
- Green public areas (mostly interested in the total green area in meters)
- Dog gardens
- Pizza places
- Ice cream parlors
- Pubs/bars (specific types of venues with no interest to the client were filtered out, as detailed in the full report in foursquare data collection).
- Client does not wish to live in close proximity to strip clubs.
- Population distribution by age – the client prefers to live in a relatively young neighborhood and considers 34 to be a young age.

2. Data

2.A. Data introduction

I have used two main data sources. The first is **TLV OpenData**, a free publicly available website provided by the Tel Aviv-Yafo Municipality This website is dedicated to exposing the public datasets of the Tel Aviv-Yafo Municipality and is a great resource for getting data about Tel Aviv. However, many of the API's are returning results in Hebrew and need to be translated. I use this website to retrieve the following data:

1. Population distribution by city neighborhoods – the data format is google sheet JSON. I use this data to calculate the proportion of young people (up to 34) in each neighborhood and eventually will match each school to the age of population in each neighborhood. Unfortunately, the most recent data available is from 2017. After consulting with the client, I will not use this data in the clustering process. However, I will use it to give the client an indication of the age distribution of the population, as well as to filter out schools located in neighborhoods where there are no people aged under 34.
2. API - developer portal – among other things, this enables GisLayers: a REST API for GIS (Geographic Information System) Layers. (Everything about municipal geographic) data. This data is provided in Hebrew and will be translated using google cloud translate (see below). From this API I will request the following JSON data:
    A. Green areas (layer code 503, geometry: polygons) – For each school (from the elementary schools 2021 data), I will calculate the distance to each green area and will sum the total area (in meters) of all green areas whose territory begins within 500 meters from the school.
    B. Neighborhoods (layer code 511, geometry: polygons) – I will match each school to the neighborhood in which it resides and will incorporate the population age distribution data to allow filtering out those schools that reside in neighborhoods with no young residents.
    C. Dog gardens (layer code 586, geometry: points) – for each school, I will count the number of dog gardens that are within 500 meters.
    D. Kindergartens 2021 (layer code 598, geometry: points) – for each school, I will count the number of kindergartens that are within 500 meters.
    E. Elementary schools 2021 (layer code 599, geometry: points) - I will filter the data in accordance with the preferences set by the client and will use them as a proxy for their preferred place of residence.
    F. Recognized daycares for toddlers (layer code 624, geometry: points) – for each school, I will count the number of daycares that are within 500 meters.
    G. Playgrounds (layer code 696, geometry: points) – I will filter only playgrounds with at least one facility for toddlers and will sum up the total number of playground facilities in the area.

The second main data source I use is **Foursquare Places API**, which offers real-time access to Foursquare's global database of venue data and user content. As this is part of the project requirements, this is the first source I explored, however, it contained hardly any data on schools and other educational venues in Tel Aviv. Therefore, I searched for the missing data in the abovementioned open TLV, while using Foursquare Places API for data on the other categories. I utilized the Foursquare Places API explore endpoint to find a list of the relevant venues near each school location. I only requested the following venue categories:

- For the client's family weekly tradition:
    - Ice cream shop (category id.: 4bf58dd8d48988d1c9941735) – I group all venues that are returned under "ice cream".

        - Pizza place (category id.: 4bf58dd8d48988d1ca941735) – I group all venues that are returned under “pizza”.
- For fun for parents – – I group all venues that are returned under both categories below under “parents’ fun”, apart from venues that the client has instructed me to ignore (e.g., restaurants, hotels – the full list will be detailed in the notebook with the code in filtering process):
    - Bar (category id.: 4bf58dd8d48988d116941735)
    - Pub (category id.: 4bf58dd8d48988d11b941735)
- Client’s request not to live near strip clubs (category id.: 4bf58dd8d48988d1d6941735)

In addition to these two main sources, I use a couple of google API’s for the following reasons:

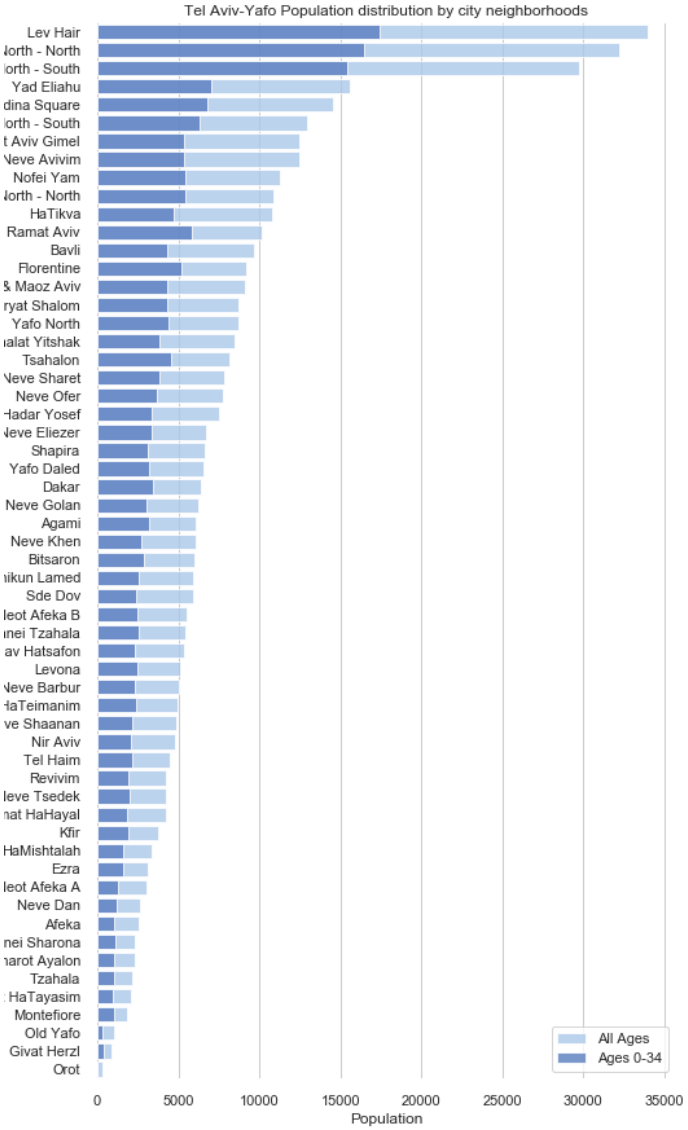
- **Google Maps** – used to retrieve Tel Aviv-Yafo coordinates (latitude and longitude) and center most of my visualizations according to these coordinates and to obtain the properly formatted (English) addresses of the schools from the school geocode (latitude, longitude) data.
- **Google Cloud Translate Client –** most of the data that is returned by the Tel-Aviv Municipality API is in Hebrew. Even the fields’ names that are written in English letters are mostly in phonetic Hebrew. Even though my client and I are fluent in Hebrew, in order to facilitate peer review for this analysis, I will translate (to English) the fields’ names and any fields’ values that will be used for filtering or understanding the data analysis. I will not translate the names of the venues (such as schools, day cares, kindergartens, etc.) and will be using system Id's in the report.

2.B. Data visualizations

After parsing, translating, filtering and general cleaning of the data, I did some basic data exploratory analysis and created a few visualizations to help understand and examine the data.

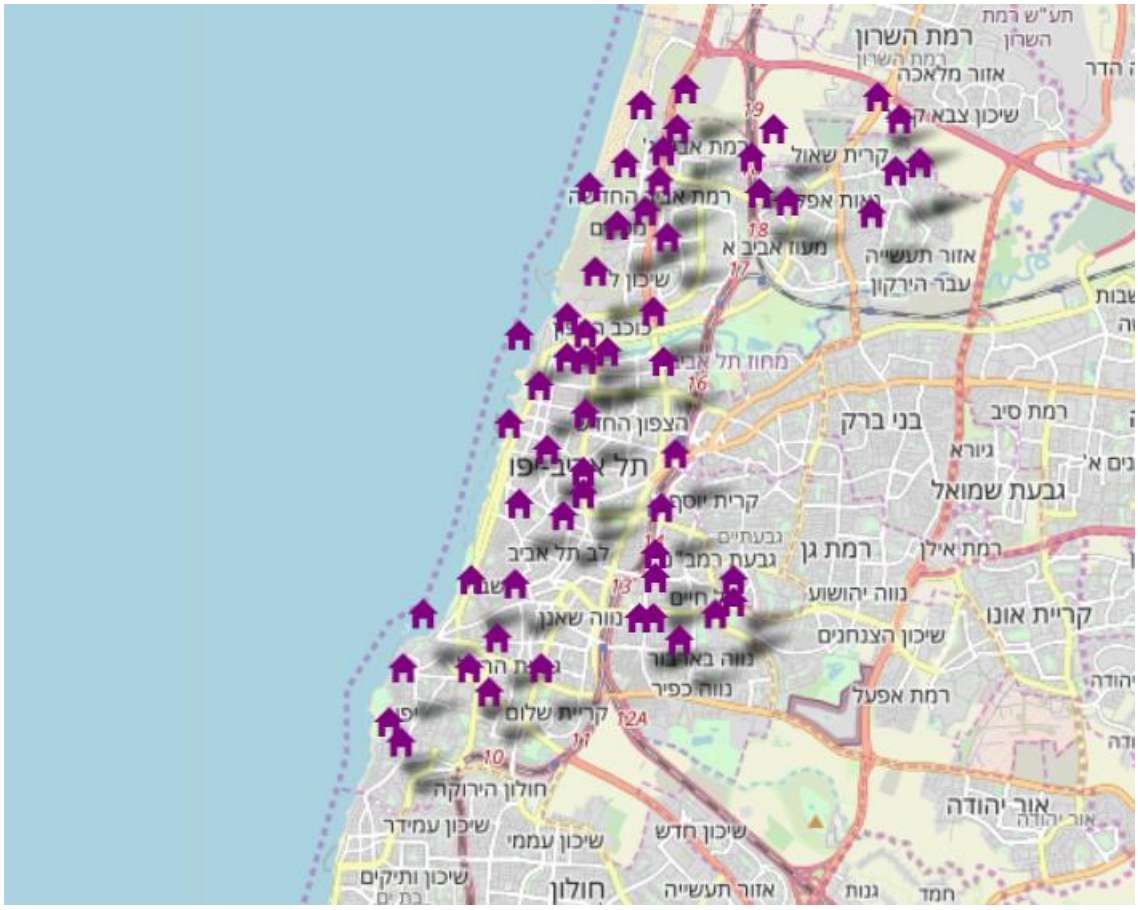
2.B.1. The "Population distribution by city neighborhoods" data

file has data of population by neighborhood, including population by age group.



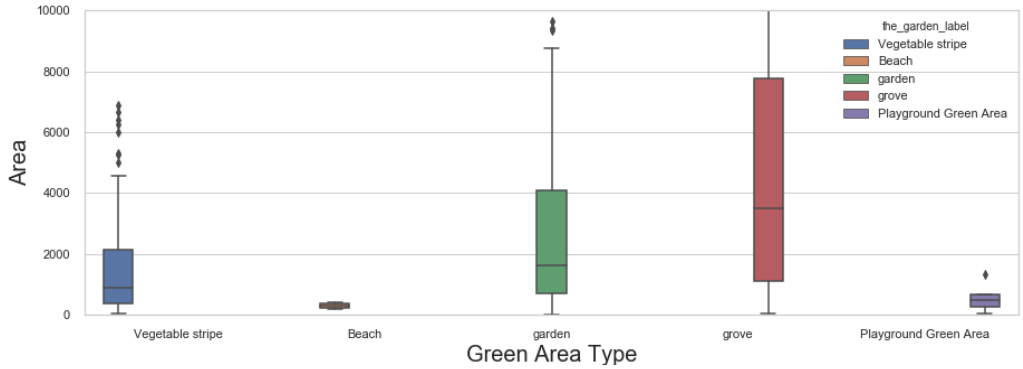
2.B.2. The Schools data

Map visualization:

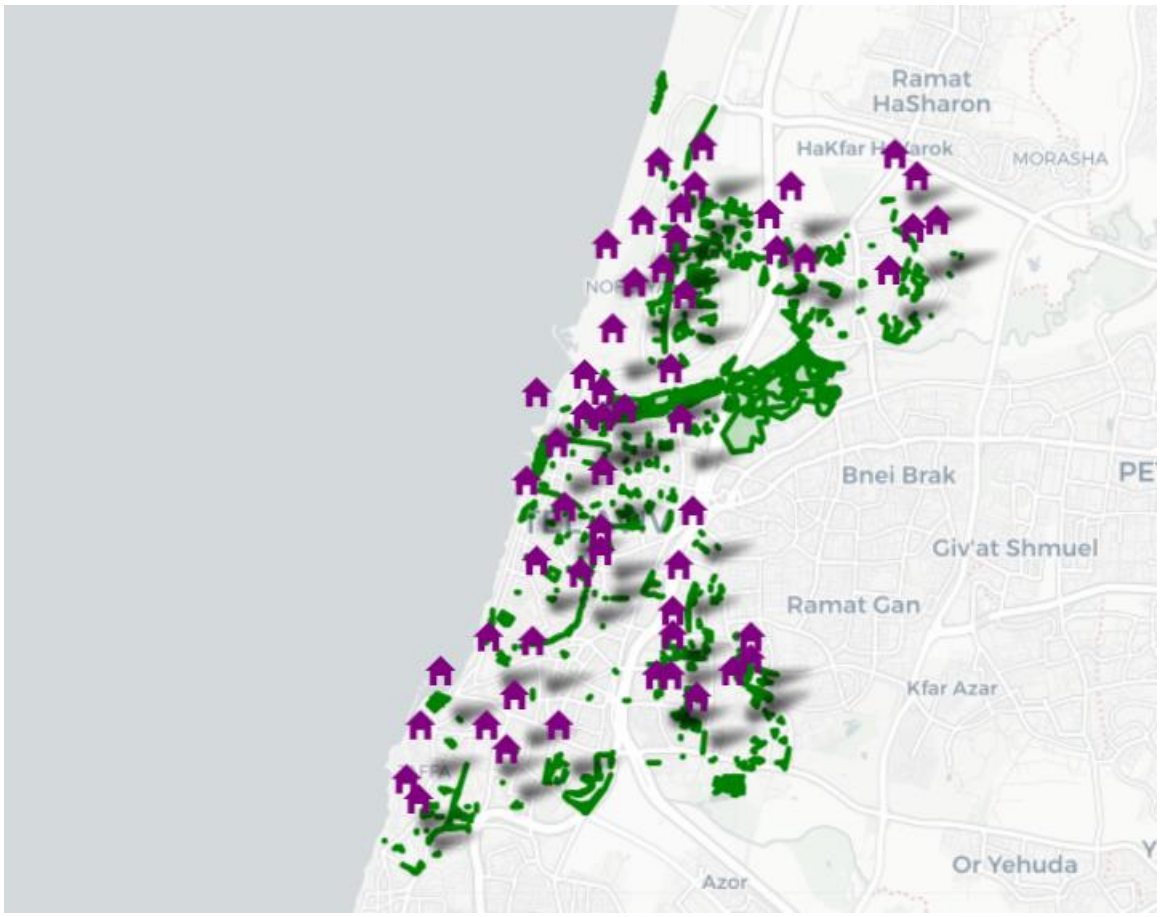


2.B.2. The Green Areas Data

Area distribution in meter square by green area type.

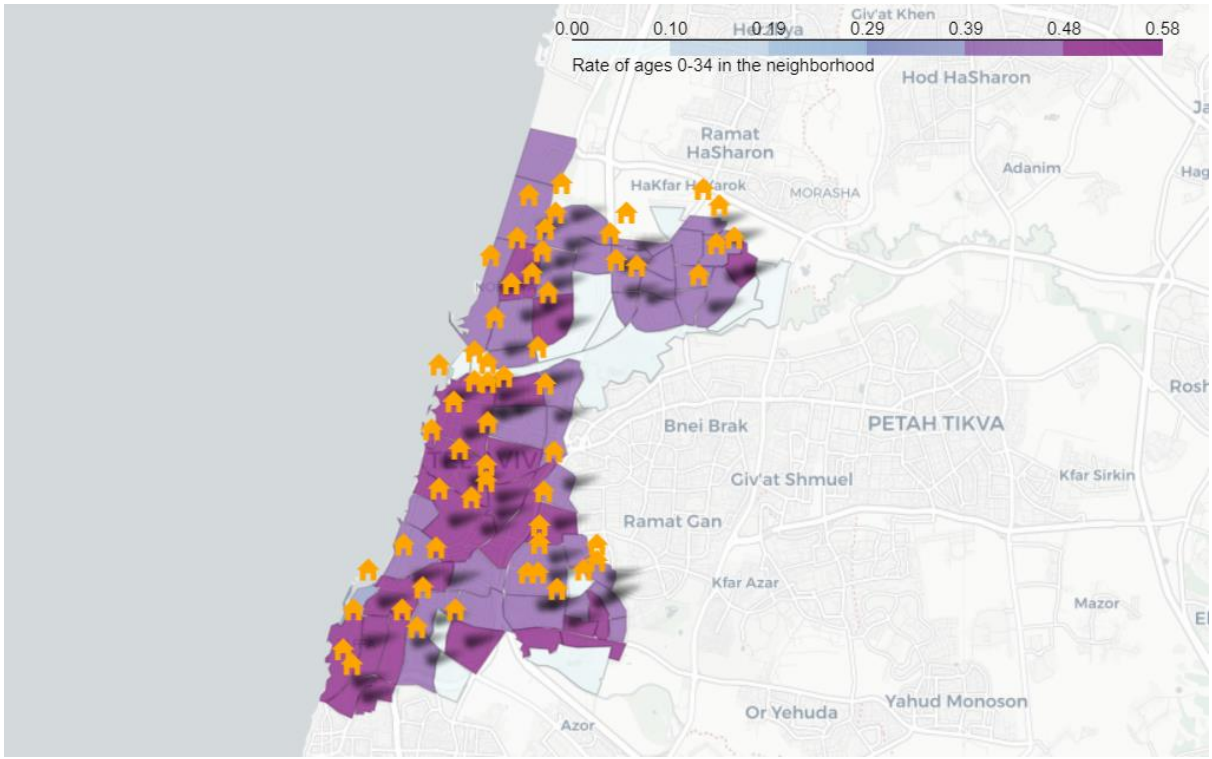


Map visualization:



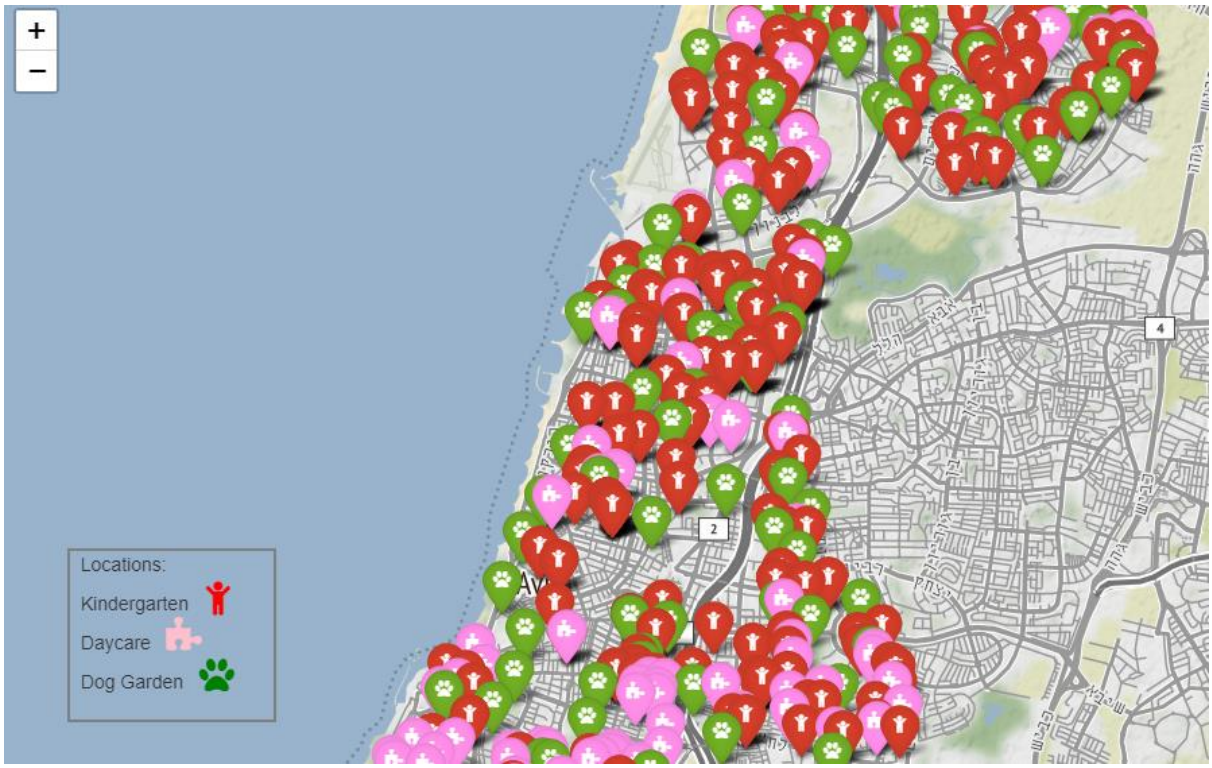
2.B.3. The Neighborhoods Data

I use the neighborhoods data to match schools to neighborhoods (each school is in only one neighborhood). I then incorporate a measure of age distribution (that is available for neighborhoods) to the schools data. I filter out schools that are in neighborhoods with no population (under the age of 34)

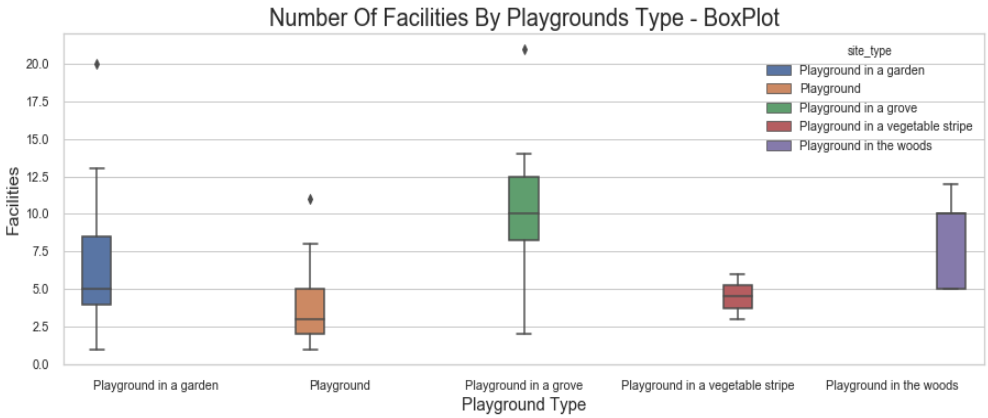


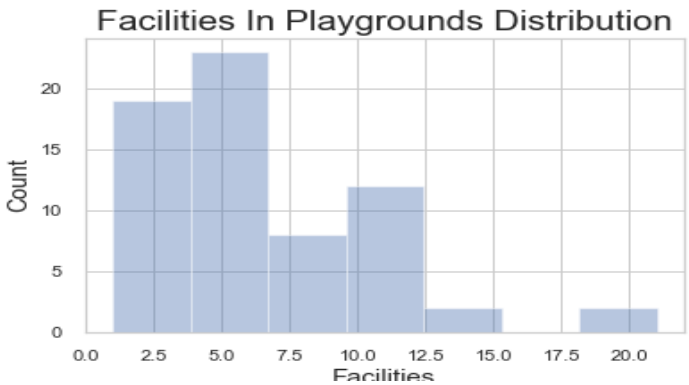
2.B.4. The Dog Gardens, kindergartens & Daycares Data

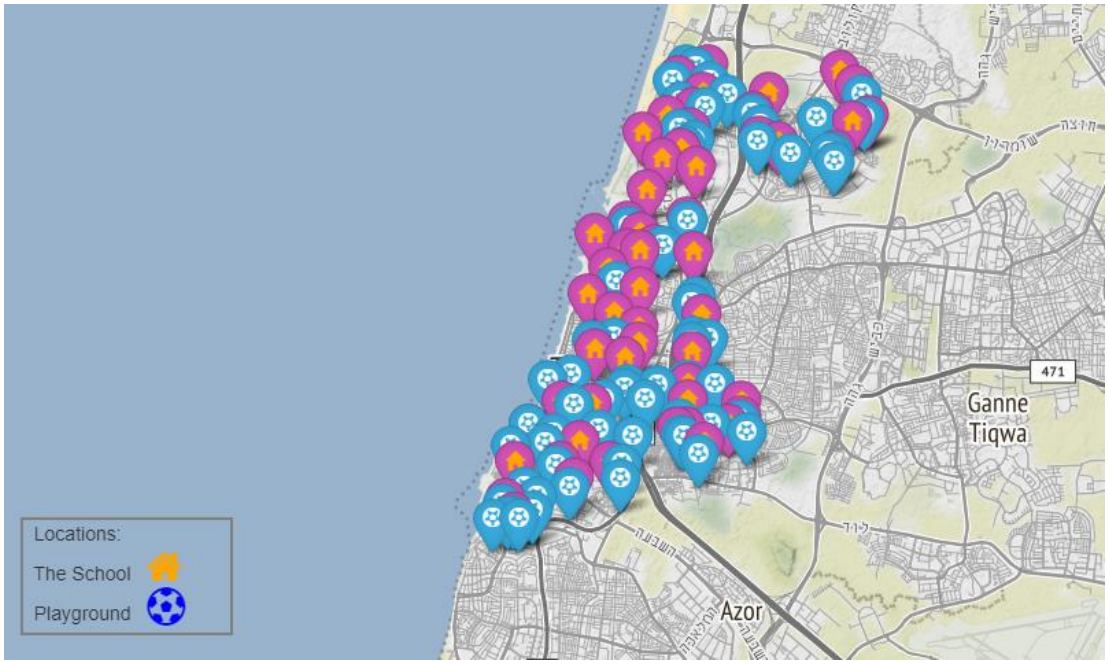
I Calculate the distance (in kilometers) between each school and the locations in *Dog Gardens*, *kindergartens* **&** *Daycares* data.



2.B.5. The playgrounds Data



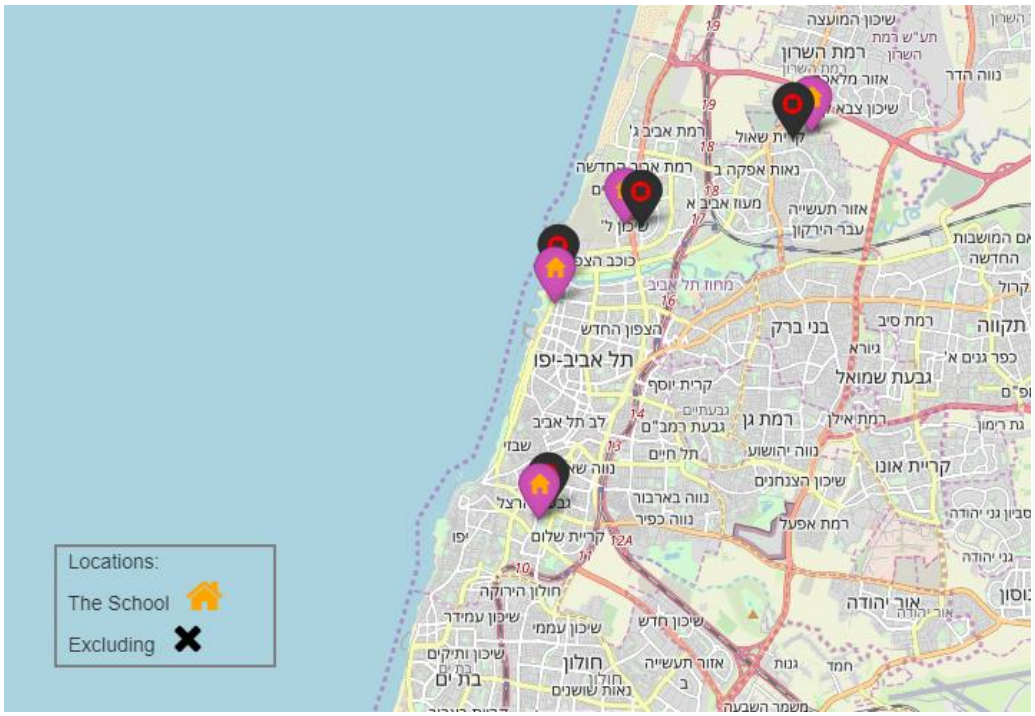




I add the number of all the playground facilities near each school to the Schools Data.

2.B.6. Filtering schools

- Near a strip club
- With no young population (up to age 34)



3. Methodology

To segment the schools, I use K-Means clustering algorithm. The K-Means clustering algorithm is relatively simple to implement and can be ggeneralized to clusters of different shapes and sizes.

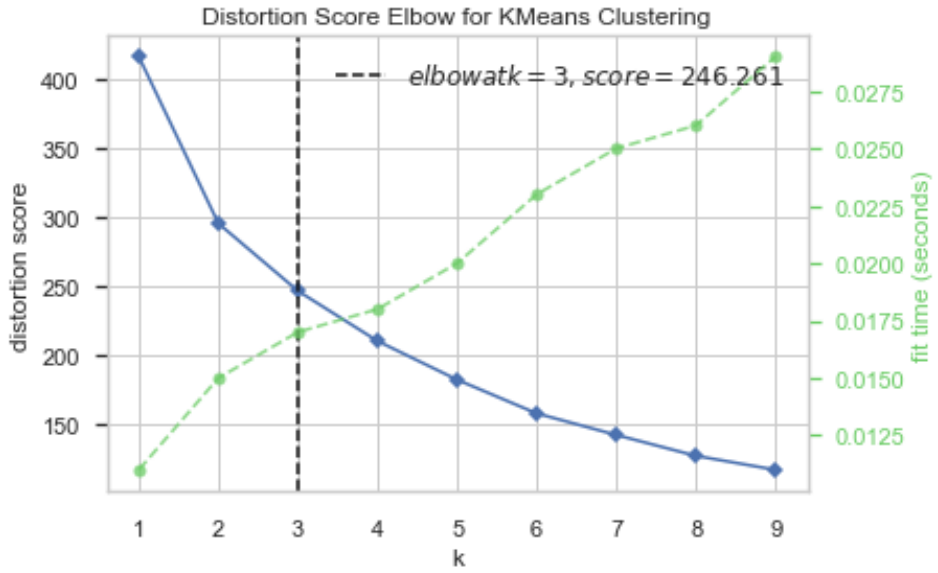
In order to prepare the data for the clustering analysis, there is need for pre-processing. I first merge the foursquare data with the TLV OpenData. Then I transform the data (using One Hot Encoding). I filter undesirable schools (near proximity to strip clubs, no population under 34, etc.), so as to handle different magnitudes of the data. I normalize the feature over their standard deviation.

Upon gathering all of the relevant information for each school, I utilize this information to segment the schools using K-Means clustering algorithm. This allows me to characterize each cluster and find the most relevant clusters for the client. Either way, it helps the client understand all the available options. I highlight at least one school in each cluster that is most compatible with the parameters set by the client. Additionally, I create a function that allows the client to get a full report for any school ID.

3.A. Modeling

To segment the schools, I will use k-Means clustering algorithm. One potential drawback to this approach is the need to choose the number of clusters. I use the elbow method to assist me in this decision.

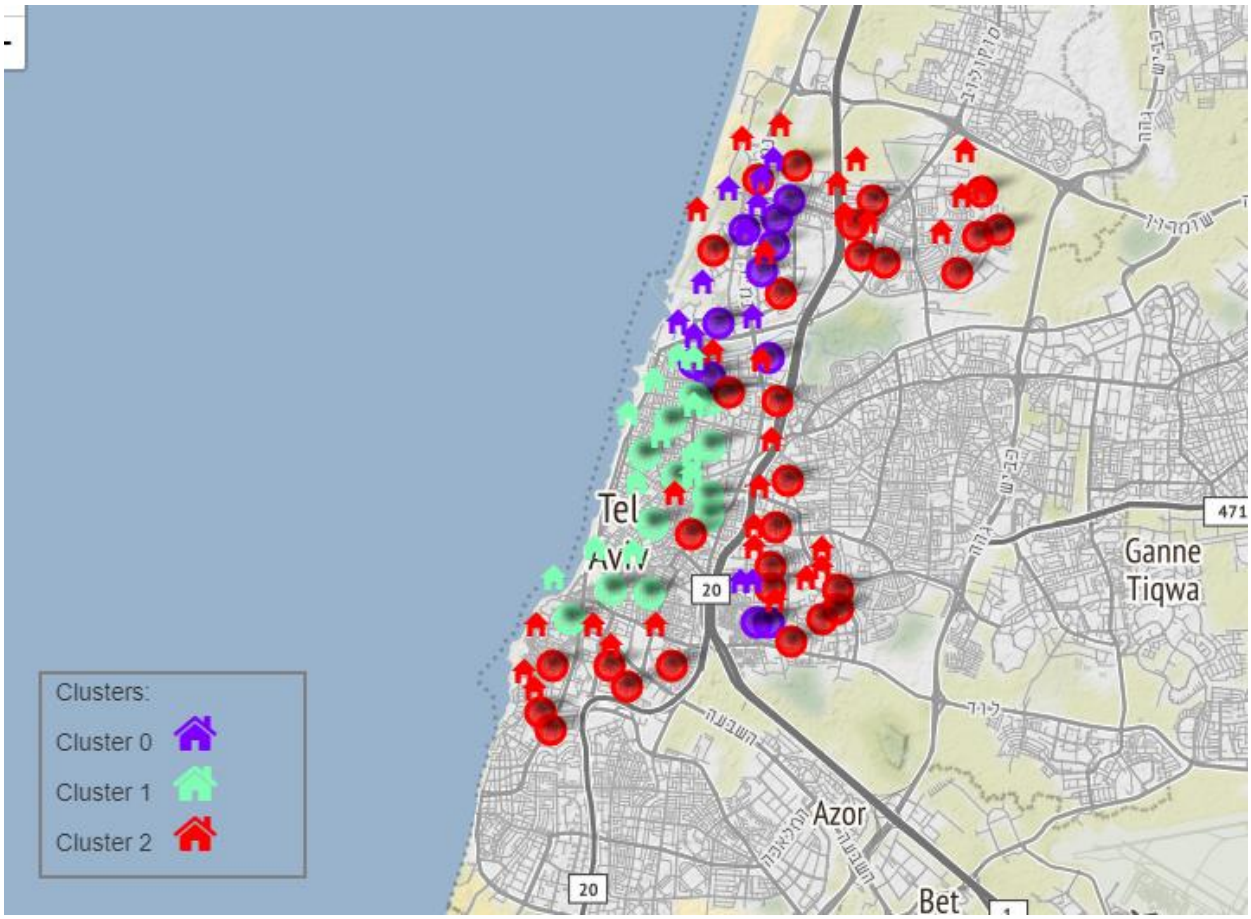
Finding The Optimal K (number of clusters) Using The **Elbow Method**:



3.B. Results

The number of schools in each cluster

Cluster Labels	School Count
0	11
1	12
2	29



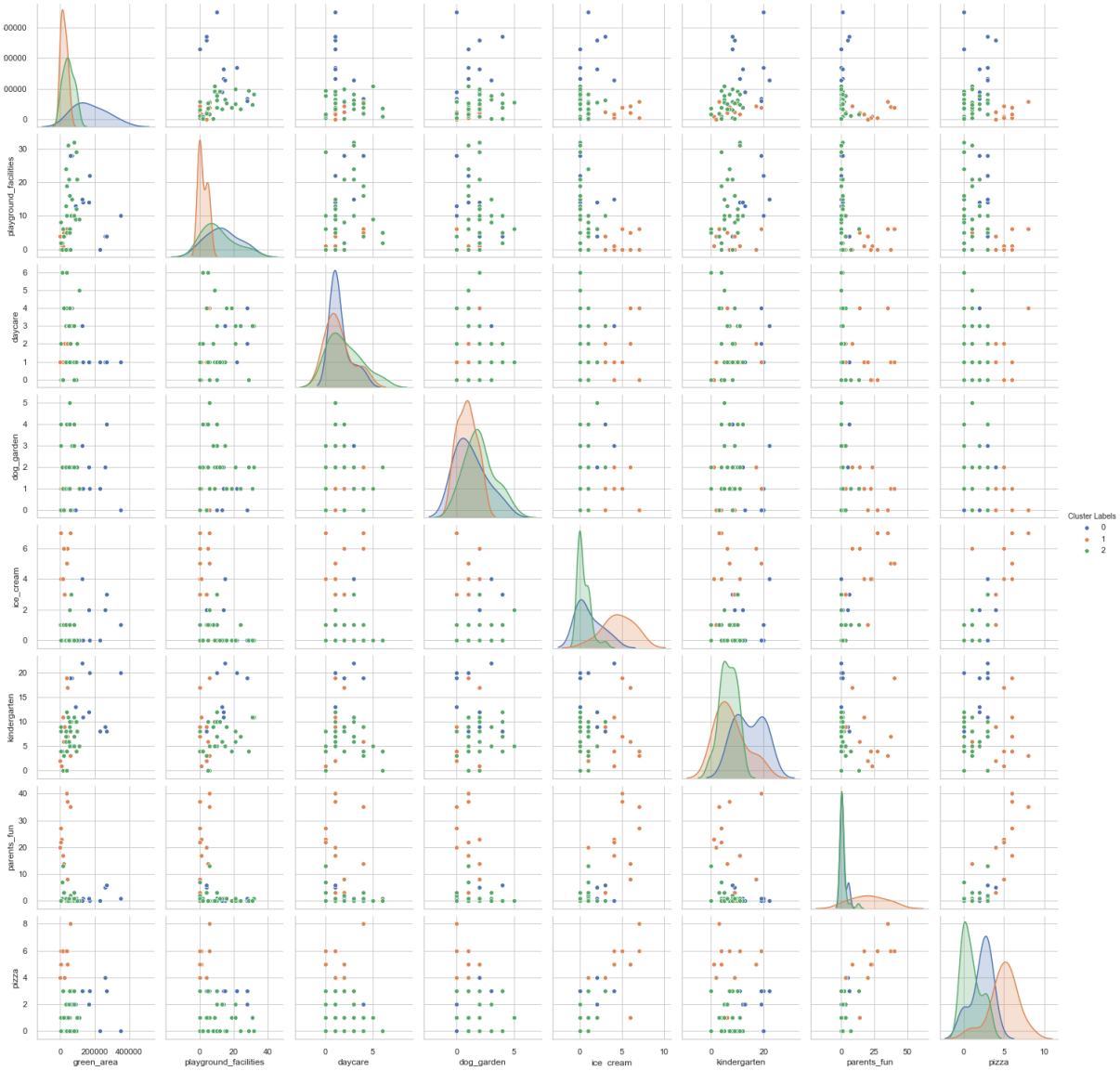
3.A.1. Characterization of the clusters:

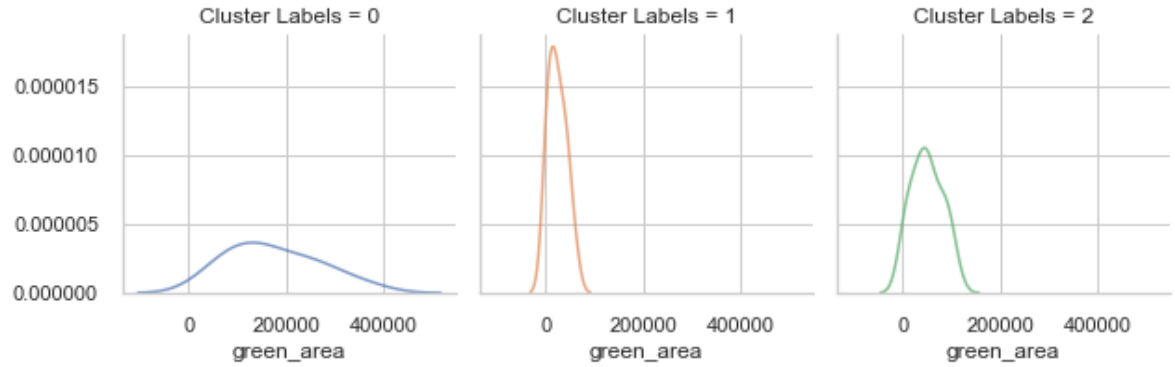
In [222]:

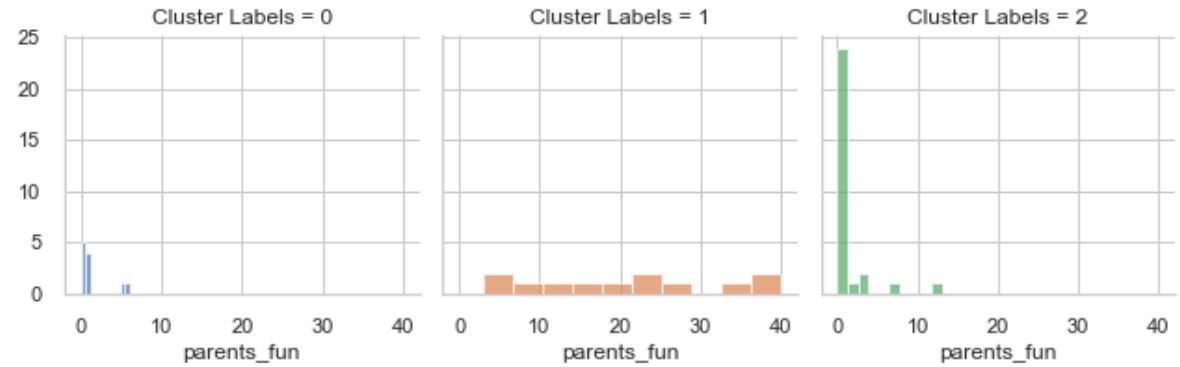
```
1 data.groupby('Cluster Labels').mean().round(1)
```

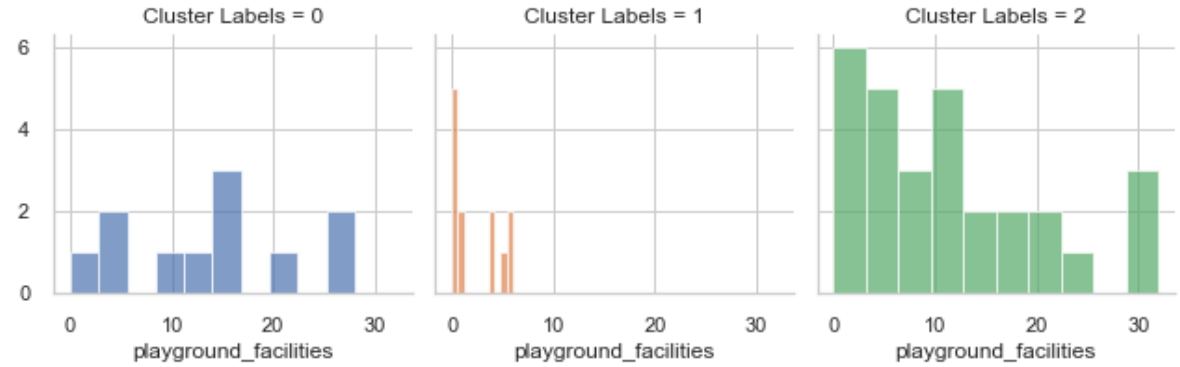
Cluster Labels	green_area	playground_facilities	daycare	dog_garden	ice_cream	kindergarten	parents_fun	pizza
0	175144.7	13.8	1.5	1.3	1.1	14.6	1.4	2.3
1	23896.6	2.2	1.4	0.9	4.6	7.7	20.8	5.0
2	49964.0	11.3	2.1	2.0	0.5	6.7	1.2	1.0

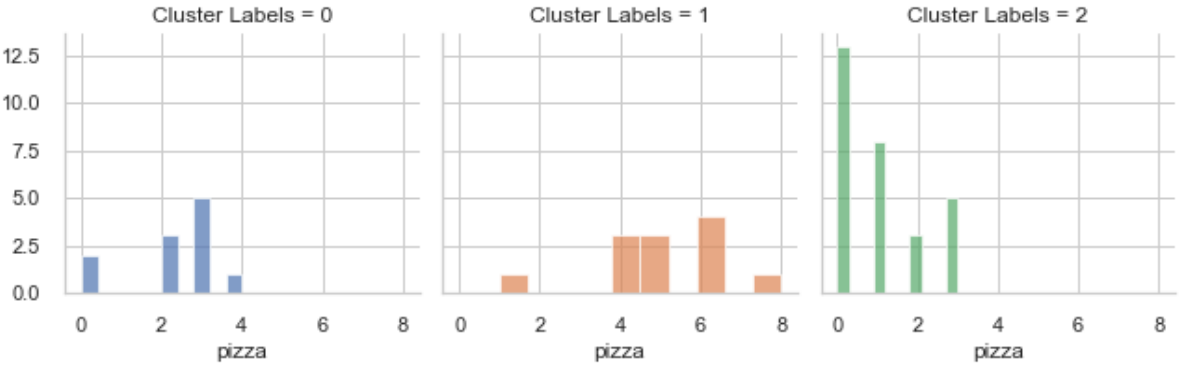
Visual examination of clusters data

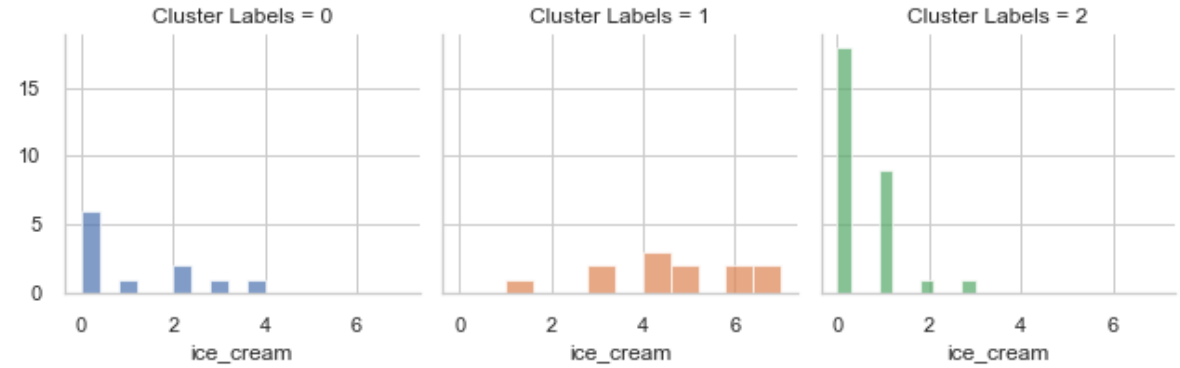


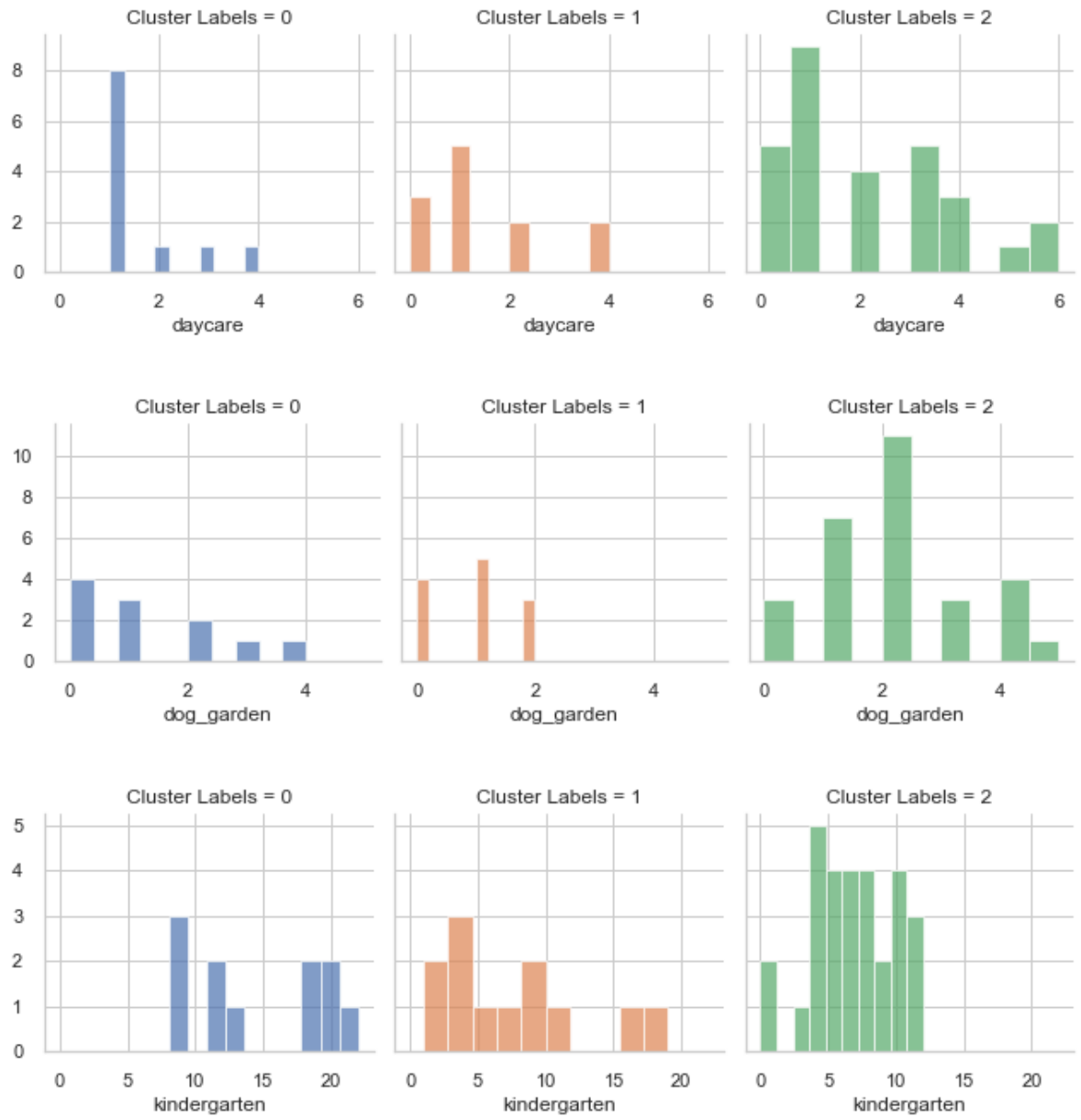



Cluster Labels = 0
Cluster Labels = 1
Cluster Labels = 2
parents_fun


Cluster Labels = 0
Cluster Labels = 1
Cluster Labels = 2
playground_facilities


Cluster Labels = 0
Cluster Labels = 1
Cluster Labels = 2
pizza


Cluster Labels = 0
Cluster Labels = 1
Cluster Labels = 2
ice_cream


Cluster Labels = 0
Cluster Labels = 1
Cluster Labels = 2
daycare
dog_garden
kindergarten

4. Discussion

According to my conclusions, **cluster 0** seems most suitable for the client's needs. This cluster averages highest on green areas and children's playgrounds, both of which are important to the client. Cluster 0 is also very diverse in terms of types of venues. Only in this cluster does each school have more than one venue of each location type on average. Geographically speaking, we see that while it is not entirely homogenous, cluster 0 is mainly located in the northern neighborhoods of Tel Aviv. This finding seems consistent with the strong social-economic profile of these neighborhoods.

As the visualization shows, **cluster 1** is located in the center of the city. This cluster is less suitable for my client, as it contains the smallest amount of green areas and playgrounds of the three clusters. However, cluster 1 does meet some of the client's needs, as it has a wide variety of pubs/bars, pizza parlours and ice cream parlours.

Cluster 2 is somewhat in the middle. It contains more green areas and playgrounds than cluster 1 but less than cluster 0. It has more daycares and dog gardens than cluster 0, but less pubs/bars, pizza and ice cream parlours. It is far less diverse in terms of location types. This cluster seems least suited for the client's needs, mainly because geographically, it is located mostly in the southern, eastern and northern margins of the city (the west is occupied by the Mediterranean Sea). These locations, most of which are far from the city center, make it difficult to manage without a private vehicle, as my client plans to do. Additionally, even assuming the client is willing to sacrifice the proximity to the city center (including such parameters as bars/pubs or family weekly tradition), in favor of green areas and playgrounds, it would make more sense to choose cluster 0 and not cluster 2.

As we can see in the illustrations, there is a variance in the distribution of location types within the clusters. Therefore, I will examine the other clusters as well and will highlight one particularly diverse and interesting school in each cluster.

4.1 A. Highlighting candidate Schools in each cluster:

I will try to highlight schools with as many different location types as possible, as opposed to number of venues. I do so thinking it is probably preferable to have, for example, one bar and one dog garden in near proximity, than to have ten bars but no dog gardens at all.

Cluster 0: School - 599-300490

School: 599-300490, In Neighborhood: 511-22, Address: Antigonus St 6, Tel Aviv-Yafo, Israel.

The School has 1 nearby Daycare:
1. 624-33 ,approximately 85 meters from the school.

The School has 2 nearby Dog Gardens:
1. 586-9 ,approximately 297 meters from the school.
2. 586-72 ,approximately 485 meters from the school.

The School has 9 nearby Kindergartens:
1. 598-21131 ,approximately 429 meters from the school.
2. 598-54441 ,approximately 252 meters from the school.
3. 598-54442 ,approximately 252 meters from the school.
4. 598-54443 ,approximately 252 meters from the school.
5. 598-54444 ,approximately 252 meters from the school.
6. 598-80111 ,approximately 216 meters from the school.
7. 598-212121 ,approximately 216 meters from the school.
8. 598-287121 ,approximately 496 meters from the school.
9. 598-287122 ,approximately 496 meters from the school.

The School has 1 nearby playground (with 4 facilities):
1. 696-29 (playground in a garden, with 4 facilities), approximately 326 meters from the school.

The School has 2 nearby Ice-Cream Parlours:
1. Venue id: 17 - Ice-Cream (Ice Cream Shop), approximately 467 meters from the school.
2. Venue id: 20 - Ice-Cream (Ice Cream Shop), approximately 468 meters from the school.

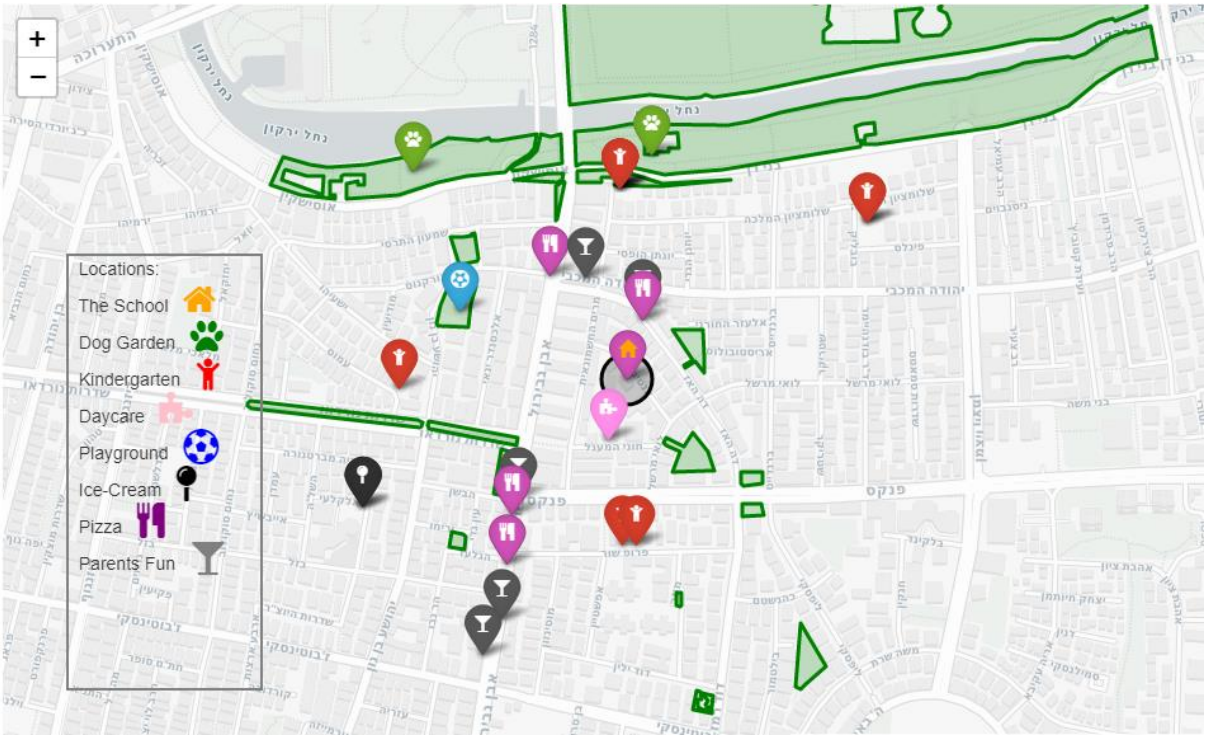
The School has 5 nearby Bars/Pubs:
1. Venue id: 16 - Parents-Fun (Bar), approximately 174 meters from the school.
2. Venue id: 18 - Parents-Fun (Bar), approximately 255 meters from the school.
3. Venue id: 21 - Parents-Fun (Bar), approximately 431 meters from the school.
4. Venue id: 22 - Parents-Fun (Pub), approximately 496 meters from the school.
5. Venue id: 26 - Parents-Fun (Wine Bar), approximately 113 meters from the school.

The School has 4 nearby Pizza Places:
1. Venue id: 19 - Pizza (Pizza Place), approximately 205 meters from the school.
2. Venue id: 23 - Pizza (Pizza Place), approximately 98 meters from the school.
3. Venue id: 24 - Pizza (Pizza Place), approximately 282 meters from the school.
4. Venue id: 25 - Pizza (Pizza Place), approximately 349 meters from the school.

The School has 21 nearby Green Areas (with total area of 258,827 meters squared):

The School has 6 nearby Vegetable Stripes:
1. 842-360 (area of 2,284.1 meters squared), approximately 254 meters from the school.
2. 842-362 (area of 729.3 meters squared), approximately 288 meters from the school.
3. 842-363 (area of 408.9 meters squared), approximately 246 meters from the school.
4. 842-401 (area of 3,040.4 meters squared), approximately 387 meters from the school.
5. 842-407 (area of 1,722.5 meters squared), approximately 218 meters from the school.
6. 842-410 (area of 1,581.5 meters squared), approximately 232 meters from the school.

The School has 15 nearby Gardens:
1. 842-102 (area of 66,197.9 meters squared), approximately 275 meters from the school.
2. 842-106 (area of 2,446.4 meters squared), approximately 307 meters from the school.
3. 842-345 (area of 145,979.9 meters squared), approximately 367 meters from the school.
4. 842-356 (area of 19,600.5 meters squared), approximately 354 meters from the school.
5. 842-371 (area of 1,570.4 meters squared), approximately 319 meters from the school.
6. 842-379 (area of 3,396.1 meters squared), approximately 305 meters from the school.
7. 842-387 (area of 1,912.2 meters squared), approximately 109 meters from the school.
8. 842-408 (area of 2,785.5 meters squared), approximately 107 meters from the school.
9. 842-413 (area of 707.4 meters squared), approximately 248 meters from the school.
10. 842-430 (area of 605.6 meters squared), approximately 272 meters from the school.
11. 842-437 (area of 575.7 meters squared), approximately 364 meters from the school.
12. 842-444 (area of 193.5 meters squared), approximately 295 meters from the school.
13. 842-453 (area of 2,526.3 meters squared), approximately 456 meters from the school.
14. 842-463 (area of 336.8 meters squared), approximately 429 meters from the school.
15. 842-464 (area of 226.5 meters squared), approximately 435 meters from the school.



Highlighting candidate Schools in each cluster
Cluster 0: School - 599-304030

School: 599-304030, In Neighborhood: 511-23, Address: Shim'on ha-Tarsi St 31, Tel Aviv-Yafo, Israel.

The School has 1 nearby Daycare:
1. 624-33 ,approximately 413 meters from the school.

The School has 4 nearby Dog Gardens:

1. 586-9 ,approximately 397 meters from the school.
2. 586-10 ,approximately 465 meters from the school.
3. 586-72 ,approximately 95 meters from the school.
4. 586-75 ,approximately 476 meters from the school.

The School has 8 nearby Kindergartens:
1. 598-21131 ,approximately 230 meters from the school.
2. 598-54441 ,approximately 332 meters from the school.
3. 598-54442 ,approximately 332 meters from the school.
4. 598-54443 ,approximately 332 meters from the school.
5. 598-54444 ,approximately 332 meters from the school.
6. 598-96131 ,approximately 240 meters from the school.
7. 598-284801 ,approximately 448 meters from the school.
8. 598-284802 ,approximately 448 meters from the school.

The School has 1 nearby playground (with 4 facilities):
1. 696-29 (playground in a garden, with 4 facilities), approximately 114 meters from the school.

The School has 3 nearby Ice-Cream Parlours:
1. Venue id: 200 - Ice-Cream (Ice Cream Shop), approximately 465 meters from the school.
2. Venue id: 202 - Ice-Cream (Ice Cream Shop), approximately 486 meters from the school.
3. Venue id: 203 - Ice-Cream (Ice Cream Shop), approximately 465 meters from the school.

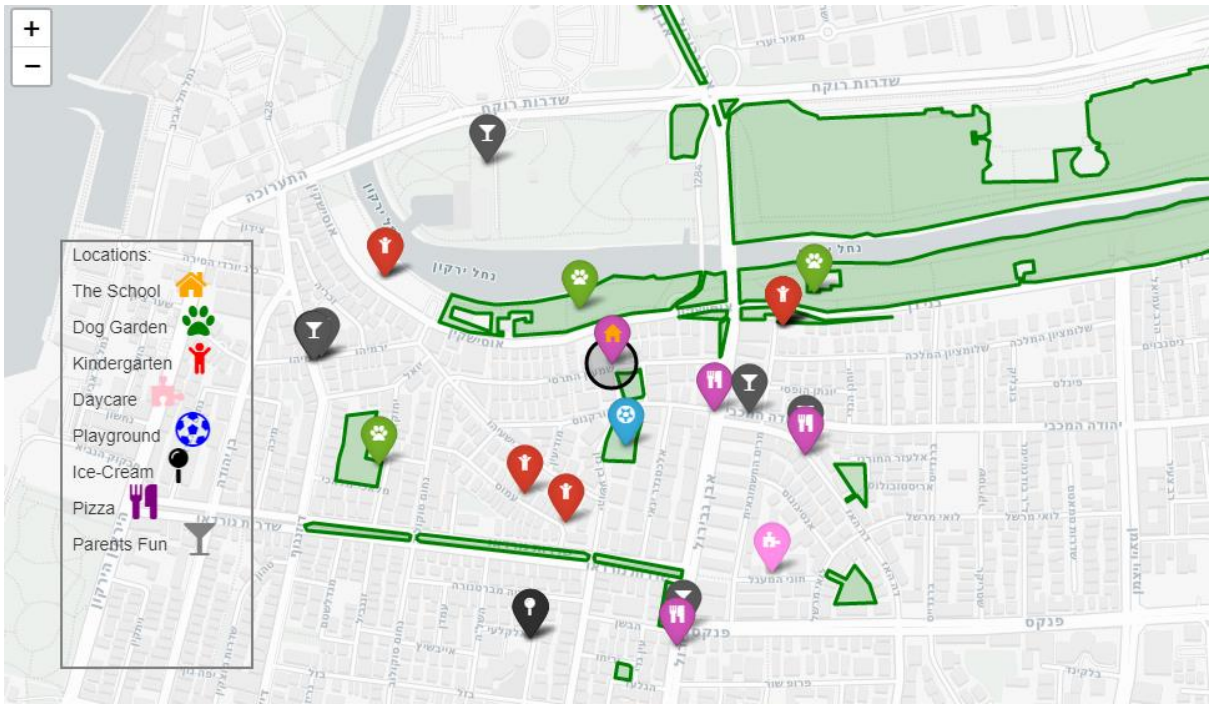
The School has 6 nearby Bars/Pubs:
1. Venue id: 199 - Parents-Fun (Bar), approximately 237 meters from the school.
2. Venue id: 204 - Parents-Fun (Pub), approximately 470 meters from the school.
3. Venue id: 205 - Parents-Fun (Bar), approximately 445 meters from the school.
4. Venue id: 206 - Parents-Fun (Bar), approximately 483 meters from the school.
5. Venue id: 208 - Parents-Fun (Bar), approximately 380 meters from the school.
6. Venue id: 210 - Parents-Fun (Wine Bar), approximately 340 meters from the school.

The School has 3 nearby Pizza Places:
1. Venue id: 201 - Pizza (Pizza Place), approximately 183 meters from the school.
2. Venue id: 207 - Pizza (Pizza Place), approximately 347 meters from the school.
3. Venue id: 209 - Pizza (Pizza Place), approximately 470 meters from the school.

The School has 21 nearby Green Areas (with total area of 270,624 meters squared):

The School has 10 nearby Vegetable Stripes:
1. 842-96 (area of 55.1 meters squared), approximately 378 meters from the school.
2. 842-355 (area of 417.5 meters squared), approximately 393 meters from the school.
3. 842-360 (area of 2,284.1 meters squared), approximately 255 meters from the school.
4. 842-362 (area of 729.3 meters squared), approximately 143 meters from the school.
5. 842-363 (area of 408.9 meters squared), approximately 208 meters from the school.
6. 842-399 (area of 1,983.3 meters squared), approximately 447 meters from the school.
7. 842-401 (area of 3,040.4 meters squared), approximately 259 meters from the school.
8. 842-407 (area of 1,722.5 meters squared), approximately 257 meters from the school.
9. 842-410 (area of 1,581.5 meters squared), approximately 311 meters from the school.
10. 842-994 (area of 3,925.8 meters squared), approximately 410 meters from the school.

The School has 11 nearby Gardens:
1. 842-95 (area of 4,078.8 meters squared), approximately 297 meters from the school.
2. 842-102 (area of 66,197.9 meters squared), approximately 258 meters from the school.
3. 842-106 (area of 2,446.4 meters squared), approximately 146 meters from the school.
4. 842-345 (area of 145,979.9 meters squared), approximately 283 meters from the school.
5. 842-356 (area of 19,600.5 meters squared), approximately 59 meters from the school.
6. 842-371 (area of 1,570.4 meters squared), approximately 17 meters from the school.
7. 842-379 (area of 3,396.1 meters squared), approximately 68 meters from the school.
8. 842-380 (area of 5,932.6 meters squared), approximately 452 meters from the school.
9. 842-387 (area of 1,912.2 meters squared), approximately 447 meters from the school.
10. 842-408 (area of 2,785.5 meters squared), approximately 499 meters from the school.
11. 842-437 (area of 575.7 meters squared), approximately 400 meters from the school.



Highlighting candidate Schools in each cluster
Cluster 0: School - 599-302470

School: 599-302470, In Neighborhood: 511-7, Address: Asher Barash St 2, Tel Aviv-Yafo, Israel.

The School has 1 nearby Daycare:
1. 624-38 ,approximately 483 meters from the school.

The School has 2 nearby Dog Gardens:
1. 586-21 ,approximately 201 meters from the school.
2. 586-51 ,approximately 287 meters from the school.

The School has 12 nearby Kindergartens:
1. 598-116191 ,approximately 411 meters from the school.
2. 598-153131 ,approximately 455 meters from the school.
3. 598-153132 ,approximately 455 meters from the school.
4. 598-182181 ,approximately 470 meters from the school.
5. 598-182182 ,approximately 470 meters from the school.
6. 598-195131 ,approximately 496 meters from the school.
7. 598-195132 ,approximately 496 meters from the school.
8. 598-220121 ,approximately 485 meters from the school.
9. 598-220122 ,approximately 485 meters from the school.
10. 598-220123 ,approximately 485 meters from the school.
11. 598-266171 ,approximately 498 meters from the school.
12. 598-266172 ,approximately 498 meters from the school.

The School has 3 nearby playgrounds (with 14 facilities):
1. 696-73 (playground in a garden, with 11 facilities), approximately 387 meters from the school.
2. 696-87 (playground in a garden, with 1 facility), approximately 358 meters from the school.
3. 696-1809 (playground, with 2 facilities), approximately 107 meters from the school.

The School has 2 nearby Ice-Cream Parlours:
1. Venue id: 185 - Ice-Cream (Ice Cream Shop), approximately 148 meters from the school.
2. Venue id: 187 - Ice-Cream (Ice Cream Shop), approximately 109 meters from the school.

The School has 1 nearby Bar/Pub:
1. Venue id: 188 - Parents-Fun (Bar), approximately 363 meters from the school.

The School has 2 nearby Pizza Places:
1. Venue id: 186 - Pizza (Pizza Place), approximately 76 meters from the school.
2. Venue id: 189 - Pizza (Pizza Place), approximately 459 meters from the school.

The School has 26 nearby Green Areas (with total area of 164,949 meters squared):

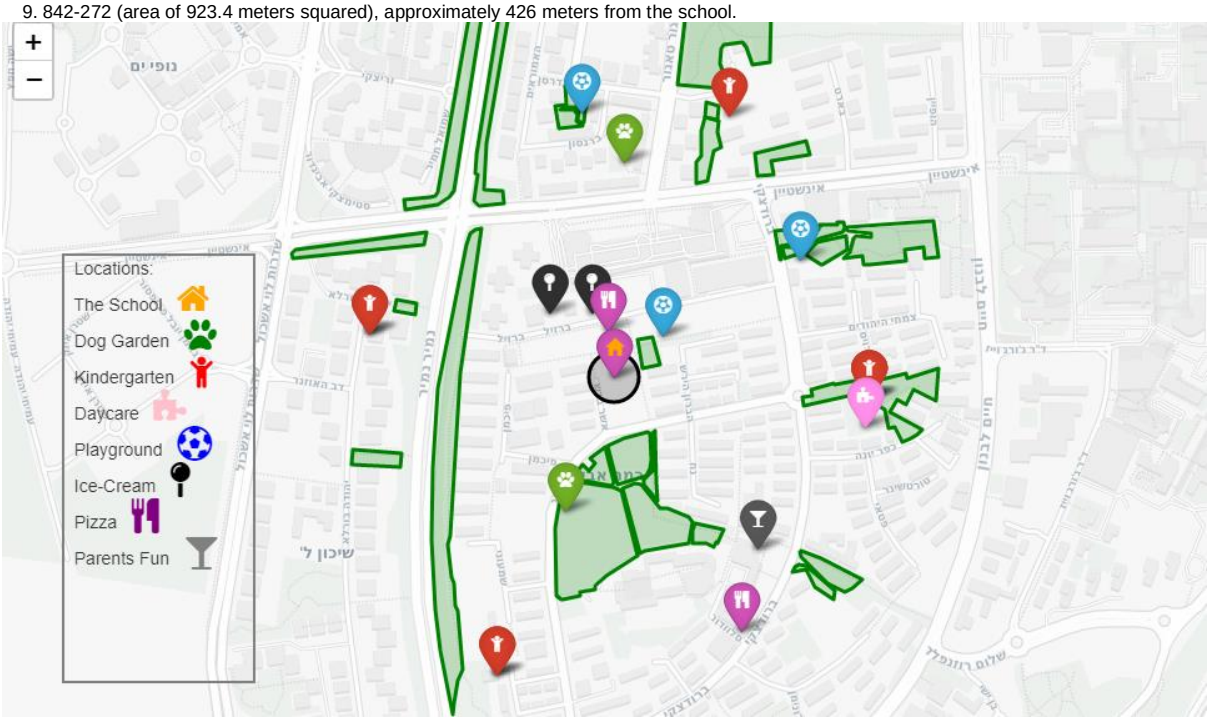
The School has 1 nearby Playground Green Area:
1. 842-151 (area of 1,312.6 meters squared), approximately 55 meters from the school.

The School has 9 nearby Vegetable Stripes:
1. 842-52 (area of 25,628.8 meters squared), approximately 394 meters from the school.
2. 842-56 (area of 28,206.9 meters squared), approximately 313 meters from the school.
3. 842-203 (area of 2,440.5 meters squared), approximately 302 meters from the school.
4. 842-240 (area of 21,799.5 meters squared), approximately 289 meters from the school.

5. 842-955 (area of 1,810.2 meters squared), approximately 419 meters from the school.
6. 842-957 (area of 620.0 meters squared), approximately 389 meters from the school.
7. 842-996 (area of 3,472.0 meters squared), approximately 402 meters from the school.
8. 842-997 (area of 2,256.8 meters squared), approximately 383 meters from the school.
9. 842-998 (area of 498.2 meters squared), approximately 387 meters from the school.

The School has 7 nearby Gardens:
1. 842-199 (area of 1,491.3 meters squared), approximately 340 meters from the school.
2. 842-201 (area of 510.1 meters squared), approximately 344 meters from the school.
3. 842-226 (area of 7,530.5 meters squared), approximately 465 meters from the school.
4. 842-227 (area of 2,711.1 meters squared), approximately 352 meters from the school.
5. 842-232 (area of 1,845.9 meters squared), approximately 402 meters from the school.
6. 842-233 (area of 376.5 meters squared), approximately 362 meters from the school.
7. 842-958 (area of 16,698.1 meters squared), approximately 408 meters from the school.

The School has 9 nearby Groves:
1. 842-244 (area of 7,940.1 meters squared), approximately 361 meters from the school.
2. 842-251 (area of 933.2 meters squared), approximately 104 meters from the school.
3. 842-252 (area of 4,345.3 meters squared), approximately 84 meters from the school.
4. 842-253 (area of 2,115.1 meters squared), approximately 95 meters from the school.
5. 842-257 (area of 18,634.6 meters squared), approximately 146 meters from the school.
6. 842-259 (area of 6,932.8 meters squared), approximately 147 meters from the school.
7. 842-264 (area of 1,297.0 meters squared), approximately 247 meters from the school.
8. 842-269 (area of 2,618.4 meters squared), approximately 424 meters from the school.
9. 842-272 (area of 923.4 meters squared), approximately 426 meters from the school.



Highlighting candidate Schools in each cluster

Cluster 1: School - 599-309650

'599-309650': I'm highlighting this school because it has the largest green area, most playground facilities and a lot of bars, so it is the best representation of the cluster from the options with maximum diversity of location types.

School: 599-309650, In Neighborhood: 511-28, Address: Balfour St 12, Tel Aviv-Yafo, Israel.

The School has 1 nearby Daycare:
1. 624-14 ,approximately 482 meters from the school.

The School has 1 nearby Dog Garden:
1. 586-3 ,approximately 465 meters from the school.

The School has 19 nearby Kindergartens:
1. 598-9191 ,approximately 318 meters from the school.
2. 598-9192 ,approximately 318 meters from the school.
3. 598-9193 ,approximately 318 meters from the school.
4. 598-9194 ,approximately 318 meters from the school.
5. 598-9195 ,approximately 318 meters from the school.
6. 598-9196 ,approximately 318 meters from the school.

7. 598-9197 ,approximately 318 meters from the school.
8. 598-9198 ,approximately 318 meters from the school.
9. 598-9199 ,approximately 318 meters from the school.
10. 598-60151 ,approximately 332 meters from the school.
11. 598-60152 ,approximately 332 meters from the school.
12. 598-60153 ,approximately 332 meters from the school.
13. 598-60154 ,approximately 332 meters from the school.
14. 598-60155 ,approximately 332 meters from the school.
15. 598-60156 ,approximately 332 meters from the school.
16. 598-60157 ,approximately 332 meters from the school.
17. 598-60158 ,approximately 332 meters from the school.
18. 598-83831 ,approximately 391 meters from the school.
19. 598-230101 ,approximately 307 meters from the school.

The School has 1 nearby playground (with 6 facilities):
1. 696-264 (playground in a garden, with 6 facilities), approximately 186 meters from the school.

The School has 5 nearby Ice-Cream Parlours:
1. Venue id: 379 - Ice-Cream (Ice Cream Shop), approximately 328 meters from the school.
2. Venue id: 381 - Ice-Cream (Ice Cream Shop), approximately 438 meters from the school.
3. Venue id: 399 - Ice-Cream (Ice Cream Shop), approximately 431 meters from the school.
4. Venue id: 400 - Ice-Cream (Dessert Shop), approximately 403 meters from the school.
5. Venue id: 417 - Ice-Cream (Ice Cream Shop), approximately 383 meters from the school.

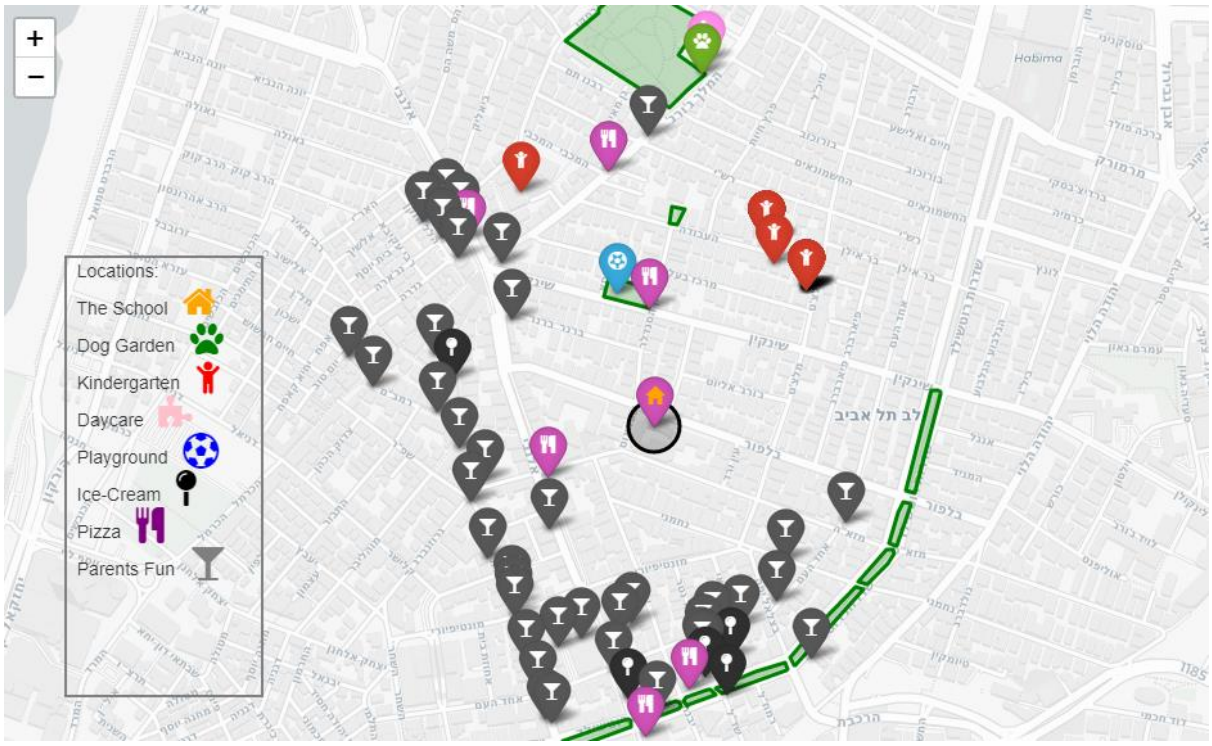
The School has 40 nearby Bars/Pubs:
1. Venue id: 380 - Parents-Fun (Bar), approximately 308 meters from the school.
2. Venue id: 382 - Parents-Fun (Bar), approximately 342 meters from the school.
3. Venue id: 383 - Parents-Fun (Bar), approximately 338 meters from the school.
4. Venue id: 384 - Parents-Fun (Bar), approximately 336 meters from the school.
5. Venue id: 385 - Parents-Fun (Bar), approximately 447 meters from the school.
6. Venue id: 386 - Parents-Fun (Bar), approximately 407 meters from the school.
7. Venue id: 387 - Parents-Fun (Bar), approximately 353 meters from the school.
8. Venue id: 388 - Parents-Fun (Pub), approximately 381 meters from the school.
9. Venue id: 389 - Parents-Fun (Pub), approximately 472 meters from the school.
10. Venue id: 390 - Parents-Fun (Bar), approximately 441 meters from the school.
11. Venue id: 391 - Parents-Fun (Bar), approximately 360 meters from the school.
12. Venue id: 392 - Parents-Fun (Bar), approximately 313 meters from the school.
13. Venue id: 393 - Parents-Fun (Bar), approximately 336 meters from the school.
14. Venue id: 394 - Parents-Fun (Bar), approximately 485 meters from the school.
15. Venue id: 395 - Parents-Fun (Bar), approximately 444 meters from the school.
16. Venue id: 396 - Parents-Fun (Bar), approximately 492 meters from the school.
17. Venue id: 398 - Parents-Fun (Bar), approximately 330 meters from the school.
18. Venue id: 401 - Parents-Fun (Bar), approximately 342 meters from the school.
19. Venue id: 402 - Parents-Fun (Bar), approximately 232 meters from the school.
20. Venue id: 403 - Parents-Fun (Bar), approximately 353 meters from the school.
21. Venue id: 404 - Parents-Fun (Burger Joint), approximately 392 meters from the school.
22. Venue id: 406 - Parents-Fun (Bar), approximately 350 meters from the school.
23. Venue id: 407 - Parents-Fun (Cocktail Bar), approximately 296 meters from the school.
24. Venue id: 411 - Parents-Fun (Bar), approximately 449 meters from the school.
25. Venue id: 412 - Parents-Fun (Bistro), approximately 376 meters from the school.
26. Venue id: 413 - Parents-Fun (Pub), approximately 378 meters from the school.
27. Venue id: 414 - Parents-Fun (Bar), approximately 279 meters from the school.
28. Venue id: 415 - Parents-Fun (Bar), approximately 281 meters from the school.
29. Venue id: 416 - Parents-Fun (Bar), approximately 336 meters from the school.
30. Venue id: 418 - Parents-Fun (Bar), approximately 371 meters from the school.
31. Venue id: 419 - Parents-Fun (Bar), approximately 420 meters from the school.
32. Venue id: 420 - Parents-Fun (Bar), approximately 456 meters from the school.
33. Venue id: 421 - Parents-Fun (Bar), approximately 456 meters from the school.
34. Venue id: 422 - Parents-Fun (Beer Bar), approximately 494 meters from the school.
35. Venue id: 424 - Parents-Fun (Pub), approximately 351 meters from the school.
36. Venue id: 425 - Parents-Fun (Bar), approximately 494 meters from the school.
37. Venue id: 426 - Parents-Fun (Wine Bar), approximately 372 meters from the school.
38. Venue id: 427 - Parents-Fun (Dive Bar), approximately 443 meters from the school.
39. Venue id: 428 - Parents-Fun (Bar), approximately 363 meters from the school.
40. Venue id: 429 - Parents-Fun (Bar), approximately 312 meters from the school.

The School has 6 nearby Pizza Places:
1. Venue id: 397 - Pizza (Pizza Place), approximately 489 meters from the school.
2. Venue id: 405 - Pizza (Pizza Place), approximately 186 meters from the school.
3. Venue id: 408 - Pizza (Pizza Place), approximately 185 meters from the school.
4. Venue id: 409 - Pizza (Pizza Place), approximately 409 meters from the school.
5. Venue id: 410 - Pizza (Pizza Place), approximately 416 meters from the school.
6. Venue id: 423 - Pizza (Pizza Place), approximately 417 meters from the school.

The School has 12 nearby Green Areas (with total area of 39,472 meters squared):

The School has 9 nearby Vegetable Stripes:
1. 842-600 (area of 2,374.9 meters squared), approximately 474 meters from the school.
2. 842-607 (area of 1,024.5 meters squared), approximately 461 meters from the school.
3. 842-614 (area of 995.4 meters squared), approximately 430 meters from the school.
4. 842-617 (area of 2,143.9 meters squared), approximately 398 meters from the school.
5. 842-621 (area of 1,577.8 meters squared), approximately 358 meters from the school.
6. 842-627 (area of 603.7 meters squared), approximately 356 meters from the school.
7. 842-628 (area of 893.8 meters squared), approximately 359 meters from the school.
8. 842-629 (area of 1,647.2 meters squared), approximately 382 meters from the school.
9. 842-631 (area of 2,039.8 meters squared), approximately 453 meters from the school.

The School has 3 nearby Gardens:
1. 842-109 (area of 23,459.5 meters squared), approximately 413 meters from the school.
2. 842-580 (area of 441.4 meters squared), approximately 265 meters from the school.
3. 842-591 (area of 2,270.1 meters squared), approximately 153 meters from the school.



Highlighting candidate Schools in each cluster
Cluster 2: School - 599-302130

I have failed to find a school with at least one venue of each location type. I still want to highlight a school in this cluster, so I have consulted with the client about the location type he could most easily do without. The client has suggested ommitting the "parents fun" category (bars/pubs).

'599-302130': I chose to highlight this school because from all the options that are left after filtering bars/pubs while still searching for maximum variety of location types, it has the largest green area in its proximity. Additionally, there is no school with more playgrounds. Since the client "gave up" "parents fun", he might as well at least enjoy as many green areas and playgrounds as possible.

School: 599-302130, In Neighborhood: 511-56, Address: Kehilat Varsha St 12, Tel Aviv-Yafo, Israel.

The School has 1 nearby Daycare:
1. 624-48 ,approximately 135 meters from the school.

The School has 4 nearby Dog Gardens:
1. 586-23 ,approximately 253 meters from the school.
2. 586-31 ,approximately 178 meters from the school.
3. 586-52 ,approximately 436 meters from the school.
4. 586-54 ,approximately 227 meters from the school.

The School has 7 nearby Kindergartens:
1. 598-84171 ,approximately 466 meters from the school.
2. 598-186141 ,approximately 469 meters from the school.
3. 598-186142 ,approximately 469 meters from the school.
4. 598-271101 ,approximately 163 meters from the school.
5. 598-271102 ,approximately 163 meters from the school.
6. 598-271103 ,approximately 163 meters from the school.
7. 598-271104 ,approximately 163 meters from the school.

The School has 1 nearby playground (with 10 facilities):
1. 696-336 (playground in a grove, with 10 facilities), approximately 426 meters from the school.

The School has 1 nearby Ice-Cream Parlour:
1. Venue id: 179 - Ice-Cream (Ice Cream Shop), approximately 262 meters from the school.

The School has 3 nearby Pizza Places:
1. Venue id: 178 - Pizza (Pizza Place), approximately 258 meters from the school.
2. Venue id: 180 - Pizza (Pizza Place), approximately 266 meters from the school.
3. Venue id: 181 - Pizza (Pizza Place), approximately 273 meters from the school.

The School has 22 nearby Green Areas (with total area of 81,924 meters squared):

The School has 3 nearby Vegetable Stripes:
1. 842-191 (area of 1,171.3 meters squared), approximately 454 meters from the school.
2. 842-194 (area of 6,410.7 meters squared), approximately 316 meters from the school.
3. 842-212 (area of 1,410.1 meters squared), approximately 499 meters from the school.

The School has 15 nearby Gardens:
1. 842-198 (area of 1,779.9 meters squared), approximately 326 meters from the school.
2. 842-202 (area of 867.3 meters squared), approximately 357 meters from the school.
3. 842-208 (area of 3,347.5 meters squared), approximately 287 meters from the school.
4. 842-209 (area of 1,393.9 meters squared), approximately 257 meters from the school.
5. 842-210 (area of 1,355.3 meters squared), approximately 288 meters from the school.
6. 842-249 (area of 971.6 meters squared), approximately 188 meters from the school.
7. 842-260 (area of 1,388.5 meters squared), approximately 360 meters from the school.
8. 842-261 (area of 352.1 meters squared), approximately 346 meters from the school.
9. 842-262 (area of 2,219.3 meters squared), approximately 463 meters from the school.
10. 842-265 (area of 241.1 meters squared), approximately 404 meters from the school.
11. 842-266 (area of 1,164.7 meters squared), approximately 434 meters from the school.
12. 842-268 (area of 944.7 meters squared), approximately 474 meters from the school.
13. 842-270 (area of 932.0 meters squared), approximately 441 meters from the school.
14. 842-942 (area of 9,362.3 meters squared), approximately 485 meters from the school.
15. 842-951 (area of 2,326.4 meters squared), approximately 168 meters from the school.

The School has 4 nearby Groves:
1. 842-195 (area of 8,942.6 meters squared), approximately 432 meters from the school.
2. 842-237 (area of 8,403.8 meters squared), approximately 25 meters from the school.
3. 842-243 (area of 20,017.6 meters squared), approximately 234 meters from the school.
4. 842-255 (area of 6,921.1 meters squared), approximately 476 meters from the school.

5. Conclusion

This project was devoted to exploring and segmenting elementary schools in Tel Aviv, based on their proximity to other venues that were of particular interest to the client - a friend of mine who has decided to move to the city with his family. The project provides clients, who wish to live near an elementary school, with data concerning other venues in the area, to inform their decision regarding where to rent an apartment. To do so, I collected the relevant data from a number of sources. I did some basic data analysis and some exploritory data visualization. I then segemented the schools based on the nearby location of interest, using Kmeans clustering algorithm, and found three clusters. This resulted in an interesting geographical differentiation between the city center (cluster 1), the Southern and Eastern neighborhoods (cluster 2) and the Northern neighborhoods (cluster 0). The latter cluster was found to be most suitable for the clients needs, as it is most diverse in terms of location types and contains the largest green areas and most playgrounds. This is consistent with the strong social-economic background of the Northern neighborhoods of Tel Aviv, in which most of cluster 0 resides. In addition to the general characterization of the segements, I also highlighted three highly diverse schools in cluster 0 and one school in each of the other clusters.

In conclusion, it is noteworthy that at the request of the client, some data that could have also been relevant is currently not factored into the analysis, such as quality of school; cost of rent; other recreational facilities (restaurants, movie theaters, etc.).

Thus, there is room for expanding and improving the analysis by adding parameters that are currently outside the scope of the project. I believe that adding these dimensions to the clustering algorithm could have yielded very interesting results. Additionally, it is possible to combine weight for each location type in accordance with different preferences, so that the segmentation could give more weight to certain places. It is also possible to think of variations for the features. However, we must remember that possible variations are endless and that our main objective is to create a model that is valuable for solving a concrete problem, not a perfect one (no model is perfect!).