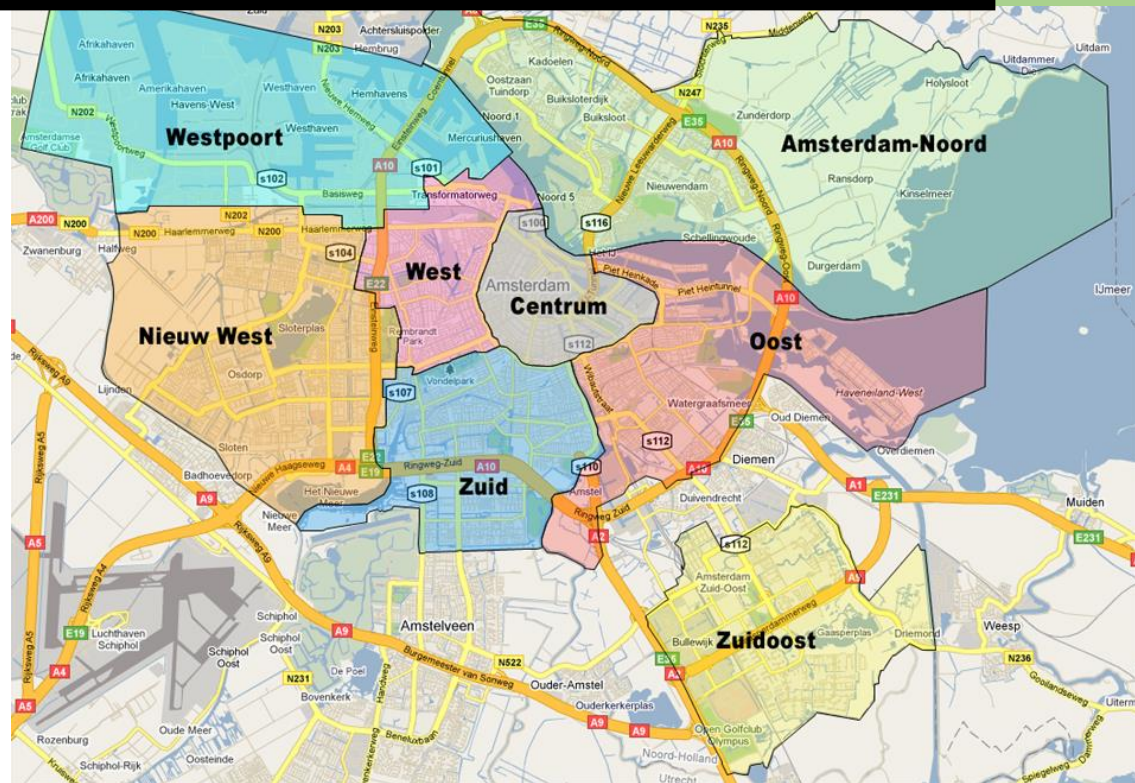


## Amsterdam Neighborhoods



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Data Science

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# Amsterdam Neighborhoods

## 1. Introduction/Business Problem

As an expat living in Amsterdam, I would like to get insights in its neighborhoods. People often asked me what are the coolest areas or the best neighborhoods. But my answer always starts with: “It depends what you are looking for.” Amsterdam has 101 different boroughs.

For those **expats**, I am set to mine Amsterdam’s neighborhoods information and cluster its neighborhoods based on their similarity and features. In this way, I give other expats a set of neighborhoods together with its features; for instance, what places are more or less popular. In other words, if you like coffee shops, restaurants or shopping, I could recommend you to check these neighborhoods. On the other hand, if you like museums, movies, parks, maybe you should go to these boroughs.

Moreover, this information might provide you (**Amsterdam citizen**) valuable insights about similar neighborhoods to the one you live now. Let’s say you want to live in another borough but very similar to the one you are living at the moment. Or the other way around, you would like to live in a different surrounding. Or maybe, you already has a restaurant and would like to open another one in a very similar environment. What area do you choose?

And last but not least, **Amsterdam Municipality** might use the result of this research to understand better the current situation of its neighborhoods. For instance, let’s assume they want to open a coffee shop in an area that it is already full of coffee shops; typical problems coming along with coffee shops might boost. It might be a better idea to open the coffee shop in a different borough, in order not to concentrate the problem in one place but to spread it and soften its effects overall.

### Business Question:

In this research, using a data-driven approach, I will segment and cluster Amsterdam neighborhoods based on their similarities and show their top 10 most common places. *What Neighborhoods in Amsterdam are similar?*

### Main Stakeholders:

- Myself
- Expats
- Amsterdam citizens
- Amsterdam municipality

Let’s data-discover Amsterdam!

## 2. Data

The stating source of data will be the name of the neighborhoods of Amsterdam. I will get their names from: <https://www.amsterdam.nl/en/districts/>.

Another source of information it will be **Foursquare**, which is a location data provider; essentially, to explore a geographical location, and to get popular venues around a location.

To utilize *Foursquare* location data, we need to pass the latitude and the longitude coordinates of the Amsterdam neighborhoods. To obtain this, we will use [Nominatim](#), a module to convert an address into latitude and longitude values from [Geopy](#). Geopy is a Python client/library for several popular geocoding web services. It makes it easy for Python developers to locate the coordinates of addresses, cities, countries, and landmarks across the globe using third-party geocoders and other data sources.

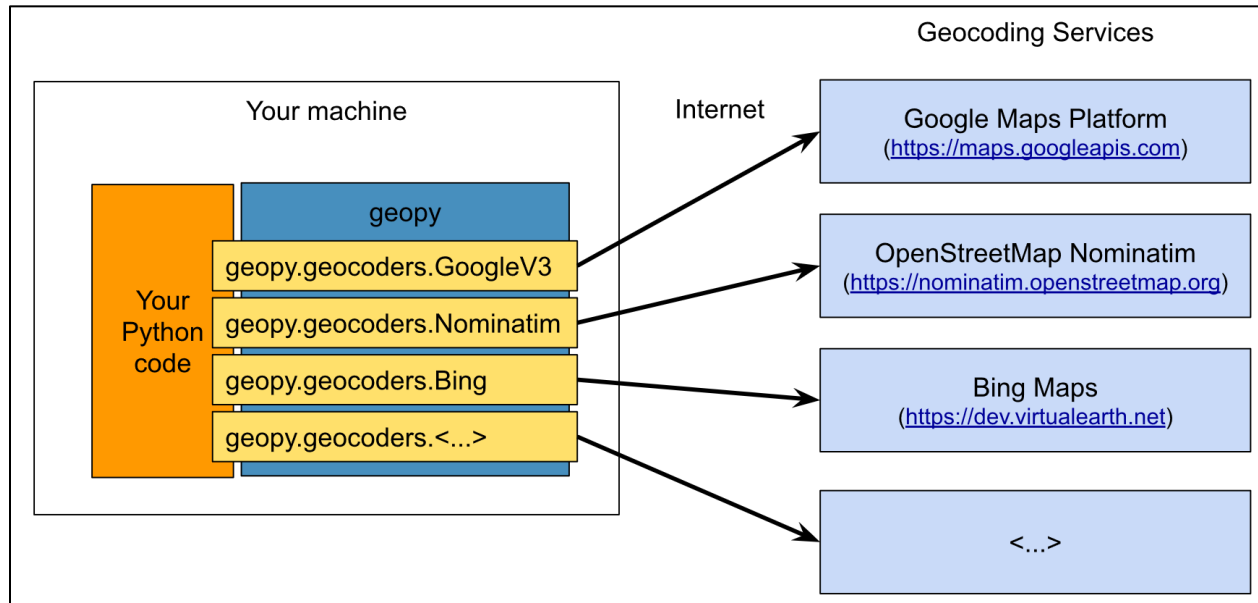


Figure 1. Geocoding Services

This were the step we performed to create the initial dataset:

- 1) Get Amsterdam neighborhoods names.
- 2) Use Geopy to obtain the coordinates of the neighborhoods.

The initial dataset looks like this:

	District	Neighborhood	Latitude	Longitude
0	Centre	Centrum-Oost	52.364560	4.906780
1	Centre	Centrum-West	52.373730	4.895691
2	West	De Baarsjes	52.368926	4.856382
3	West	Oud-West	52.364815	4.869762
4	West	Westerpark	52.387236	4.871777
5	West	Bos en Lommer	52.378521	4.848738
6	Nieuw-West	Geuzenveld	52.378394	4.801628
7	Nieuw-West	Slotermeer	52.377961	4.821952
8	Nieuw-West	Sloterdijken	52.387100	4.846500

Figure 2. Amsterdam Neighborhoods with Latitude and Longitude



There were 5 neighborhoods for which its coordinates could not be found. So I looked up on the internet and add those missing coordinates. Moreover, 4 coordinates returned by Geopy were not exactly on the center of their respective neighborhoods, so I adjust those 4 coordinates.

With that information, we can plot the neighborhoods on a map.

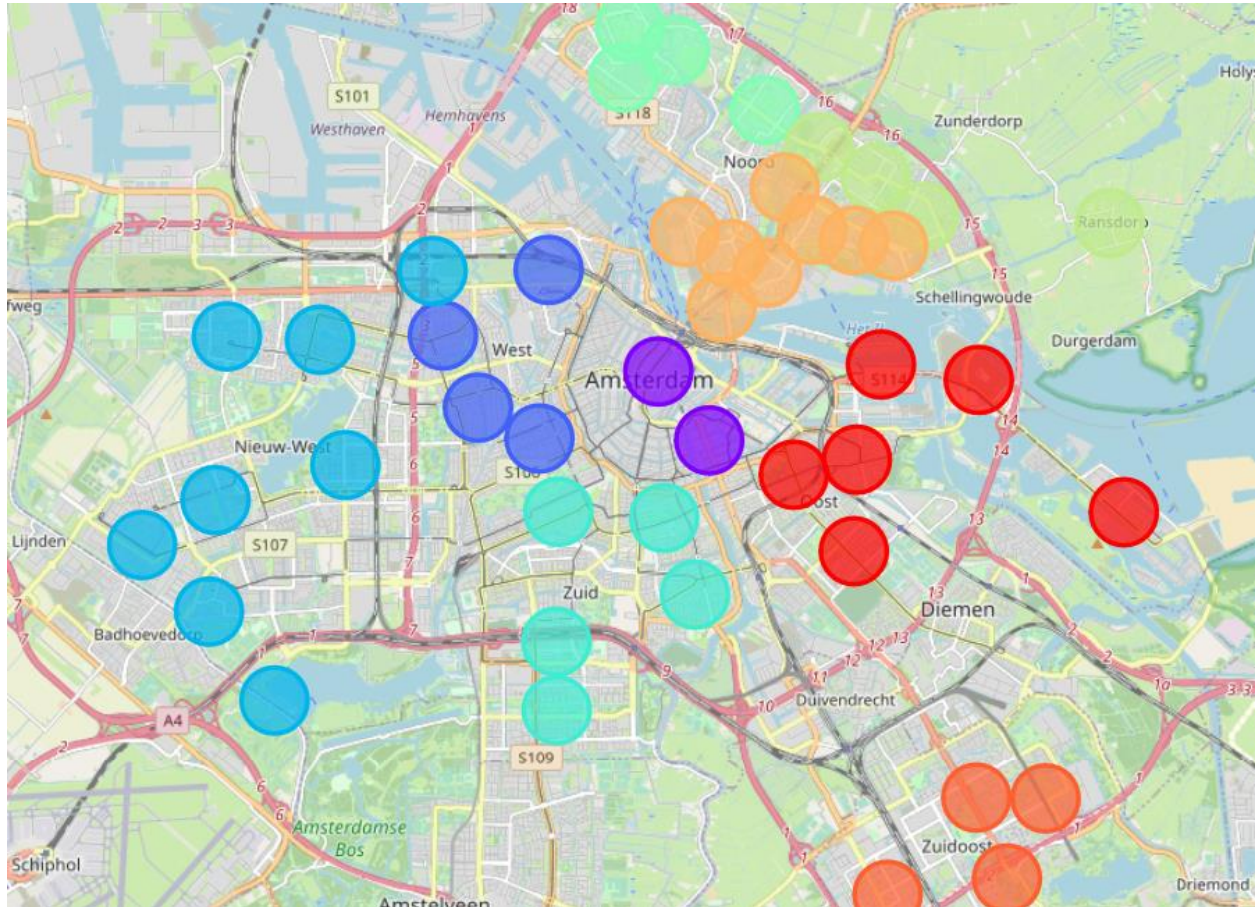


Figure 3. Amsterdam Neighborhoods on a map

### 3. Methodology

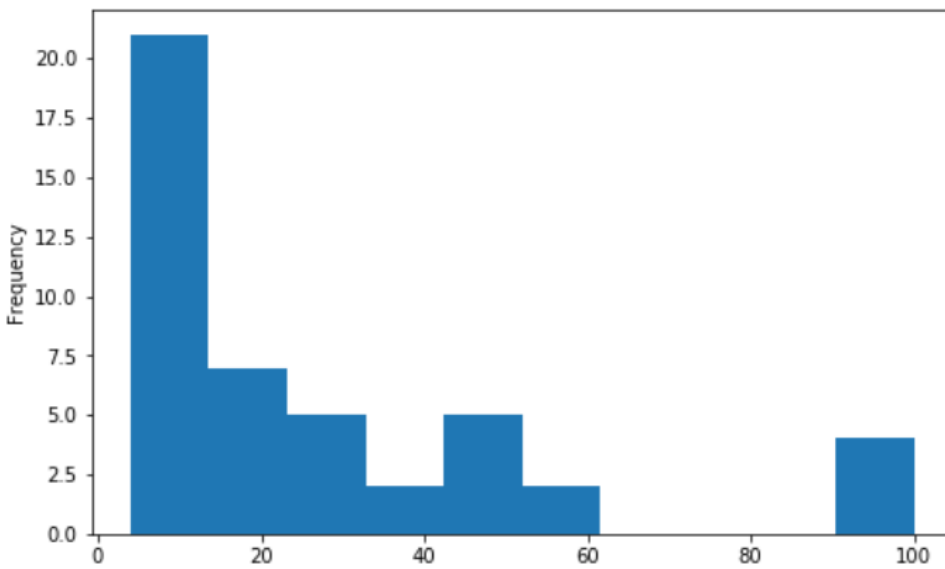
We use the *Foursquare API* to explore Amsterdam neighborhoods. I will use the *explore* function to get the most common *venue categories* in each neighborhood, and then use this feature to group the neighborhoods into clusters. I will use the k-means clustering algorithm to complete this task. Finally, I will use the Folium library to visualize the neighborhoods in Amsterdam and their emerging clusters.

Step 1) ask Foursquare for the most popular venues of the neighborhoods. Below it is an example for one neighborhoods.

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Centrum-Oost	52.36456	4.90678	Zoku	52.363891	4.906723	Hotel
1	Centrum-Oost	52.36456	4.90678	Dignita Hoftuin	52.365608	4.904464	Tea Room
2	Centrum-Oost	52.36456	4.90678	HIGH STUDIOS	52.364273	4.906484	Gym / Fitness Center
3	Centrum-Oost	52.36456	4.90678	Delight Yoga	52.362259	4.905868	Yoga Studio
4	Centrum-Oost	52.36456	4.90678	De Hortus	52.366952	4.907511	Botanical Garden

Figure 4. Venue Categories

We plotted the distribution of popular venues per neighborhoods and noticed that most of the venue returned a few venues. The image below shows on the  $x$  axis the number of venues returned per neighborhoods and on the  $y$  axis its frequency. 20 neighborhoods returned less than 10 venues.



With all popular venues per neighborhoods at hand, we calculated the mean of the frequency of those categories for each neighborhood and the resulting dataset is the one we use as input to cluster the neighborhoods. It looks like this:

	Neighborhood	Accessories Store	Arcade	Argentinian Restaurant	Art Gallery	Art Museum	Arts & Crafts Store	Arts & Entertainment	Asian Restaurant	Athletics & Sports	Australian Restaurant
0	Amstel III	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.066667	0.000000	0.000000
1	Banne Buiksloot	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000
2	Bijlmer-Centrum	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000
3	Bijlmer-Oost	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000
4	Bos en Lommer	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000
5	Buiksloterdijk	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000
6	Buikslotermeer	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000
7	Buitenveldert	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.022222	0.000000	0.000000
8	Bullewijk	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000
9	Centrum-Oost	0.00	0.000000	0.00	0.000000	0.010309	0.00	0.000000	0.000000	0.000000	0.000000
10	Centrum-West	0.00	0.000000	0.01	0.000000	0.010000	0.00	0.000000	0.020000	0.000000	0.000000
11	De Aker	0.00	0.000000	0.00	0.000000	0.000000	0.00	0.000000	0.000000	0.000000	0.000000

Figure 5. Mean of the frequency of categories per neighborhood

With this information, we were able to show that type of categories were more popular per neighborhood. Find your neighborhood in the tables below and have a look at the popular places.

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Amstel III	Restaurant	Electronics Store	Asian Restaurant	Bistro	Fried Chicken Joint	Sandwich Place	Lounge	Food Court	Hotel	Gym
1	Banne Buiksloot	Bus Stop	Supermarket	Park	Restaurant	Bakery	Turkish Restaurant	Shopping Mall	None	None	None
2	Bijlmer-Centrum	Park	Construction & Landscaping	Bus Stop	Theater	None	None	None	None	None	None
3	Bijlmer-Oost	Supermarket	Food & Drink Shop	Bus Stop	Shopping Mall	Discount Store	Bakery	None	None	None	None
4	Bos en Lommer	Restaurant	Gym	Park	Supermarket	Bakery	Grocery Store	Pizza Place	Playground	Turkish Restaurant	Vegetarian / Vegan Restaurant
5	Buiksloterdijk	Soccer Field	Farm	Hotel	Bookstore	Monument / Landmark	Café	Pool	Rest Area	Bus Stop	Gym
6	Buikslotermeer	Supermarket	Snack Place	Clothing Store	Shopping Mall	Restaurant	Japanese Restaurant	Electronics Store	Food & Drink Shop	Café	Drugstore
7	Buitenveldert	Hotel	Bakery	Restaurant	Grocery Store	Sandwich Place	Supermarket	Sushi Restaurant	Coffee Shop	Drugstore	Bookstore
8	Bullewijk	Hotel	Restaurant	Café	Optical Shop	Indoor Play Area	Scandinavian Restaurant	Office	Fast Food Restaurant	Furniture / Home Store	Food & Drink Shop
9	Centrum-Oost	Hotel	Bar	Café	Restaurant	Coffee Shop	Bakery	Pizza Place	Plaza	French Restaurant	Breakfast Spot
10	Centrum-West	Bar	Hotel	Coffee Shop	Marijuana Dispensary	Café	Chinese Restaurant	Cocktail Bar	Burger Joint	Museum	Dessert Shop

11	De Aker	Tram Station	Pharmacy	Fish & Chips Shop	Supermarket	Cheese Shop	Snack Place	Bakery	Drugstore	Pizza Place	None
12	De Baarsjes	Bar	Coffee Shop	Restaurant	Tram Station	Snack Place	Supermarket	Café	Wine Shop	Ice Cream Shop	Ramen Restaurant
13	De Pijp	Italian Restaurant	Café	Pizza Place	Bar	Restaurant	Deli / Bodega	South American Restaurant	Coffee Shop	French Restaurant	Gourmet Shop
14	Elzenhagen	Soccer Field	Gym / Fitness Center	Clothing Store	Gym	None	None	None	None	None	None
15	Gaasperdam Driemond	Harbor / Marina	Playground	Park	Farm	Nightclub	None	None	None	None	None
16	Geuzenveld	Bus Stop	Supermarket	Tram Station	Turkish Restaurant	Trail	Grocery Store	Drugstore	Market	Convenience Store	Italian Restaurant
17	Ijburg	Italian Restaurant	Coffee Shop	Bus Stop	Park	Gym / Fitness Center	Tram Station	Bistro	Asian Restaurant	Greek Restaurant	Farmers Market
18	Ijplein	Coffee Shop	Restaurant	Bar	Performing Arts Venue	Playground	Café	Music Venue	Italian Restaurant	Nightclub	Concert Hall
19	Indische Buurt	Coffee Shop	Bakery	Modern European Restaurant	Middle Eastern Restaurant	Bar	Asian Restaurant	Plaza	Italian Restaurant	Restaurant	Grocery Store
20	Kadoelen	Pharmacy	Shopping Mall	Supermarket	Furniture / Home Store	None	None	None	None	None	None

20	Kadoelen	Pharmacy	Shopping Mall	Supermarket	Furniture / Home Store	None	None	None	None	None	None
21	Nieuw-Sloten	Harbor / Marina	Wine Shop	Boat or Ferry	Beach	None	None	None	None	None	None
22	Nieuwendammerdijk	Tennis Court	Bar	Bus Stop	Park	Indonesian Restaurant	None	None	None	None	None
23	Noordelijke IJ-oever	Bar	IT Services	Clothing Store	Coffee Shop	Thrift / Vintage Store	Café	Hardware Store	Arcade	None	None
24	Oostelijk Havengebied	Plaza	Pizza Place	Shopping Mall	Bus Stop	Fish Market	Restaurant	Chinese Restaurant	Bookstore	Dutch Restaurant	Coffee Shop
25	Oostzanerwerf	Bus Stop	Supermarket	Pharmacy	Gym / Fitness Center	Shopping Mall	Furniture / Home Store	Bookstore	None	None	None
26	Osdorp	Supermarket	Snack Place	Turkish Restaurant	Bakery	Department Store	Pharmacy	Dessert Shop	Coffee Shop	Discount Store	Shopping Mall
27	Oud-Oost	Café	Turkish Restaurant	Coffee Shop	Market	Spiritual Center	Friterie	Beer Garden	Comfort Food Restaurant	Monument / Landmark	Shopping Mall
28	Oud-West	Café	Coffee Shop	Italian Restaurant	Bar	Restaurant	Indonesian Restaurant	Movie Theater	Moroccan Restaurant	Modern European Restaurant	Dutch Restaurant
29	Oud-Zuid	Restaurant	Hotel	Italian Restaurant	French Restaurant	Bar	Bistro	Juice Bar	Café	Bakery	Concert Hall
30	Rivierenbuurt	Supermarket	Café	Coffee Shop	Snack Place	Electronics Store	Tennis Court	Pizza Place	Italian Restaurant	Pet Store	Breakfast Spot



30	Rivierenbuurt	Supermarket	Café	Coffee Shop	Snack Place	Electronics Store	Tennis Court	Pizza Place	Italian Restaurant	Pet Store	Breakfast Spot
31	Sloten	Hockey Field	Monument / Landmark	Snack Place	Football Stadium	Pub	Ice Cream Shop	Comedy Club	Café	Playground	Middle Eastern Restaurant
32	Sloterdijken	Hotel	Bus Stop	Restaurant	Café	Garden	Italian Restaurant	Casino	IT Services	Supermarket	Gym
33	Slotermeer	Bus Stop	Turkish Restaurant	Café	Dessert Shop	Discount Store	Supermarket	Furniture / Home Store	Snack Place	Falafel Restaurant	Food Truck
34	Slotervaart	Asian Restaurant	Bus Stop	Steakhouse	Moroccan Restaurant	Bakery	Indian Chinese Restaurant	IT Services	Italian Restaurant	Food Service	Soccer Field
35	Tuindorp Buiksloot	Park	Pharmacy	Ice Cream Shop	Bus Stop	Campground	Rest Area	Tennis Court	None	None	None
36	Tuindorp Nieuwendam	Park	Pharmacy	Bus Stop	Plaza	Indonesian Restaurant	None	None	None	None	None
37	Tuindorp Oostzaan	Snack Place	Theater	Bus Stop	Plaza	Business Service	Baseball Field	Motorcycle Shop	None	None	None
38	Vogelbuurt	Brewery	Yoga Studio	Plaza	Skate Park	Burger Joint	Café	Fast Food Restaurant	Rock Club	Mexican Restaurant	Supermarket
39	Volewijk	Grocery Store	Café	Restaurant	Bakery	Snack Place	Plaza	Shopping Plaza	Market	Modern European Restaurant	Cheese Shop
40	Watergraafsmeer	Fast Food Restaurant	Stadium	Playground	Cheese Shop	Supermarket	Restaurant	Chinese Restaurant	Museum	Drugstore	Café
41	Waterland	Dairy Store	Brewery	Café	Tea Room	None	None	None	None	None	None
42	Waterlandpleinbuurt	Snack Place	Bus Stop	Grocery Store	Fried Chicken Joint	Supermarket	Drugstore	Discount Store	Convenience Store	Concert Hall	None
43	Westerpark	Nightclub	Bar	Restaurant	BBQ Joint	Café	Coffee Shop	Italian Restaurant	Ice Cream Shop	Farm	Hotel Bar
44	Zeeburgereiland	Bus Stop	Snack Place	Tram Station	Café	Rock Club	None	None	None	None	None
45	Zuidas	Coffee Shop	Italian Restaurant	Restaurant	Salad Place	Breakfast Spot	Sushi Restaurant	Cocktail Bar	Plaza	Hotel	Gym

## Cluster Neighborhoods

We use K-means to cluster the neighborhoods of Amsterdam. However, we make sure the select the right value for K. The *Elbow Method* did not work out in this case. Therefore we explore another alternative.

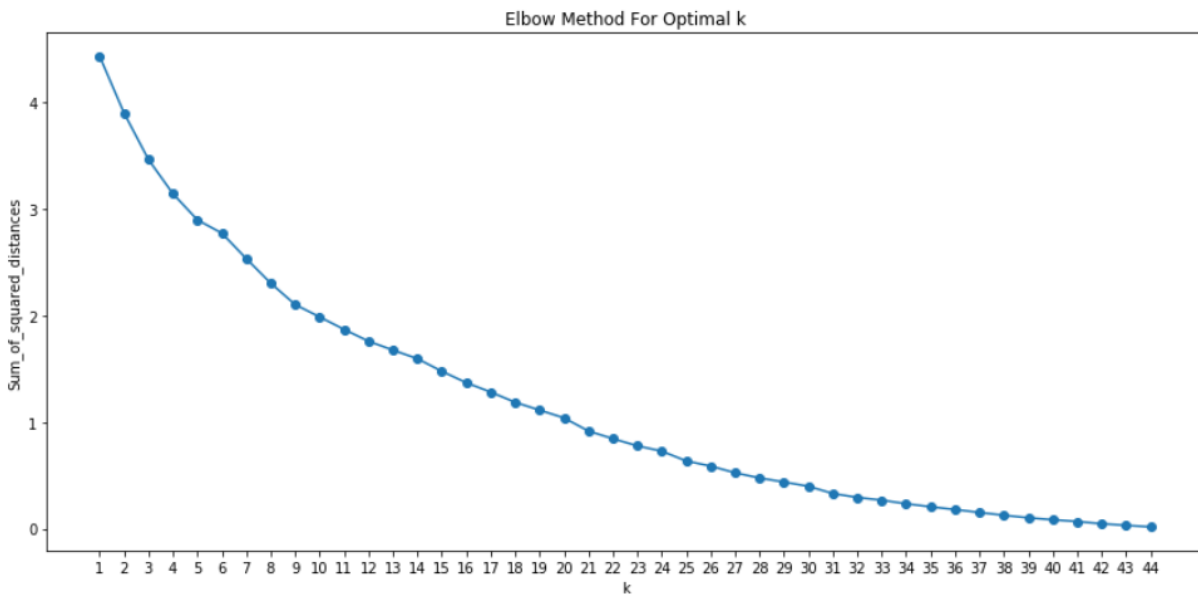


Figure 6. Elbow Method

*Silhouette Coefficient* provided better results after running k-means and agglomerative clustering.

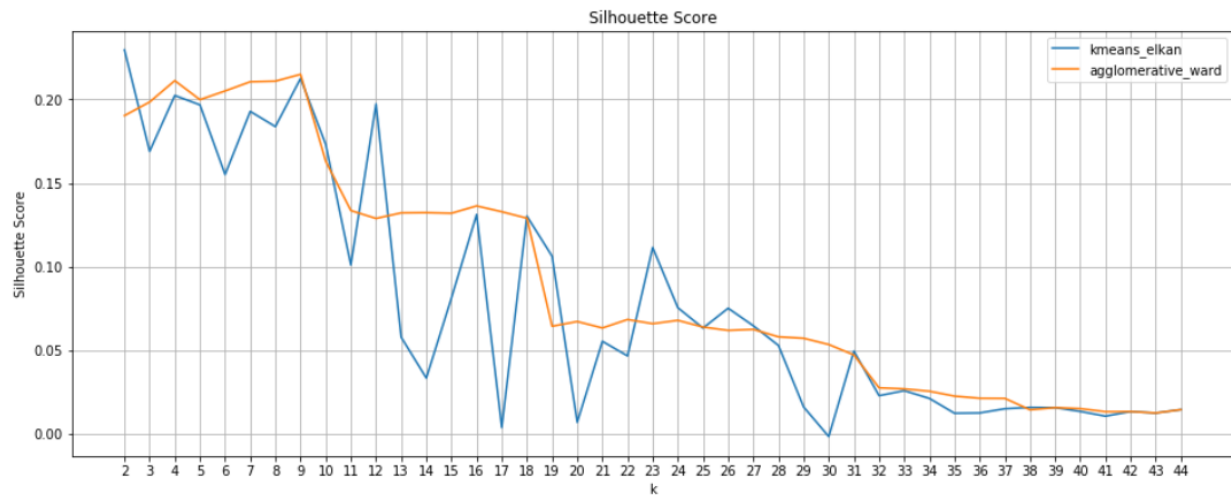


Figure 7. Silhouette Coefficient

The image above shows the best values of k for the different algorithms:

Algorithm	k	Silhouette Score	
K-Means	2	0.229668	global optimal
K-Means	9	0.212618	local optimal
Agglomerative Clustering	9	0.21506346	global optimal

Although k=2 was the global optimal for K-means, the algorithm is clustering outliers into the clusters. Therefore, we are not going to select k=2 to run k-means but the first local optimal k=9.

Moreover, k=9 was also the global optimal for the Agglomerative Clustering Algorithm. Therefore, we are selecting k=9 as the right value for k to run k-means.

After running k-means with k=9, we got the following cluster with the amount of neighborhoods shown below:

```

0:1
1:29
2:3
3:1
4:4
5:4
6:2
7:1
8:1

```

Let's show them on a map.

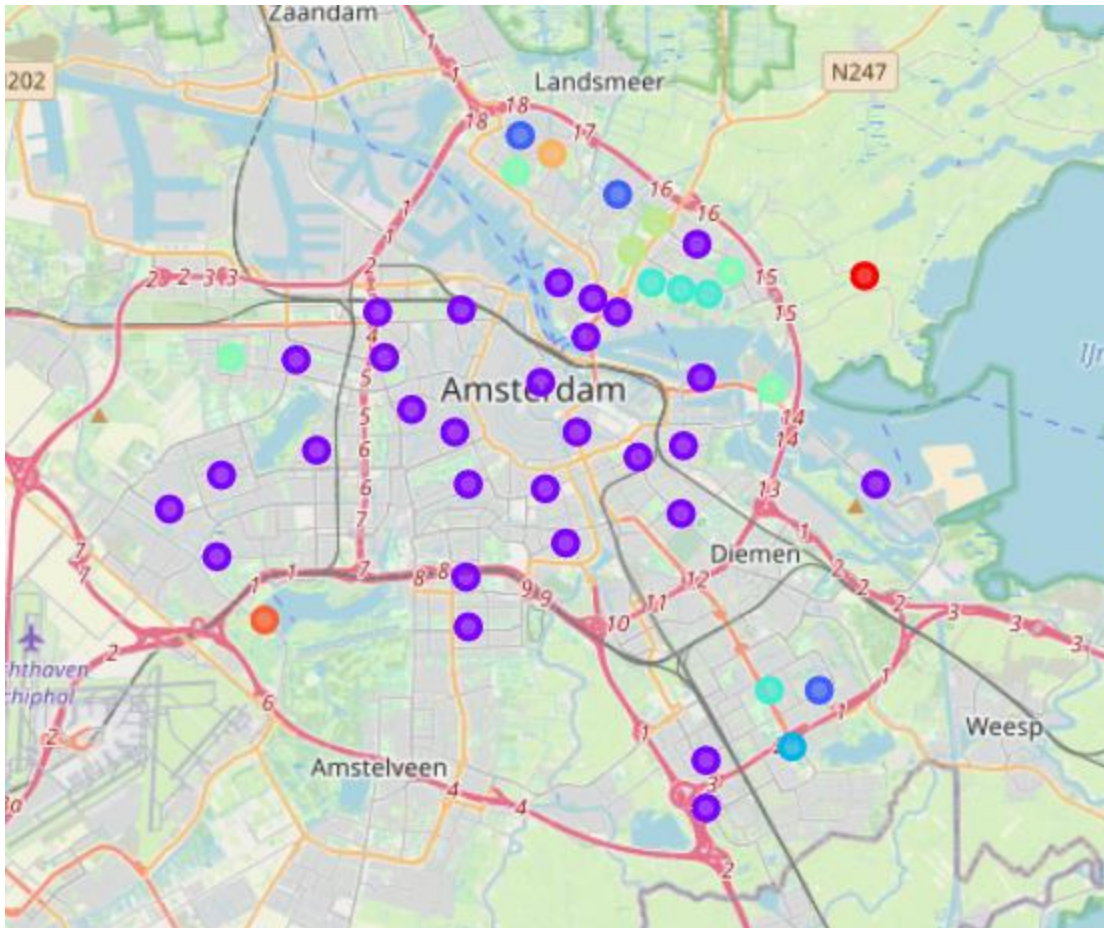


Figure 8. Clustering on the map.

## 4. Results

Let's examine each cluster and determine the discriminating venue categories that distinguish each cluster. We will start counting from Cluster 0.

### Cluster 0

Cluster 0 has only 1 neighborhood, this is because it is an outlier for k-means.

Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
25 Waterland	Dairy Store	Brewery	Café	Tea Room	None	None	None	None	None	None

Let's have a quick view to its venues.

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
930	Waterland	52.39345	4.99409	De Zwaan	52.393630	4.994309	Café
931	Waterland	52.39345	4.99409	Patisserie Kevin Van Velthoven	52.391876	4.994897	Tea Room
932	Waterland	52.39345	4.99409	Boekes BBQ plek	52.395177	4.995051	Brewery
933	Waterland	52.39345	4.99409	Zuivelboerderij Dikhoeve	52.395435	4.992621	Dairy Store

This neighborhood distinguish categories are café, tea room, brewery and dairy store.

# Cluster 1

Cluster 1 contains 29 neighborhoods.

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Centrum-Oost	Hotel	Bar	Café	Restaurant	Coffee Shop	Bakery	Pizza Place	Plaza	French Restaurant	Breakfast Spot
1	Centrum-West	Bar	Hotel	Coffee Shop	Marijuana Dispensary	Café	Chinese Restaurant	Cocktail Bar	Burger Joint	Museum	Dessert Shop
2	De Baarsjes	Bar	Coffee Shop	Restaurant	Tram Station	Snack Place	Supermarket	Café	Wine Shop	Ice Cream Shop	Ramen Restaurant
3	Oud-West	Café	Coffee Shop	Italian Restaurant	Bar	Restaurant	Indonesian Restaurant	Movie Theater	Moroccan Restaurant	Modern European Restaurant	Dutch Restaurant
4	Westerpark	Nightclub	Bar	Restaurant	BBQ Joint	Café	Coffee Shop	Italian Restaurant	Ice Cream Shop	Farm	Hotel Bar
5	Bos en Lommer	Restaurant	Gym	Park	Supermarket	Bakery	Grocery Store	Pizza Place	Playground	Turkish Restaurant	Vegetarian / Vegan Restaurant
7	Slotermeer	Bus Stop	Turkish Restaurant	Café	Dessert Shop	Discount Store	Supermarket	Furniture / Home Store	Snack Place	Falafel Restaurant	Food Truck
8	Sloterdijken	Hotel	Bus Stop	Restaurant	Café	Garden	Italian Restaurant	Casino	IT Services	Supermarket	Gym
9	Slotervaart	Asian Restaurant	Bus Stop	Steakhouse	Moroccan Restaurant	Bakery	Indian Chinese Restaurant	IT Services	Italian Restaurant	Food Service	Soccer Field
10	De Aker	Tram Station	Pharmacy	Fish & Chips Shop	Supermarket	Cheese Shop	Snack Place	Bakery	Drugstore	Pizza Place	None
11	Sloten	Hockey Field	Monument / Landmark	Snack Place	Football Stadium	Pub	Ice Cream Shop	Comedy Club	Café	Playground	Middle Eastern Restaurant
13	Osdorp	Supermarket	Snack Place	Turkish Restaurant	Bakery	Department Store	Pharmacy	Dessert Shop	Coffee Shop	Discount Store	Shopping Mall
14	Buitenveldert	Hotel	Bakery	Restaurant	Grocery Store	Sandwich Place	Supermarket	Sushi Restaurant	Coffee Shop	Drugstore	Bookstore
15	Zuidas	Coffee Shop	Italian Restaurant	Restaurant	Salad Place	Breakfast Spot	Sushi Restaurant	Cocktail Bar	Plaza	Hotel	Gym
16	Rivierenbuurt	Supermarket	Café	Coffee Shop	Snack Place	Electronics Store	Tennis Court	Pizza Place	Italian Restaurant	Pet Store	Breakfast Spot
17	De Pijp	Italian Restaurant	Café	Pizza Place	Bar	Restaurant	Deli / Bodega	South American Restaurant	Coffee Shop	French Restaurant	Gourmet Shop
18	Oud-Zuid	Restaurant	Hotel	Italian Restaurant	French Restaurant	Bar	Bistro	Juice Bar	Café	Bakery	Concert Hall
23	Buikslotermeer	Supermarket	Snack Place	Clothing Store	Shopping Mall	Restaurant	Japanese Restaurant	Electronics Store	Food & Drink Shop	Café	Drugstore
29	Ijplein	Coffee Shop	Restaurant	Bar	Performing Arts Venue	Playground	Café	Music Venue	Italian Restaurant	Nightclub	Concert Hall
30	Vogelbuurt	Brewery	Yoga Studio	Plaza	Skate Park	Burger Joint	Café	Fast Food Restaurant	Rock Club	Mexican Restaurant	Supermarket
30	Vogelbuurt	Brewery	Yoga Studio	Plaza	Skate Park	Burger Joint	Café	Fast Food Restaurant	Rock Club	Mexican Restaurant	Supermarket
31	Noordelijke IJ-oever	Bar	IT Services	Clothing Store	Coffee Shop	Thrift / Vintage Store	Café	Hardware Store	Arcade	None	None
34	Vollewijk	Grocery Store	Café	Restaurant	Bakery	Snack Place	Plaza	Shopping Plaza	Market	Modern European Restaurant	Cheese Shop
35	Amstel III	Restaurant	Electronics Store	Asian Restaurant	Bistro	Fried Chicken Joint	Sandwich Place	Lounge	Food Court	Hotel	Gym
36	Bullewijk	Hotel	Restaurant	Café	Optical Shop	Indoor Play Area	Scandinavian Restaurant	Office	Fast Food Restaurant	Furniture / Home Store	Food & Drink Shop
40	Indische Buurt	Coffee Shop	Bakery	Modern European Restaurant	Middle Eastern Restaurant	Bar	Asian Restaurant	Plaza	Italian Restaurant	Restaurant	Grocery Store
41	Ijburg	Italian Restaurant	Coffee Shop	Bus Stop	Park	Gym / Fitness Center	Tram Station	Bistro	Asian Restaurant	Greek Restaurant	Farmers Market
43	Oud-Oost	Café	Turkish Restaurant	Coffee Shop	Market	Spiritual Center	Friterie	Beer Garden	Comfort Food Restaurant	Monument / Landmark	Shopping Mall
44	Watergraafsmeer	Fast Food Restaurant	Stadium	Playground	Cheese Shop	Supermarket	Restaurant	Chinese Restaurant	Museum	Drugstore	Café
45	Oostelijk Havengebied	Plaza	Pizza Place	Shopping Mall	Bus Stop	Fish Market	Restaurant	Chinese Restaurant	Bookstore	Dutch Restaurant	Coffee Shop

I show here the most popular categories within cluster 1. We can see that cluster 1 has a lot of restaurants, cafes, coffee shops, supermarkets, hotels and bars. Typical of popular neighborhoods.

	venue_category	freq
0	Restaurant	1.463930
1	Café	1.321395
2	Coffee Shop	1.239822
3	Supermarket	1.029846
4	Hotel	0.999570
5	Bar	0.925300
6	Italian Restaurant	0.870437
7	Bakery	0.762651
8	Bus Stop	0.624304
9	Snack Place	0.601377

## Cluster 2

Cluster 2 contains only 3 neighborhoods.

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
19	Banne Buiksloot	Bus Stop	Supermarket	Park	Restaurant	Bakery	Turkish Restaurant	Shopping Mall	None	None	None
21	Oostzanerwerf	Bus Stop	Supermarket	Pharmacy	Gym / Fitness Center	Shopping Mall	Furniture / Home Store	Bookstore	None	None	None
38	Bijlmer-Oost	Supermarket	Food & Drink Shop	Bus Stop	Shopping Mall	Discount Store	Bakery	None	None	None	None

Here the top 10 most common venues in this cluster for your reference. We can see that cluster 2 is caracterized for Bus Stops and Supermarkets.

	venue_category	freq
0	Bus Stop	0.756494
1	Supermarket	0.717532
2	Shopping Mall	0.317100
3	Bakery	0.226190
4	Park	0.166667
5	Discount Store	0.142857
6	Food & Drink Shop	0.142857
7	Pharmacy	0.090909
8	Gym / Fitness Center	0.090909
9	Furniture / Home Store	0.090909

## Cluster 3

*Cluster 3* contains only one neighborhood. This neighborhood is caracterized by its Habor/Marina, Play Ground and Park and Farm.

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
39	Gaasperdam Driemond	Harbor / Marina	Playground	Park	Farm	Nightclub	None	None	None	None	None

## Cluster 4

*Cluster 4* contains 4 neighborhoods.

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
28	Nieuwendammerdijk	Tennis Court	Bar	Bus Stop	Park	Indonesian Restaurant	None	None	None	None	None
32	Tuindorp Buiksloot	Park	Pharmacy	Ice Cream Shop	Bus Stop	Campground	Rest Area	Tennis Court	None	None	None
33	Tuindorp Nieuwendam	Park	Pharmacy	Bus Stop	Plaza	Indonesian Restaurant	None	None	None	None	None
37	Bijlmer-Centrum	Park	Construction & Landscaping	Bus Stop	Theater	None	None	None	None	None	None

This neighborhood is characterized by its park, bus stop, indonesia restaurants and tennis court and pharmacy.

	venue_category	freq
0	Park	1.283333
1	Bus Stop	0.658333
2	Indonesian Restaurant	0.366667
3	Tennis Court	0.325000
4	Pharmacy	0.291667
5	Bar	0.200000
6	Theater	0.166667
7	Construction & Landscaping	0.166667
8	Plaza	0.166667
9	Rest Area	0.125000

## Cluster 5

*Cluster 5* contains 4 neighborhoods.

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
6	Geuzenveld	Bus Stop	Supermarket	Tram Station	Turkish Restaurant	Trail	Grocery Store	Drugstore	Market	Convenience Store	Italian Restaurant
22	Tuindorp Oostzaan	Snack Place	Theater	Bus Stop	Plaza	Business Service	Baseball Field	Motorcycle Shop	None	None	None
26	Waterlandpleinbuurt	Snack Place	Bus Stop	Grocery Store	Fried Chicken Joint	Supermarket	Drugstore	Discount Store	Convenience Store	Concert Hall	None
42	Zeeburgereiland	Bus Stop	Snack Place	Tram Station	Café	Rock Club	None	None	None	None	None

This neighborhood is characterized by bus stop, snack place, tram station and supermarket.



	venue_category	freq
0	Bus Stop	0.811855
1	Snack Place	0.491342
2	Tram Station	0.320513
3	Supermarket	0.244755
4	Convenience Store	0.167832
5	Grocery Store	0.167832
6	Drugstore	0.167832
7	Café	0.166667
8	Rock Club	0.166667
9	Theater	0.142857

## Cluster 6

*Cluster 6* contains 2 neighborhoods. These neighborhoods are characterized by its soccer fields, gyms and clothing store.

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
24	Elzenhagen	Soccer Field	Gym / Fitness Center	Clothing Store	Gym	None	None	None	None	None	None
27	Buiksloterdijk	Soccer Field	Farm	Hotel	Bookstore	Monument / Landmark	Café	Pool	Rest Area	Bus Stop	Gym

	venue_category	freq
0	Soccer Field	0.464286
1	Gym	0.321429
2	Clothing Store	0.250000
3	Gym / Fitness Center	0.250000
4	Bus Stop	0.071429
5	Café	0.071429
6	Bookstore	0.071429
7	Monument / Landmark	0.071429
8	Pool	0.071429
9	Farm	0.071429

## Cluster 7

Cluster 7 contains 2 neighborhoods. This neighborhood is characterized by its Pharmacy, Shopping Mall, Supermarket and Furniture / Home Store.

	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
20	Kadoelen	Pharmacy	Shopping Mall	Supermarket	Furniture / Home Store	None	None	None	None	None	None

## 5. Discussion

There are some points that are important to discuss.

1) The result of the clustering depends on the venues and their categories. We noticed that for some neighborhoods, we did not get enough venues. And therefore, these neighborhoods are considered as outliers quite often because of the small amount of venues. We will have to check with another location data provider, for example Google Maps, to see if we get more information about those neighborhoods.

2) Although the global optimal for k-means was on  $k=2$ , the algorithm clusters some outliers together and therefore, we chose the first best local optimal to compensate this effect.

## 6. Conclusion

In this research, we clustered 45 Amsterdam neighborhoods into 9 clusters based on the category of the most popular venues.

29 out of 45 clusters were put on the same cluster. This is because they contain many restaurants, cafes, coffee shops, supermarkets, hotels and bars. Typical of popular neighborhoods.

4 neighborhoods were considered outliers by K-means. Mainly because Foursquare did not return enough venues for these locations.

Another 4 clusters (containing 2, 3, 4 and 4 neighborhoods) hold neighborhoods sharing mainly shopping mall, supermarkets, parks, farm and bus stops as most popular places. They are located outside the center of Amsterdam and share the characteristic of upcoming developed areas.

We conclude this notebook showing on the map how Amsterdam neighborhoods can be clustered based on their popular venues.

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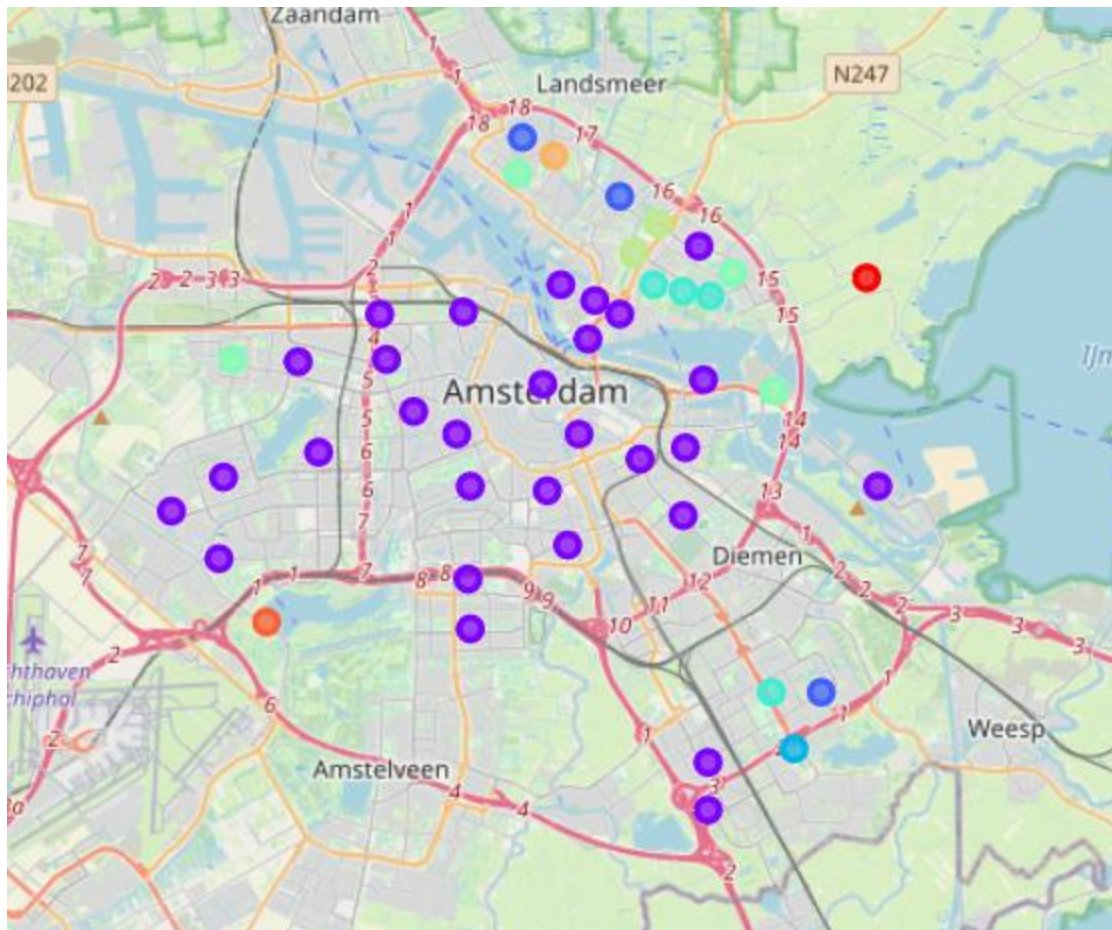


Figure 9. Clustering on the map