Neighborhood analysis of the City in Stuttgart, Germany

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Date: July 4, 2021

1 Introduction

1.1 Background

All over the world there are a lot of Cafes with different styles and different drinks and food. And all over the world, people love to go to Cafes for different reasons. E.g. they might meet with someone or they want to be alone to relax or to work on a project.
There are different reasons why people love to visit one Cafe while another one is completely empty. However one major key to success of a Cafe is its place. Not only the country and city, but also the neighborhood.

1.2 Problem

A friend of mine lives in Stuttgart and he wants to open a Cafe in Stuttgart. So he is facing the question which district and which neighborhood is the most suitable for opening a Cafe.
Since the success of a Cafe depends on the number of visitors, one might want to open a Cafe where there are a lot of people around in the neighborhood.
Regarding the neighborhood important factors could be:

- Are there shopping possibilities in the neighborhood? Some people might want to relax and drink a coffee after shopping.
- Are there restaurants in the neighborhood? After a lunch of dinner, some people might want to have dessert.
- Are there offices in the neighborhood?

This project aims to analyze the different districts and neighborhoods in Stuttgart to find out, which place is the most suitable for opening a Cafe.

1.3 Interest

Not only my friend, but anybody who wants to open a Cafe in Stuttgart would be interested in the analysis of the different neighborhoods and districts of Stuttgart. Also tourists and visitors in Stuttgart might be interested in the analysis.

2 Data acquisition

2.1 Data sources

For the analysis of the different districts and neighborhoods in Stuttgart, Wikipedia[1] will be used to find out the names and postal codes of the districts in Stuttgart.
With the postal codes, the Python library *geopy*[2] will be used to convert the address into coordinates (latitude and longitude).
The Foursquare API[3] will be used to get the venues around the given coordinates.

2.2 Use the data to solve the problem

We get the names of the districts in Stuttgart via web scraping wikipedia with the python library *BeautifulSoup*[4]. The result is the following list: Stuttgart-Mitte, Stuttgart-Nord, Stuttgart-Ost, Stuttgart-Süd, Stuttgart-West, Bad-Cannstatt, Birkach, Botnang, Degerloch, Feuerbach, Hedelfingen, Möhringen, Mühlhausen, Münster, Obertürkheim, Plieningen, Sillenbuch, Stammheim, Untertürkheim, Vaihingen, Wangen, Weilimdorf, Zuffenhausen.
We can go through the list of district names and web scrape the specific website of each district by appending the district name to the following string: *https://de.wikipedia.org/wiki/*.
In some cases we need to be careful, because the name of the website is not the district

1 https://de.wikipedia.org/wiki/Liste_der_Stadtbezirke_und_Stadtteile_von_Stuttgart
2 https://geopy.readthedocs.io/en/stable
3 https://foursquare.com
4 https://www.crummy.com/software/BeautifulSoup/bs4/doc

name only. The reason is that there are other places in Germany called like the district. So we need to change the name in the following way: the text *Birkach* becomes *Birkach_(Stuttgart)*.
The following list of postal codes is the result of web scraping the district names:
Stuttgart-Mitte: 70173, 70174, 70178, 70182
Stuttgart-Nord: 70174, 70191, 70192
Stuttgart-Ost: 70148-70190
Stuttgart-Süd: 70178, 70180, 70184, 70199, 70569
Stuttgart-West: 70176, 70178, 70193, 70197
Bad_Cannstatt: 70331-70378
Birkach_(Stuttgart): 70599
Botnang: 70195
Degerloch: 70597
Feuerbach_(Stuttgart): 70469, 70499
Hedelfingen: 70329
Möhringen_(Stuttgart): 70567, 70565
Mühlhausen_(Stuttgart): 70378, 70437
Münster_(Stuttgart): 70376
Obertürkheim: 70329
Plieningen: 70599
Sillenbuch: 70619
Stammheim_(Stuttgart): 70439
Untertürkheim: 70327
Vaihingen_(Stuttgart): 70563, 70565, 70569
Wangen_(Stuttgart): 70327
Weilimdorf: 70499
Zuffenhausen: 70435, 70437, 70439

In case of Stuttgart-Ost and Bad_Cannstatt there are a lot of postal codes, which can be identified by the hyphen in the returned postal codes: 70148-70190 and 70331-70378. In the following, we will concentrate on the 5 postal codes with the biggest population. For Stuttgart-Ost those are 70184, 70186, 70188, 70190 and 70327. For Bad_Cannstatt: 70332, 70372, 70374, 70376 and 70378.

To avoid duplicates in the resulting *pandas* Dataframe, we will append the postal code to the district name, in cases of districts with more than one postal code. One example would

be Stuttgart-Mitte. Here we have the postal codes 70173, 70174, 70178 and 70182. So the resulting names would be Stuttgart-Mitte_70173, Stuttgart-Mitte_70174, Stuttgart-Mitte_70178 and Stuttgart-Mitte_70182.

Some districts share the same postal code in Stuttgart. We will chain the district names and the shared postal code, e.g. Stuttgart-Ost-Untertürkheim-Wangen_70327 will be the name of the postal code 70327.

The first 5 rows of resulting dataframe look as follows:

	District	PostalCode
0	Stuttgart-Mitte_70173	70173
1	Stuttgart-Mitte_70182	70182
2	Stuttgart-Nord_70191	70191
3	Stuttgart-Nord_70192	70192
4	Stuttgart-Ost_70186	70186

The next step is to add the coordinates (latitude and longitude) to the postal codes. We will do this by using the python library *geopy*. We will loop through our dataframe and send a geocode request using the Nominatim package for each row (e.g. *70195, Stuttgart, Germany*) and store the result in a separate dataframe. The first 5 rows of the coordinates dataframe:

	PostalCode	Latitude	Longitude
0	70173	48.777808	9.178420
1	70182	48.774376	9.184793
2	70191	48.798102	9.182559
3	70192	48.795235	9.165006
4	70186	48.775952	9.207278

Next we will join the two dataframes to get the final dataframe which will be used in the analysis of the Stuttgart districts. Here is the head of the final dataframe:

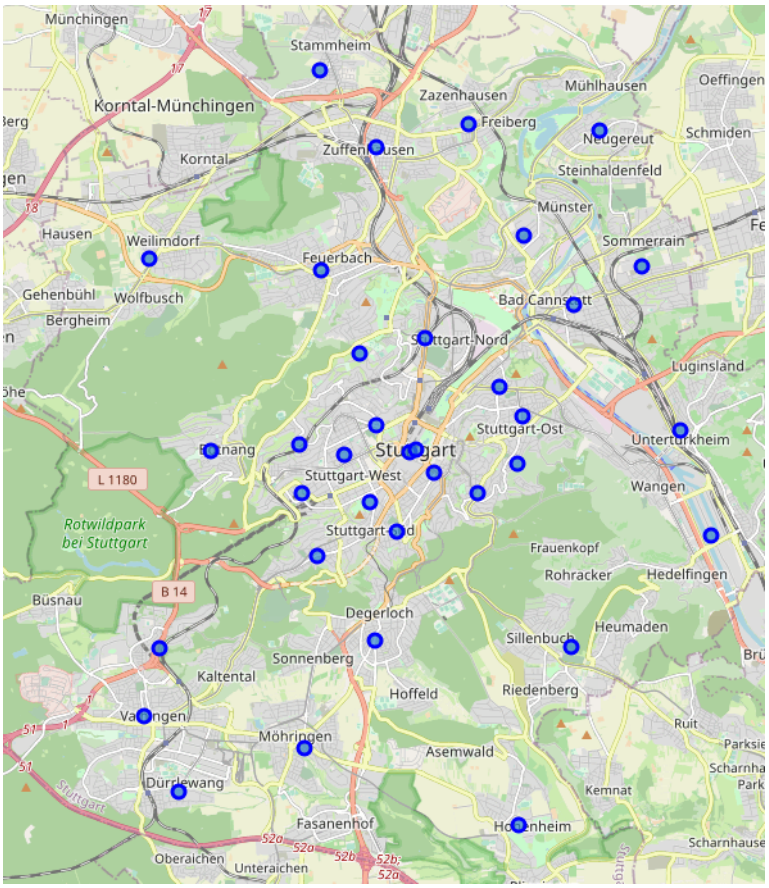
	District	PostalCode	Latitude	Longitude
0	Stuttgart-Mitte_70173	70173	48.777808	9.178420
1	Stuttgart-Mitte_70182	70182	48.774376	9.184793
2	Stuttgart-Nord_70191	70191	48.798102	9.182559
3	Stuttgart-Nord_70192	70192	48.795235	9.165006
4	Stuttgart-Ost_70186	70186	48.775952	9.207278

With the given postal codes, we will get all the venues in the radius of 500 meters around the coordinates and try to cluster the districts of Stuttgart into clusters with different venues. Then we will analyze those clusters and see if the problem described in chapter *1.2 Problem* can be solved with this clustering.

3 Methodology

3.1 Explore districts

To get an overview of the city and the distribution of the different districts, we will create a map of Stuttgart and mark all the districts from our dataframe in it. We will get the latitude and longitude values of Stuttgart by using the geopy library: 48.7784485, 9.1800132:



We can see that most of the districts are in the center of Stuttgart and the other districts are distributed around the center.

The next step is to get all venues for each district in Stuttgart by calling the Foursquare API and setting the radius to 500 meters. The head of the resulting dataframe looks like the following:

	District	District Latitude	District Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Stuttgart-Mitte_70173	48.777808	9.17842	Schlossplatz	48.778549	9.179855	Plaza
1	Stuttgart-Mitte_70173	48.777808	9.17842	Feinkost Böhm	48.778077	9.176317	Gourmet Shop
2	Stuttgart-Mitte_70173	48.777808	9.17842	Kleiner Schlossplatz	48.778394	9.176860	Plaza
3	Stuttgart-Mitte_70173	48.777808	9.17842	bungalow	48.776175	9.177970	Men's Store
4	Stuttgart-Mitte_70173	48.777808	9.17842	Old Bridge	48.780007	9.177899	Ice Cream Shop

To get an overview we will count how many venues were returned for each district:

District	District Latitude	District Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Bad_Cannstatt_70332	80	80	80	80	80	80
Bad_Cannstatt_70372	36	36	36	36	36	36
Bad_Cannstatt_70374	3	3	3	3	3	3
Botnang	4	4	4	4	4	4
Degerloch	14	14	14	14	14	14
Feuerbach_70469	16	16	16	16	16	16
Möhringen_70567	14	14	14	14	14	14
Sillenbuch	10	10	10	10	10	10
Stuttgart-Bad_Cannstatt-Mühlhausen_70378	2	2	2	2	2	2
Stuttgart-Bad_Cannstatt-Münster_70376	13	13	13	13	13	13
Stuttgart-Birkach-Plieningen_70599	10	10	10	10	10	10
Stuttgart-Feuerbach-Weilimdorf_70499	11	11	11	11	11	11
Stuttgart-Hedelfingen-Obertürkheim_70329	4	4	4	4	4	4
Stuttgart-Mitte-Nord_70174	24	24	24	24	24	24
Stuttgart-Mitte-Süd-West_70178	50	50	50	50	50	50
Stuttgart-Mitte_70173	100	100	100	100	100	100
Stuttgart-Mitte_70182	65	65	65	65	65	65
Stuttgart-Möhringen-Vaihingen_70565	5	5	5	5	5	5
Stuttgart-Mühlhausen-Zuffenhausen_70437	6	6	6	6	6	6
Stuttgart-Nord_70191	4	4	4	4	4	4
Stuttgart-Nord_70192	6	6	6	6	6	6
Stuttgart-Ost-Süd_70184	4	4	4	4	4	4
Stuttgart-Ost-Untertürkheim-Wangen_70327	11	11	11	11	11	11
Stuttgart-Ost_70186	7	7	7	7	7	7
Stuttgart-Ost_70188	23	23	23	23	23	23
Stuttgart-Ost_70190	14	14	14	14	14	14
Stuttgart-Stammheim-Zuffenhausen_70439	5	5	5	5	5	5
Stuttgart-Süd-Vaihingen_70569	5	5	5	5	5	5
Stuttgart-Süd_70180	38	38	38	38	38	38
Stuttgart-Süd_70199	12	12	12	12	12	12
Stuttgart-West_70176	44	44	44	44	44	44
Stuttgart-West_70193	5	5	5	5	5	5
Stuttgart-West_70197	20	20	20	20	20	20
Vaihingen_70563	32	32	32	32	32	32
Zuffenhausen_70435	22	22	22	22	22	22

As we can see most of the venues are in the center of Stuttgart (Stuttgart-Mitte). Also in Bad Cannstatt there are a lot of venues.

From the returned venues 148 unique categories can be curated. We will create a new

dataframe where the venue categories are separated via one hot encoding. To get an idea of how the resulting dataframe looks like, here is the head of it:

	District	African Restaurant	American Restaurant	Art Museum	Asian Restaurant	Athletics & Sports	BBQ Joint	Bakery	Bank	Bar	Beach Bar
0	Stuttgart-Mitte_70173	0	0	0	0	0	0	0	0	0	0
1	Stuttgart-Mitte_70173	0	0	0	0	0	0	0	0	0	0
2	Stuttgart-Mitte_70173	0	0	0	0	0	0	0	0	0	0
3	Stuttgart-Mitte_70173	0	0	0	0	0	0	0	0	0	0
4	Stuttgart-Mitte_70173	0	0	0	0	0	0	0	0	0	0

Next we will group rows by district name and take the mean of the frequency of occurrence of each category:

	District	African Restaurant	American Restaurant	Art Museum	Asian Restaurant	Athletics & Sports	BBQ Joint
0	Bad_Cannstatt_70332	0.000000	0.000000	0.0125	0.012500	0.000000	0.00
1	Bad_Cannstatt_70372	0.000000	0.000000	0.0000	0.027778	0.000000	0.00
2	Bad_Cannstatt_70374	0.000000	0.000000	0.0000	0.000000	0.000000	0.00
3	Botnang	0.000000	0.000000	0.0000	0.000000	0.000000	0.00
4	Degerloch	0.000000	0.071429	0.0000	0.000000	0.000000	0.00

Now we can order the venues by occurrence and list the top 5 venues for each district:

----Bad_Cannstatt_70332----

	venue	freq
0	German Restaurant	0.08
1	Plaza	0.06
2	Café	0.05
3	Bar	0.04
4	Sushi Restaurant	0.04

----Möhringen_70567----

	venue	freq
0	Hotel	0.14
1	Bakery	0.14
2	Middle Eastern Restaurant	0.14
3	Restaurant	0.07
4	Farm	0.07

----Stuttgart-Hedelfingen-Obertürkheim_70329----

	venue	freq
0	Supermarket	0.50
1	Fast Food Restaurant	0.25
2	Lounge	0.25
3	African Restaurant	0.00
4	Opera House	0.00

----Bad_Cannstatt_70372----

	venue	freq
0	Drugstore	0.08
1	Café	0.08
2	Bakery	0.06
3	Bar	0.06
4	Greek Restaurant	0.06

----Sillenbuch----

	venue	freq
0	Yoga Studio	0.1
1	Gym	0.1
2	Farmers Market	0.1
3	Shopping Mall	0.1
4	Chinese Restaurant	0.1

----Stuttgart-Mitte-Nord_70174----

	venue	freq
0	Italian Restaurant	0.12
1	Concert Hall	0.12
2	Hotel	0.08
3	German Restaurant	0.08
4	Botanical Garden	0.04

----Bad_Cannstatt_70374----

	venue	freq
0	Pizza Place	0.33
1	Metro Station	0.33
2	Taverna	0.33
3	African Restaurant	0.00
4	Park	0.00

----Stuttgart-Bad_Cannstatt-Mühlhausen_70378----

	venue	freq
0	Historic Site	0.5
1	Photography Studio	0.5
2	African Restaurant	0.0
3	Pedestrian Plaza	0.0
4	Nightclub	0.0

----Stuttgart-Mitte-Süd-West_70178----

	venue	freq
0	German Restaurant	0.14
1	Italian Restaurant	0.06
2	Bar	0.06
3	Turkish Restaurant	0.06
4	Spanish Restaurant	0.04

----Botnang----

	venue	freq
0	Supermarket	0.50
1	Bakery	0.25
2	Farmers Market	0.25
3	African Restaurant	0.00
4	Pedestrian Plaza	0.00

----Stuttgart-Bad_Cannstatt-Münster_70376----

	venue	freq
0	Bakery	0.15
1	Supermarket	0.15
2	Metro Station	0.15
3	Discount Store	0.08
4	Italian Restaurant	0.08

----Stuttgart-Mitte_70173----

	venue	freq
0	German Restaurant	0.07
1	Café	0.07
2	Bar	0.05
3	Plaza	0.05
4	Coffee Shop	0.04

----Degerloch----

	venue	freq
0	Supermarket	0.14
1	Bakery	0.14
2	Ice Cream Shop	0.07
3	American Restaurant	0.07
4	Grocery Store	0.07

----Stuttgart-Birkach-Plieningen_70599----

	venue	freq
0	Café	0.2
1	Restaurant	0.1
2	Bus Station	0.1
3	Garden	0.1
4	German Restaurant	0.1

----Stuttgart-Mitte_70182----

	venue	freq
0	Café	0.09
1	German Restaurant	0.08
2	Hotel	0.05
3	Plaza	0.05
4	African Restaurant	0.03

----Feuerbach_70469----

	venue	freq
0	Hotel	0.19
1	Restaurant	0.12
2	Italian Restaurant	0.06
3	Metro Station	0.06
4	Dessert Shop	0.06

----Stuttgart-Feuerbach-Weilimdorf_70499----

	venue	freq
0	Ice Cream Shop	0.18
1	Drugstore	0.18
2	Bakery	0.18
3	Supermarket	0.09
4	Italian Restaurant	0.09

----Stuttgart-Möhringen-Vaihingen_70565----

	venue	freq
0	Indian Restaurant	0.2
1	Italian Restaurant	0.2
2	Business Service	0.2
3	Supermarket	0.2
4	Food & Drink Shop	0.2

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----Stuttgart-Mühlhausen-Zuffenhausen_70437----
           venue  freq
0  Metro Station  0.33
1  Train Station  0.17
2          Hotel  0.17
3         Bakery  0.17
4           Park  0.17

----Stuttgart-Ost_70188----
            venue  freq
0     Supermarket  0.13
1  Ice Cream Shop  0.09
2         Bakery  0.09
3           Park  0.09
4   Metro Station  0.09

----Stuttgart-West_70176----
                venue  freq
0               Café  0.14
1  Italian Restaurant  0.09
2        Supermarket  0.07
3         Playground  0.05
4             Bakery  0.05

----Stuttgart-Nord_70191----
              venue  freq
0            Museum  0.25
1  German Restaurant  0.25
2       Beer Garden  0.25
3      Neighborhood  0.25
4              Park  0.00

----Stuttgart-Ost_70190----
                 venue  freq
0                Hotel  0.14
1                Café  0.14
2   Italian Restaurant  0.07
3        Metro Station  0.07
4  Fast Food Restaurant  0.07

----Stuttgart-West_70193----
                      venue  freq
0                Playground   0.4
1  South Indian Restaurant   0.2
2           Scenic Lookout   0.2
3       German Restaurant   0.2
4      African Restaurant   0.0

----Stuttgart-Nord_70192----
              venue  freq
0           Stadium  0.17
1    Thai Restaurant  0.17
2  Athletics & Sports  0.17
3   French Restaurant  0.17
4     Tennis Stadium  0.17

----Stuttgart-Stammheim-Zuffenhausen_70439----
              venue  freq
0      Metro Station   0.4
1              Hotel   0.2
2        Supermarket   0.2
3        Pizza Place   0.2
4  African Restaurant   0.0

----Stuttgart-West_70197----
                venue  freq
0         Supermarket  0.15
1        Dessert Shop  0.10
2   Spanish Restaurant  0.10
3    German Restaurant  0.10
4  Gym / Fitness Center  0.10

----Stuttgart-Ost-Süd_70184----
              venue  freq
0      Metro Station  0.50
1        Flower Shop  0.25
2   Greek Restaurant  0.25
3  African Restaurant  0.00
4        Opera House  0.00

----Stuttgart-Süd-Vaihingen_70569----
             venue  freq
0         Bus Stop   0.2
1  Sauna / Steam Room   0.2
2  German Restaurant   0.2
3             Bistro   0.2
4        Bus Station   0.2

----Vaihingen_70563----
                venue  freq
0  Italian Restaurant  0.09
1   Asian Restaurant  0.09
2              Plaza  0.06
3  Mexican Restaurant  0.06
4    Thai Restaurant  0.06

----Stuttgart-Ost-Untertürkheim-Wangen_70327----
             venue  freq
0           Bakery  0.18
1  Doner Restaurant  0.09
2    Grocery Store  0.09
3        Gastropub  0.09
4        Wine Shop  0.09

----Stuttgart-Süd_70180----
                venue  freq
0               Café  0.16
1                Bar  0.08
2  Vietnamese Restaurant  0.05
3          Supermarket  0.05
4           Restaurant  0.05

----Zuffenhausen_70435----
                venue  freq
0        Burger Joint  0.09
1          Restaurant  0.09
2           Drugstore  0.09
3      Ice Cream Shop  0.05
4  Japanese Restaurant  0.05

----Stuttgart-Ost_70186----
              venue  freq
0           Bakery  0.29
1         Bus Stop  0.14
2      Grocery Store  0.14
3  Italian Restaurant  0.14
4               Bar  0.14

----Stuttgart-Süd_70199----
             venue  freq
0           Bakery  0.17
1  German Restaurant  0.17
2   Business Service  0.08
3  French Restaurant  0.08
4         Bus Stop  0.08
```

Next we will create a new dataframe with the top 10 venues for each district:

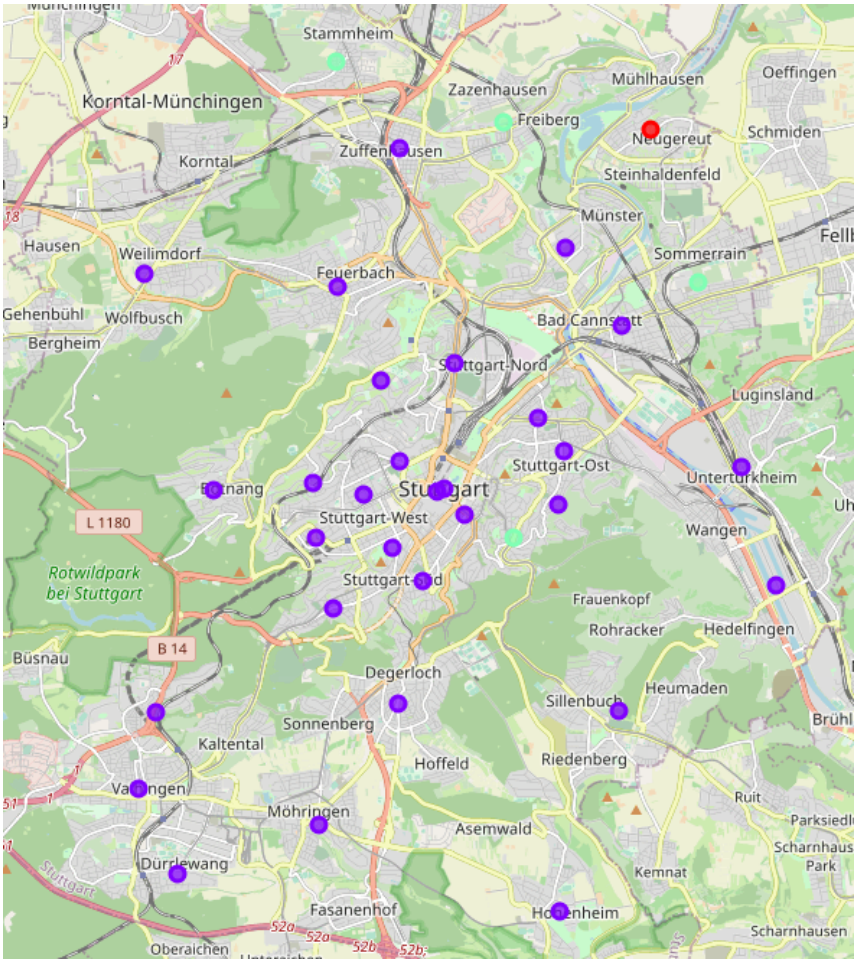
	District	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Bad_Cannstatt_70332	German Restaurant	Plaza	Café	Bar	Sushi Restaurant	History Museum	Clothing Store	Restaurant	Supermarket	Coffee Shop
1	Bad_Cannstatt_70372	Drugstore	Café	Bakery	Bar	Greek Restaurant	Metro Station	Hotel	Taverna	German Restaurant	Cupcake Shop
2	Bad_Cannstatt_70374	Pizza Place	Metro Station	Taverna	African Restaurant	Park	Nightclub	Opera House	Organic Grocery	Palace	Paper / Office Supplies Store
3	Botnang	Supermarket	Bakery	Farmers Market	African Restaurant	Pedestrian Plaza	Nightclub	Opera House	Organic Grocery	Palace	Paper / Office Supplies Store
4	Degerloch	Supermarket	Bakery	Ice Cream Shop	American Restaurant	Grocery Store	German Restaurant	French Restaurant	Playground	Drugstore	Shop & Service

Now we can cluster the districts by the top 10 venues and see if there are clusters where

it makes more sense open a Cafe.

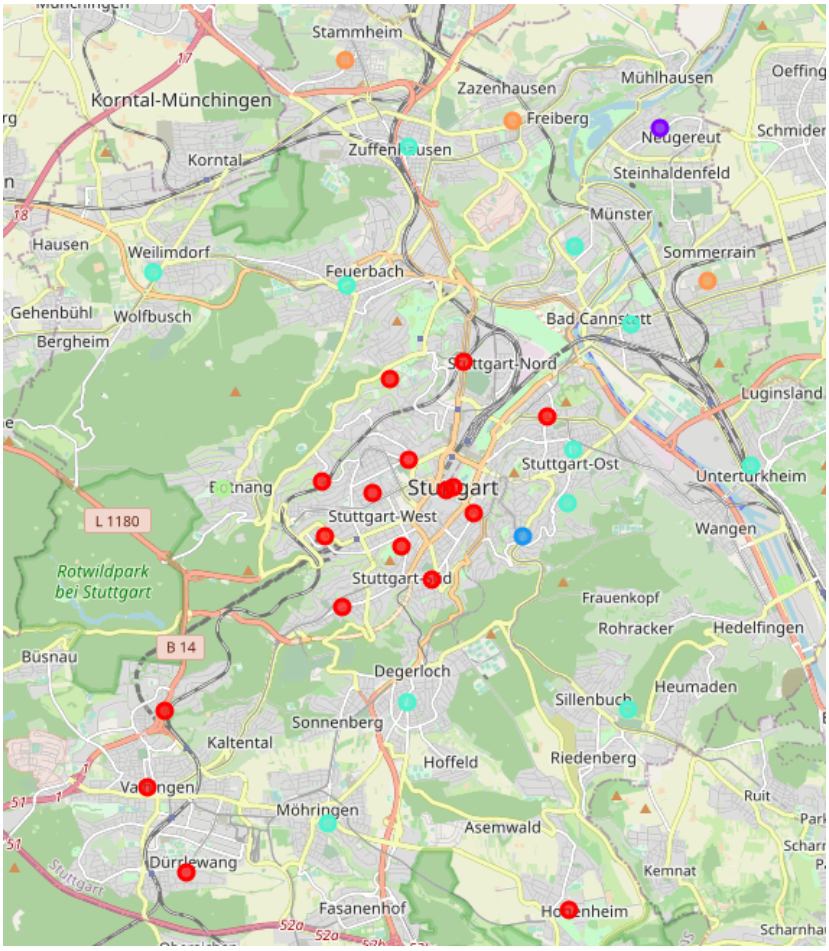
3.2 Cluster districts

To cluster the districts of Stuttgart we will use the k means clustering algorithm and set the k to be 3 for a first try. The resulting map of Stuttgart looks like the following:



The result of the k means clustering with 3 clusters is not really helpful, because in one cluster there are about 90% of the districts and in one cluster there is only one district.

We will try the k means clustering with 6 clusters. This is the result:



The result with 6 clusters looks more helpful for our case. Now we can examine the different clusters and check if we can recommend a specific cluster to my friend.

4 Results

The first cluster is the biggest one and it looks like most of the venues in this cluster belong to the categories coffee shop, cafe and restaurant:

	District	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	Stuttgart-Mitte_70173	German Restaurant	Café	Bar	Plaza	Coffee Shop	Sushi Restaurant	Clothing Store	Italian Restaurant	Ice Cream Shop	Boutique
1	Stuttgart-Mitte_70182	Café	German Restaurant	Hotel	Plaza	African Restaurant	Restaurant	History Museum	Italian Restaurant	Japanese Restaurant	Jazz Club
2	Stuttgart-Nord_70191	Museum	German Restaurant	Beer Garden	Neighborhood	Park	Nightclub	Opera House	Organic Grocery	Pool Hall	Palace
3	Stuttgart-Nord_70192	Stadium	Thai Restaurant	Athletics & Sports	French Restaurant	Tennis Stadium	Museum	Neighborhood	Nightclub	Opera House	Organic Grocery
6	Stuttgart-Ost_70190	Hotel	Café	Italian Restaurant	Metro Station	Fast Food Restaurant	Comfort Food Restaurant	Smoke Shop	Park	Pub	Burger Joint
7	Stuttgart-Süd_70180	Café	Bar	Vietnamese Restaurant	Supermarket	Restaurant	Italian Restaurant	African Restaurant	Organic Grocery	Drugstore	French Restaurant
8	Stuttgart-Süd_70199	Bakery	German Restaurant	Business Service	French Restaurant	Bus Stop	Indian Restaurant	General Entertainment	Plaza	Market	Brewery
9	Stuttgart-West_70176	Café	Italian Restaurant	Supermarket	Playground	Bakery	Bar	Pub	Drugstore	Coffee Shop	South Indian Restaurant
10	Stuttgart-West_70193	Playground	South Indian Restaurant	Scenic Lookout	German Restaurant	African Restaurant	Park	Opera House	Organic Grocery	Palace	Paper / Office Supplies Store
11	Stuttgart-West_70197	Supermarket	Dessert Shop	Spanish Restaurant	German Restaurant	Gym / Fitness Center	Japanese Restaurant	Grocery Store	Playground	Italian Restaurant	Food & Drink Shop
12	Bad_Cannstatt_70332	German Restaurant	Plaza	Café	Bar	Sushi Restaurant	History Museum	Clothing Store	Restaurant	Supermarket	Coffee Shop
20	Vaihingen_70563	Italian Restaurant	Asian Restaurant	Plaza	Mexican Restaurant	Thai Restaurant	Ice Cream Shop	Clothing Store	Coffee Shop	Construction & Landscaping	Electronics Store
22	Stuttgart-Mitte-Süd-West_70178	German Restaurant	Italian Restaurant	Bar	Turkish Restaurant	Spanish Restaurant	Café	Japanese Restaurant	Supermarket	Donut Shop	Coffee Shop
28	Stuttgart-Süd-Vaihingen_70569	Bus Stop	Sauna / Steam Room	German Restaurant	Bistro	Bus Station	Park	Nightclub	Opera House	Organic Grocery	Palace
29	Stuttgart-Birkach-Plieningen_70599	Café	Restaurant	Bus Station	Garden	German Restaurant	Palace	Park	Bus Stop	Hotel	Photography Studio
31	Stuttgart-Möhringen-Vaihingen_70565	Indian Restaurant	Italian Restaurant	Business Service	Supermarket	Food & Drink Shop	African Restaurant	Pedestrian Plaza	Organic Grocery	Palace	Paper / Office Supplies Store
32	Stuttgart-Mitte-Nord_70174	Italian Restaurant	Concert Hall	Hotel	German Restaurant	Botanical Garden	Pub	Record Shop	Food & Drink Shop	Park	Nightclub

The second has only one district and here there are some stores, an African Restaurant and a park:

	District	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
30	Stuttgart-Bad_Cannstatt-Mühlhausen_70378	Historic Site	Photography Studio	African Restaurant	Pedestrian Plaza	Nightclub	Opera House	Organic Grocery	Palace	Paper / Office Supplies Store	Park

Also the third cluster has only one district and here there are some shops, some Restaurants and a park:

	District	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
33	Stuttgart-Ost-Süd_70184	Metro Station	Flower Shop	Greek Restaurant	African Restaurant	Opera House	Organic Grocery	Palace	Paper / Office Supplies Store	Park	Pedestrian Plaza

The fourth cluster is also a bigger one and here there are a lot of different venues: we have some gyms, some hotels, restaurants, drugstores and parks:

	District	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
4	Stuttgart-Ost_70186	Bakery	Bus Stop	Grocery Store	Italian Restaurant	Bar	Trattoria/Osteria	Nightclub	Opera House	Organic Grocery	Palace
5	Stuttgart-Ost_70188	Supermarket	Ice Cream Shop	Bakery	Park	Metro Station	Gym	Drugstore	Pool	Diner	Food & Drink Shop
13	Bad_Cannstatt_70372	Drugstore	Café	Bakery	Bar	Greek Restaurant	Metro Station	Hotel	Taverna	German Restaurant	Cupcake Shop
16	Degerloch	Supermarket	Bakery	Ice Cream Shop	American Restaurant	Grocery Store	German Restaurant	French Restaurant	Playground	Drugstore	Shop & Service
17	Feuerbach_70469	Hotel	Restaurant	Italian Restaurant	Metro Station	Dessert Shop	Drugstore	Supermarket	Middle Eastern Restaurant	Greek Restaurant	Pub
18	Möhringen_70567	Hotel	Bakery	Middle Eastern Restaurant	Restaurant	Farm	Trattoria/Osteria	Supermarket	Café	Metro Station	Greek Restaurant
19	Sillenbuch	Yoga Studio	Gym	Farmers Market	Shopping Mall	Chinese Restaurant	Supermarket	Middle Eastern Restaurant	Metro Station	Drugstore	Bank
21	Zuffenhausen_70435	Burger Joint	Restaurant	Drugstore	Ice Cream Shop	Japanese Restaurant	Steakhouse	Breakfast Spot	Supermarket	German Pop-Up Restaurant	Shipping Store
23	Stuttgart-Ost-Untertürkheim-Wangen_70327	Bakery	Doner Restaurant	Grocery Store	Gastropub	Wine Shop	Pool	German Pop-Up Restaurant	German Restaurant	Metro Station	Greek Restaurant
25	Stuttgart-Bad_Cannstatt-Münster_70376	Bakery	Supermarket	Metro Station	Discount Store	Italian Restaurant	Hotel	Restaurant	German Restaurant	Theater	Middle Eastern Restaurant
34	Stuttgart-Feuerbach-Weilimdorf_70499	Ice Cream Shop	Drugstore	Bakery	Supermarket	Italian Restaurant	Kebab Restaurant	Shopping Mall	Insurance Office	Trattoria/Osteria	Museum

The fifth cluster has only two districts and the categories of the venues are also pretty mixed:

	District	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
15	Botnang	Supermarket	Bakery	Farmers Market	African Restaurant	Pedestrian Plaza	Nightclub	Opera House	Organic Grocery	Palace	Paper / Office Supplies Store
24	Stuttgart-Hedelfingen-Obertürkheim_70329	Supermarket	Fast Food Restaurant	Lounge	African Restaurant	Opera House	Organic Grocery	Palace	Paper / Office Supplies Store	Park	Pedestrian Plaza

The last cluster has three districts and the venue categories also don't really give a tendency:

	District	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
14	Bad_Cannstatt_70374	Pizza Place	Metro Station	Taverna	African Restaurant	Park	Nightclub	Opera House	Organic Grocery	Palace	Paper / Office Supplies Store
26	Stuttgart-Stammheim-Zuffenhausen_70439	Metro Station	Hotel	Supermarket	Pizza Place	African Restaurant	Park	Nightclub	Opera House	Organic Grocery	Palace
27	Stuttgart-Mühlhausen-Zuffenhausen_70437	Metro Station	Train Station	Hotel	Bakery	Park	Pedestrian Plaza	Nightclub	Opera House	Organic Grocery	Palace

5 Discussion

Based on the results from the previous chapter I would recommend my friend to open a Cafe in a district from the first cluster. In this cluster there are a lot of Parks, restaurants, shopping malls where a lot of people would be present. In the first section we discussed 3 questions which could be important factors for a successful Cafe:

- Are there shopping possibilities in the neighborhood?
- Are there restaurants in the neighborhood?
- Are there offices in the neighborhood?

For the first cluster all 3 questions can be answered with a Yes. Therefore the districts of this cluster suit best if someone wants to open a Cafe in Stuttgart.

6 Conclusion

In this study, I analyzed the districts of Stuttgart to be able to make a recommendation to a friend who wants to open a Cafe in Stuttgart and doesn't know in which district. I split the districts of Stuttgart into 6 clusters based on the venue category of the districts with the help of the K Means Clustering algorithm. After that I analyzed the categories of the clusters and answered the main questions that we asked in the introduction chapter. Since the cluster is still a big one, my friend might ask me to be more precise. So the next step would be to take only the districts of the first cluster and do some more clustering to have a better result.