

Final - Banking_in_Brussels-Copy1

November 23, 2020

1 Introduction & Business Problem :

Problem Background:

Since we are specialized in banking and insurances, one thing that is currently missing from our databases is a map showing the location of banks and bank branches in Brussels. This is a POC that could then be applied for larger regions covered in our products. This project wants to put a light on one factor that influence the locations of bank branches in establishing a bank branch network, location! We will be analyzing the locations of bank branches on the basis of their geographical characteristics.

This type of analysis could be of interest to our customers as there are different studies/analyses done on branch locations by banking institutions.

A study done in 2019 shows that while banking preferences have shifted to emphasize desktop and mobile convenience, 30% of respondents still prefer to go to the bank themselves, and despite the ability to perform many banking operations via mobile or on a desktop, the physical proximity of the bank still holds importance to banking customers. This shows that this issue is of interest to us. Finally this project is not only interesting to banks for its analytical value but to other users too as it provides an interesting visual tool that will improve their overall experience.

Problem Description:

The banks' branch strategy takes two forms. One of them is establishing a new branch and the other is relocating an existing branch. But in both cases, the question of location emerges as the most important issue. A branch is directly tied to the growth of bank, as it is the frontline of sales. Thus, when choosing a location for a branch, each bank takes various factors into account, among them competition, land value, growth potential, and the number of financial institutions. Good location means attracting more costumers.

Segmenting and Clustering banking Neighborhoods in Brussels

We will convert addresses into their equivalent latitude and longitude values. We will use Foursquare API to explore neighborhoods in Brussels. You will use the explore function to get all banks in each neighborhood, and then use this feature to group the neighborhoods into clusters. You will use the k-means clustering algorithm to complete this task. Finally, we will use the Folium library to visualize the banking neighborhoods in Brussels and their emerging clusters.

This will allow banks to study where they could install a new branch, either outside of the biggest clusters in which there is a higher demand and less competition, or inside the most popular ones in which they will have a broader customer range.

We will also add markdowns based on the specific research from our clients, these markdowns, in our example for KBC banks, allows us to see the specific locations of our bank. This a useful visualization tool.

Banking population in Brussels:

A quick search on Orbis gives us the following data:

n° of active banks in Brussels: 469

-> of which 293 are branches

Due to limitations on foursquare API's permissions we are only able to get the data for 50 banks in Brussels We will divide these entities in 5 different geographical clusters

Target Audience:

The Target audience for this project is Bureau van dijk and it's customers.

Success Criteria:

The success criteria of the project will be to show a good POC to Bureau van Dijk that will make them approve the project and a further exploration of this issue.

Here we will convert addresses into their equivalent latitude and longitude values and use the Foursquare API to explore banks in Brussels. We will then group the banks into clusters ny using the k-means clustering algorithm to complete this task. Finally, we will use the Folium library to visualize the banks in Brussels and their emerging clusters.

1.0.1 Import necessary Libraries

Before we get the data and start exploring it, let's download all the dependencies that we will need.

```
[1]: import numpy as np # library to handle data in a vectorized manner

import pandas as pd # library for data analysis
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)

import json # library to handle JSON files

!conda install -c conda-forge geopy --yes # uncomment this line if you haven't
    ↳ completed the Foursquare API lab
from geopy.geocoders import Nominatim # convert an address into latitude and
    ↳ longitude values

import requests # library to handle requests
from pandas.io.json import json_normalize # tranform JSON file into a pandas
    ↳ dataframe

# Matplotlib and associated plotting modules
import matplotlib.cm as cm
```

```
import matplotlib.colors as colors

# import k-means from clustering stage
from sklearn.cluster import KMeans

#!conda install -c conda-forge folium=0.5.0 --yes # uncomment this line if you
↳haven't completed the Foursquare API lab
import folium # map rendering library

print('Libraries imported.')
```

Collecting package metadata (current_repodata.json): done
Solving environment: done

==> WARNING: A newer version of conda exists. <==
current version: 4.9.1
latest version: 4.9.2

Please update conda by running

```
$ conda update -n base -c defaults conda
```

Package Plan

environment location: /home/jupyterlab/conda/envs/python

added / updated specs:
- geopy

The following packages will be downloaded:

package	build		
ca-certificates-2020.11.8	ha878542_0	145 KB	conda-forge
certifi-2020.11.8	py36h5fab9bb_0	150 KB	conda-forge
geographiclib-1.50	py_0	34 KB	conda-forge
geopy-2.0.0	pyh9f0ad1d_0	63 KB	conda-forge
Total:		392 KB	

The following NEW packages will be INSTALLED:

geographiclib conda-forge/noarch::geographiclib-1.50-py_0

```
geopy                                conda-forge/noarch::geopy-2.0.0-pyh9f0ad1d_0
```

The following packages will be UPDATED:

```
ca-certificates                    2020.6.20-hecda079_0 -->
2020.11.8-ha878542_0
certifi                            2020.6.20-py36h9880bd3_2 -->
2020.11.8-py36h5fab9bb_0
```

Downloading and Extracting Packages

```
certifi-2020.11.8      | 150 KB      | ##### | 100%
ca-certificates-2020   | 145 KB      | ##### | 100%
geopy-2.0.0            | 63 KB       | ##### | 100%
geographiclib-1.50     | 34 KB       | ##### | 100%
```

```
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
Libraries imported.
```

2 Download and Explore Dataset

Brussels has a total of 19 communes (or 22 if you divide Brussels Centre in 4 different ones) . In order to segment the communes and explore them, we will essentially need a dataset that contains them as well as the the latitude and logitude coordinates of each.

I wasn't able to find this dataset for free on the web so had to create it on my own using a mix of information found on the web and on bvd products, here is the link to the dataset:

“_____”

Load and explore the data

Next, let's load the data and let's take a quick look at our dataframe

2.0.1 Define Foursquare Credentials and Version

```
[2]: CLIENT_ID = 'ZW31EMD100ZKONNSV30GYDLCDSI2HDVXMDMEGB3ECTRYCMJP' # your_
      ↪Foursquare ID
CLIENT_SECRET = 'A44GWMGHYV2PMWGN3TOMYQHBOKJUIXESHZBGBLGRGGE5OKT' # your_
      ↪Foursquare Secret
VERSION = '20180604'
LIMIT = 1000
print('Your credentials:')
print('CLIENT_ID: ' + CLIENT_ID)
print('CLIENT_SECRET: ' + CLIENT_SECRET)
```

Your credentials:

```
CLIENT_ID: ZW31EMD100ZKONNSV30GYDLCD SI2HDVXMDMEGB3ECTRYCMJP
CLIENT_SECRET: A44GWGMHYV2PMWGN3TOMYQHBOKJJUIXESHZBG B LGRGGE50KT
```

Let's again assume that we are looking for banks in Brussels. So let's start by converting banks's address to their latitude and longitude coordinates. In order to define an instance of the geocoder, we need to define a user_agent. We will name our agent foursquare_agent, as shown below.

```
[3]: address = 'Brussels'

geolocator = Nominatim(user_agent="foursquare_agent")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print(latitude, longitude)
```

```
50.8465573 4.351697
```

2.1 Search for a specific venue category

```
https://api.foursquare.com/v2/venues/search?client_id=CLIENT_ID&client_secret=CLIENT_SECRET
```

Now, let's define a query to search for banks that are within 2000 metres from the Brussels center.

```
[4]: search_query = 'Bank'
radius = 2000
print(search_query + ' .... OK!')
```

```
Bank ... OK!
```

Define the corresponding URL

```
[5]: url = 'https://api.foursquare.com/v2/venues/search?
    ↪client_id={}&client_secret={}&ll={},{&v={}&query={}&radius={}&limit={}'
    ↪format(CLIENT_ID, CLIENT_SECRET, latitude, longitude, VERSION, search_query,
    ↪radius, LIMIT)
url
```

```
[5]: 'https://api.foursquare.com/v2/venues/search?client_id=ZW31EMD100ZKONNSV30GYDLCD
SI2HDVXMDMEGB3ECTRYCMJP&client_secret=A44GWGMHYV2PMWGN3TOMYQHBOKJJUIXESHZBG B LGRG
GE50KT&ll=50.8465573,4.351697&v=20180604&query=Bank&radius=2000&limit=1000'
```

Send the GET Request and examine the results

```
[6]: results = requests.get(url).json()
results
```

```
[6]: {'meta': {'code': 200, 'requestId': '5fbb9507c4e5cf3a8389c2b5'},
      'response': {'venues': [{'id': '4be7a760c5220f4724e2a8ca',
                              'name': 'National Bank of Belgium (Nationale Bank van België)',
```

```

'location': {'address': 'Boulevard de Berlaimontlaan 14',
'lat': 50.84900902656098,
'lng': 4.359598159790039,
'labeledLatLngs': [{'label': 'display',
'lat': 50.84900902656098,
'lng': 4.359598159790039}]},
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'postalCode': '1000',
'cc': 'BE',
'city': 'Brussel',
'state': 'Brussels Hoofdstedelijk Gewest',
'country': 'België',
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'1000 Brussel',
'België']],
'categories': [{'id': '4bf58dd8d48988d126941735',
'name': 'Government Building',
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'shortName': 'Government',
'icon': {'prefix':
'https://ss3.4sqi.net/img/categories_v2/building/government_',
'suffix': '.png'}},
'primary': True}],
'referralId': 'v-1606128903',
'hasPerk': False},
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'lng': 4.352683654069626}]},
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'cc': 'BE',
'city': 'Brussel',
'state': 'Brussels Hoofdstedelijk Gewest',
'country': 'België',
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'1000 Brussel',
'België']],
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'name': 'Bank',
'pluralName': 'Banks',
'shortName': 'Bank',
'icon': {'prefix':

```

```

'https://ss3.4sqi.net/img/categories_v2/shops/financial_',
  'suffix': '.png'},
  'primary': True]],
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  'hasPerk': False},
{'id': '501a4b8fe4b04946ea130b25',
 'name': 'The Royal Bank of Scotland RBS',
 'location': {'address': 'Kanselarijstraat 17A Rue de la Chancellerie',
 'lat': 50.84610263879461,
 'lng': 4.357124042737529,
 'labeledLatLngs': [{'label': 'display',
 'lat': 50.84610263879461,
 'lng': 4.357124042737529}]},
 'distance': 384,
 'postalCode': '1000',
 'cc': 'BE',
 'city': 'Brussel',
 'state': 'Brussels Hoofdstedelijk Gewest',
 'country': 'België',
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 'België']},
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 'shortName': 'Bank',
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'https://ss3.4sqi.net/img/categories_v2/shops/financial_',
 'suffix': '.png'},
 'primary': True]],
  'referralId': 'v-1606128903',
  'hasPerk': False},
{'id': '4ba0d860f964a520bf8137e3',
 'name': 'Bank Degroef Petercam',
 'location': {'address': "Nijverheidsstraat 44 Rue de l'Industrie",
 'lat': 50.84382,
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```

```

    '1040 Brussel',
    'België']},
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            'labeledLatLngs': [{ 'label': 'display',
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            'primary': True}],
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```



```

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        'primary': True}],
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Bank van België',
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'shortName': 'Factory',
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'https://ss3.4sqi.net/img/categories_v2/building/factory_',
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'primary': True}],
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{ 'id': '51e688a7498e383b2686b3e4',
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```

```

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```

```

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```

```

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        'state': 'Brussels Hoofdstedelijk Gewest',
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            'primary': True}],
            'referralId': 'v-1606128903',
            'hasPerk': False},
          {'id': '4dd4b80ed22d8e00fcd0703a',
            'name': 'Auditorium Nationale Bank',
            'location': {'address': 'Warmoesberg 61',
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              'lng': 4.357471168041229,
              'labeledLatLngs': [{'label': 'display',
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                'lng': 4.357471168041229}]},
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                  'shortName': 'Auditorium',

```

```

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'https://ss3.4sqi.net/img/categories_v2/building/auditorium_',
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      'referralId': 'v-1606128903',
      'hasPerk': False},
    {'id': '586385111e1de53813d1283f',
      'name': 'trust merchand bank',
      'location': {'lat': 50.827173,
        'lng': 4.35809,
        'labeledLatLngs': [{'label': 'display',
          'lat': 50.827173,
          'lng': 4.35809}]},
      'distance': 2204,
      'cc': 'BE',
      'country': 'België',
      'formattedAddress': ['België']],
      'categories': [{'id': '4bf58dd8d48988d10a951735',
        'name': 'Bank',
        'pluralName': 'Banks',
        'shortName': 'Bank',
        'icon': {'prefix':
'https://ss3.4sqi.net/img/categories_v2/shops/financial_',
          'suffix': '.png'},
          'primary': True}],
          'referralId': 'v-1606128903',
          'hasPerk': False},
        {'id': '50588721e4b05809b102053b',
          'name': 'NBB Personeelsingang',
          'location': {'lat': 50.848727270739026,
            'lng': 4.358211479286246,
            'labeledLatLngs': [{'label': 'display',
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              'lng': 4.358211479286246}]},
            'distance': 517,
            'cc': 'BE',
            'country': 'België',
            'formattedAddress': ['België']],
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              'name': 'Office',
              'pluralName': 'Offices',
              'shortName': 'Office',
              'icon': {'prefix':
'https://ss3.4sqi.net/img/categories_v2/building/default_',

```

```

    'suffix': '.png'},
    'primary': True]],
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    'hasPerk': False},
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     'location': {'address': "Boulevard de l'Impératrice 56 Keizerinlaan",
                  'lat': 50.84755940558577,
                  'lng': 4.357044696807861,
                  'labeledLatLngs': [{'label': 'display',
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                                       'lng': 4.357044696807861}]},
     'distance': 392,
     'postalCode': '1000',
     'cc': 'BE',
     'city': 'Brussel',
     'state': 'Brussels Hoofdstedelijk Gewest',
     'country': 'België',
     'formattedAddress': ["Boulevard de l'Impératrice 56 Keizerinlaan",
                          '1000 Brussel',
                          'België']},
     'categories': [{'id': '4bf58dd8d48988d124941735',
                     'name': 'Office',
                     'pluralName': 'Offices',
                     'shortName': 'Office',
                     'icon': {'prefix':
'https://ss3.4sqi.net/img/categories_v2/building/default_',
                           'suffix': '.png'}},
                     'primary': True]],
     'referralId': 'v-1606128903',
     'hasPerk': False},
    {'id': '4ca95fe7b0b8236a3dfdbce6',
     'name': 'Nagelmackers',
     'location': {'address': 'Sterrenkundelaan 23',
                  'lat': 50.85173708171644,
                  'lng': 4.3699431759992775,
                  'labeledLatLngs': [{'label': 'display',
                                       'lat': 50.85173708171644,
                                       'lng': 4.3699431759992775}]},
     'distance': 1406,
     'postalCode': '1210',
     'cc': 'BE',
     'city': 'Brussel',
     'state': 'Brussels Hoofdstedelijk Gewest',
     'country': 'België',
     'formattedAddress': ['Sterrenkundelaan 23', '1210 Brussel', 'België']},
     'categories': [{'id': '4bf58dd8d48988d10a951735',

```

```

    'name': 'Bank',
    'pluralName': 'Banks',
    'shortName': 'Bank',
    'icon': {'prefix':
'https://ss3.4sqi.net/img/categories_v2/shops/financial_',
    'suffix': '.png'},
    'primary': True}],
    'referralId': 'v-1606128903',
    'hasPerk': False},
{'id': '5002eb7fe4b0b51bff9371c5',
 'name': 'Bankstraat / Rue de la Banque (Bankstraat)',
 'location': {'address': 'Bankstraat / Rue de la Banque',
 'lat': 50.84919869326253,
 'lng': 4.360899031162262,
 'labeledLatLngs': [{'label': 'display',
 'lat': 50.84919869326253,
 'lng': 4.360899031162262}],
 'distance': 710,
 'cc': 'BE',
 'city': 'Brussel',
 'state': 'Brussels Hoofdstedelijk Gewest',
 'country': 'België',
 'formattedAddress': ['Bankstraat / Rue de la Banque',
 'Brussel',
 'België']},
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 'shortName': 'Road',
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'https://ss3.4sqi.net/img/categories_v2/travel/highway_',
 'suffix': '.png'},
 'primary': True}],
 'referralId': 'v-1606128903',
 'hasPerk': False},
{'id': '50dc18a1e4b0e3204382e96a',
 'name': 'Banque Carrefour de la Sécurité Sociale / Kruispuntbank van de
Sociale Zekerheid (Kruispuntbank van de Sociale Zekerheid)',
 'location': {'address': 'Willebroekkaai 38 Quai de Willebroeck',
 'crossStreet': 'Place des Armateurs / Redersplein',
 'lat': 50.86421200583674,
 'lng': 4.353092583490413,
 'labeledLatLngs': [{'label': 'display',
 'lat': 50.86421200583674,
 'lng': 4.353092583490413}],
 'distance': 1967,
 'postalCode': '1000',

```

```

    'cc': 'BE',
    'city': 'Brussel',
    'state': 'Brussels Hoofdstedelijk Gewest',
    'country': 'België',
    'formattedAddress': ['Willebroekkaai 38 Quai de Willebroeck (Place des
Armateurs / Redersplein)',
    '1000 Brussel',
    'België']],
    'categories': [{ 'id': '4bf58dd8d48988d126941735',
    'name': 'Government Building',
    'pluralName': 'Government Buildings',
    'shortName': 'Government',
    'icon': { 'prefix':
'https://ss3.4sqi.net/img/categories_v2/building/government_',
    'suffix': '.png'},
    'primary': True}],
    'referralId': 'v-1606128903',
    'hasPerk': False},
    { 'id': '5051b123e4b0253ca511c627',
    'name': 'Parking NBB',
    'location': { 'lat': 50.84900902656098,
    'lng': 4.359598159790039,
    'labeledLatLngs': [{ 'label': 'display',
    'lat': 50.84900902656098,
    'lng': 4.359598159790039}],
    'distance': 618,
    'cc': 'BE',
    'country': 'België',
    'formattedAddress': ['België']],
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    'name': 'Parking',
    'pluralName': 'Parking',
    'shortName': 'Parking',
    'icon': { 'prefix':
'https://ss3.4sqi.net/img/categories_v2/building/parking_',
    'suffix': '.png'},
    'primary': True}],
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    'hasPerk': False},
    { 'id': '563ceaa0cd108d475ee8cf4e',
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    'location': { 'address': 'Jourdanplein 34 Place Jourdan',
    'lat': 50.836629459133974,
    'lng': 4.381802479567753,
    'labeledLatLngs': [{ 'label': 'display',
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    'lng': 4.381802479567753}],

```

```

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'cc': 'BE',
'city': 'Etterbeek',
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'country': 'België',
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'1040 Etterbeek',
'België']],
'categories': [{ 'id': '4bf58dd8d48988d11b941735',
'name': 'Pub',
'pluralName': 'Pubs',
'shortName': 'Pub',
'icon': { 'prefix':
'https://ss3.4sqi.net/img/categories_v2/nightlife/pub_',
'suffix': '.png'},
'primary': True}],
'referralId': 'v-1606128903',
'hasPerk': False},
{'id': '4d2d9e9f853ff04de342cada',
'name': 'KBC BRUhav12',
'location': { 'address': 'Havenlaan 12 Avenue du Port',
'lat': 50.8613016360698,
'lng': 4.347210053730226,
'labeledLatLngs': [{ 'label': 'display',
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'lng': 4.347210053730226}],
'distance': 1671,
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'cc': 'BE',
'city': 'Molenbeek-Wersbeek',
'state': 'Vlaams-Brabant',
'country': 'België',
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'1080 Molenbeek',
'België']],
'categories': [{ 'id': '4bf58dd8d48988d124941735',
'name': 'Office',
'pluralName': 'Offices',
'shortName': 'Office',
'icon': { 'prefix':
'https://ss3.4sqi.net/img/categories_v2/building/default_',
'suffix': '.png'},
'primary': True}],
'referralId': 'v-1606128903',
'hasPerk': False},
{'id': '4ffe8a50e4b0970f4d4237ac',

```

```

'name': 'Magazijn Bankstraat NBB',
'location': {'address': 'Bankstraat',
'lat': 50.84886801830134,
'lng': 4.3601350386782025,
'labeledLatLngs': [{'label': 'display',
'lat': 50.84886801830134,
'lng': 4.3601350386782025}]},
'distance': 646,
'postalCode': '1000',
'cc': 'BE',
'city': 'Vlaams-Brabant',
'state': 'Vlaams-Brabant',
'country': 'België',
'formattedAddress': ['Bankstraat', '1000 Vlaams-Brabant', 'België']],
'categories': [{'id': '52e81612bcbc57f1066b7a36',
'name': 'Warehouse',
'pluralName': 'Warehouses',
'shortName': 'Warehouse',
'icon': {'prefix':
'https://ss3.4sqi.net/img/categories_v2/building/default_',
'suffix': '.png'}},
'primary': True}],
'referralId': 'v-1606128903',
'hasPerk': False},
{'id': '4e1eea8762840ee807451e89',
'name': 'Societe Generale Private Banking',
'location': {'lat': 50.846572901539986,
'lng': 4.359798813122637,
'labeledLatLngs': [{'label': 'display',
'lat': 50.846572901539986,
'lng': 4.359798813122637}]},
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'city': 'Brussel',
'state': 'Brussels Hoofdstedelijk Gewest',
'country': 'België',
'formattedAddress': ['Brussel', 'België']],
'categories': [],
'referralId': 'v-1606128903',
'hasPerk': False}}]}

```

Get relevant part of JSON and transform it into a *pandas* dataframe

```

[7]: # assign relevant part of JSON to venues
venues = results['response']['venues']

# tranform venues into a dataframe

```

```
dataframe = json_normalize(venues)
dataframe.head()
```

```
/home/jupyterlab/conda/envs/python/lib/python3.6/site-
packages/ipykernel_launcher.py:5: FutureWarning: pandas.io.json.json_normalize
is deprecated, use pandas.json_normalize instead
"""
```

```
[7]:
```

	id \
0	4be7a760c5220f4724e2a8ca
1	4e4cb6c3091afe9bcd673184
2	501a4b8fe4b04946ea130b25
3	4ba0d860f964a520bf8137e3
4	5130c68de4b0f82ce273d16d

	name \
0	National Bank of Belgium (Nationale Bank van B...
1	bpost banque / bpost bank
2	The Royal Bank of Scotland RBS
3	Bank Degroof Petercam
4	Euroclear Bank - Floor 12

	categories	referralId	hasPerk \
0	[{'id': '4bf58dd8d48988d126941735', 'name': 'G...	v-1606128903	False
1	[{'id': '4bf58dd8d48988d10a951735', 'name': 'B...	v-1606128903	False
2	[{'id': '4bf58dd8d48988d10a951735', 'name': 'B...	v-1606128903	False
3	[{'id': '4bf58dd8d48988d10a951735', 'name': 'B...	v-1606128903	False
4	[{'id': '4bf58dd8d48988d124941735', 'name': 'O...	v-1606128903	False

	location.address	location.lat	location.lng \
0	Boulevard de Berlaimontlaan 14	50.849009	4.359598
1	Boulevard Anspachlaan 1	50.850077	4.352684
2	Kanselarijstraat 17A Rue de la Chancellerie	50.846103	4.357124
3	Nijverheidsstraat 44 Rue de l'Industrie	50.843820	4.370449
4	NaN	50.856575	4.355321

	location.labeledLatLngs	location.distance \
0	[{'label': 'display', 'lat': 50.84900902656098...	618
1	[{'label': 'display', 'lat': 50.85007671716576...	397
2	[{'label': 'display', 'lat': 50.84610263879461...	384
3	[{'label': 'display', 'lat': 50.84382, 'lng': ...	1352
4	[{'label': 'display', 'lat': 50.85657462598756...	1143

	location.postalCode	location.cc	location.city \
0	1000	BE	Brussel
1	1000	BE	Brussel
2	1000	BE	Brussel

3	1040	BE	Brussel
4	NaN	BE	NaN

	location.state	location.country	\
0	Brussels Hoofdstedelijk Gewest		België
1	Brussels Hoofdstedelijk Gewest		België
2	Brussels Hoofdstedelijk Gewest		België
3	Brussels Hoofdstedelijk Gewest		België
4		NaN	België

	location.formattedAddress	venuePage.id	\
0	[Boulevard de Berlaimontlaan 14, 1000 Brussel,...		NaN
1	[Boulevard Anspachlaan 1, 1000 Brussel, België]		NaN
2	[Kanselarijstraat 17A Rue de la Chancellerie, ...		NaN
3	[Nijverheidsstraat 44 Rue de l'Industrie, 1040...		NaN
4		[België]	NaN

	location.neighborhood	location.crossStreet
0	NaN	NaN
1	NaN	NaN
2	NaN	NaN
3	NaN	NaN
4	NaN	NaN

Define information of interest and filter dataframe

```
[8]: # keep only columns that include venue name, and anything that is associated
      ↪with location
filtered_columns = ['name', 'categories'] + [col for col in dataframe.columns
      ↪if col.startswith('location.')] + ['id']
dataframe_filtered = dataframe.loc[:, filtered_columns]

# function that extracts the category of the venue
def get_category_type(row):
    try:
        categories_list = row['categories']
    except:
        categories_list = row['venue.categories']

    if len(categories_list) == 0:
        return None
    else:
        return categories_list[0]['name']

# filter the category for each row
dataframe_filtered['categories'] = dataframe_filtered.apply(get_category_type,
      ↪axis=1)
```

```
# clean column names by keeping only last term
dataframe_filtered.columns = [column.split('.')[0] for column in dataframe_filtered.columns]

dataframe_filtered
```

```
[8]:
```

	name \
0	National Bank of Belgium (Nationale Bank van B...
1	bpost banque / bpost bank
2	The Royal Bank of Scotland RBS
3	Bank Degroef Petercam
4	Euroclear Bank - Floor 12
5	Byblos Bank Belgium
6	Hello bank!
7	Musée de la Banque Nationale de Belgique / Mus...
8	Drukkerij Nationale Bank van België
9	MeDirect Bank
10	bpost Bank HQ
11	Bank Direct FX
12	Record Bank
13	Attijariwafa Bank Brussel
14	Auditorium Nationale Bank
15	Hello bank! pop-up
16	Hoofdkas nationale bank van België
17	Restaurant van de nationale bank
18	Refter Nationale Bank
19	Triodos Bank
20	Attijariwafa Bank
21	Bank Of China
22	Deutsche Bank Headquarters
23	Bank Of Baroda
24	Triodos Bank Bureau de Sécurité
25	KBC
26	Chaabi Bank
27	DHB Bank
28	The World Bank Group
29	Bank of New York Mellon
30	World Bank
31	NIBC Bank
32	KBC Bank
33	Chaabi Bank
34	Record Bank
35	AXA Bank
36	ING Bank
37	KBC
38	Euroclear

39	trust merchand bank
40	NBB Personeelsingang
41	Fintro
42	Nagelmackers
43	Bankstraat / Rue de la Banque (Bankstraat)
44	Banque Carrefour de la Sécurité Sociale / Krui...
45	Parking NBB
46	Beers Bank
47	KBC BRUhav12
48	Magazijn Bankstraat NBB
49	Societe Generale Private Banking

	categories \
0	Government Building
1	Bank
2	Bank
3	Bank
4	Office
5	Office
6	Office
7	History Museum
8	Factory
9	Office
10	Office
11	Financial or Legal Service
12	Bank
13	Bank
14	Auditorium
15	Pop-Up Shop
16	Distribution Center
17	Corporate Cafeteria
18	Corporate Cafeteria
19	Office
20	Bank
21	Office
22	Office
23	Building
24	Building
25	Bank
26	Bank
27	Bank
28	Non-Profit
29	Office
30	None
31	Office
32	Bank
33	Bank

34	Bank
35	Bank
36	Building
37	Bank
38	Office
39	Bank
40	Office
41	Office
42	Bank
43	Road
44	Government Building
45	Parking
46	Pub
47	Office
48	Warehouse
49	None

	address	lat	lng \
0	Boulevard de Berlaimontlaan 14	50.849009	4.359598
1	Boulevard Anspachlaan 1	50.850077	4.352684
2	Kanselarijstraat 17A Rue de la Chancellerie	50.846103	4.357124
3	Nijverheidsstraat 44 Rue de l'Industrie	50.843820	4.370449
4	NaN	50.856575	4.355321
5	Rue Montoyerstraat 10	50.841557	4.368451
6	Vooruitgangstraat 55 Rue du Progres	50.858809	4.359005
7	Warmoesberg 57 Rue Montagne aux Herbes potagères	50.849849	4.357275
8	Berlaimontlaan	50.849990	4.360487
9	Keizerinlaan 66	50.847730	4.357989
10	Markiesstraat 1 Rue du Marquis	50.847111	4.359184
11	Rue des Colonies 11 1000 Brussels	50.847373	4.357731
12	NaN	50.844021	4.352483
13	NaN	50.846018	4.347103
14	Warmoesberg 61	50.850008	4.357471
15	Wolvengracht 14 Rue du Fossé aux Loups	50.850554	4.353227
16	NaN	50.849295	4.360541
17	NaN	50.850077	4.357798
18	Wolvengracht	50.850032	4.357630
19	Hoogstraat 139/3 Rue Haute	50.838583	4.349611
20	Boulevard Maurice Lemonnier 126, 1000 City of ...	50.842264	4.343640
21	NaN	50.846325	4.369310
22	Avenue Marnixlaan 13-15	50.839183	4.363333
23	Wetstraat 28 Rue de la Loi	50.845608	4.369640
24	NaN	50.838495	4.349560
25	Grote Markt 16	50.846593	4.352892
26	Boulevard Du Midi 62	50.839787	4.341521
27	Rue Royale 168	50.851036	4.364554
28	Avenue Marnix 17	50.839680	4.363916

29	Rue montoyer 46	50.840565	4.372777
30	17 Avenue Marnix	50.839314	4.363837
31	Wetenschapsstraat 41	50.843989	4.372530
32	NaN	50.839446	4.336193
33	NaN	50.856495	4.339552
34	NaN	50.836258	4.368800
35	NaN	50.849171	4.377155
36	Kasteelstraat 10	50.861990	4.339762
37	NaN	50.847915	4.357022
38	Koning Albert II laan 1 Bld Roi Albert II	50.856330	4.356164
39	NaN	50.827173	4.358090
40	NaN	50.848727	4.358211
41	Boulevard de l'Impératrice 56 Keizerinlaan	50.847559	4.357045
42	Sterrenkundelaan 23	50.851737	4.369943
43	Bankstraat / Rue de la Banque	50.849199	4.360899
44	Willebroekkaai 38 Quai de Willebroeck	50.864212	4.353093
45	NaN	50.849009	4.359598
46	Jourdanplein 34 Place Jourdan	50.836629	4.381802
47	Havenlaan 12 Avenue du Port	50.861302	4.347210
48	Bankstraat	50.848868	4.360135
49	NaN	50.846573	4.359799

	labeledLatLngs	distance	postalCode	\
0	[{'label': 'display', 'lat': 50.84900902656098...	618	1000	
1	[{'label': 'display', 'lat': 50.85007671716576...	397	1000	
2	[{'label': 'display', 'lat': 50.84610263879461...	384	1000	
3	[{'label': 'display', 'lat': 50.84382, 'lng': ...	1352	1040	
4	[{'label': 'display', 'lat': 50.85657462598756...	1143	NaN	
5	[{'label': 'display', 'lat': 50.84155712182662...	1302	1000	
6	[{'label': 'display', 'lat': 50.85880893408551...	1457	1030	
7	[{'label': 'display', 'lat': 50.8498489732418,...	536	1000	
8	[{'label': 'display', 'lat': 50.84999040829540...	726	1000	
9	[{'label': 'display', 'lat': 50.84773009869129...	461	1000	
10	[{'label': 'display', 'lat': 50.84711144299797...	529	1000	
11	[{'label': 'display', 'lat': 50.84737311925018...	433	1000	
12	[{'label': 'display', 'lat': 50.84402087052202...	287	NaN	
13	[{'label': 'display', 'lat': 50.84601796322069...	328	NaN	
14	[{'label': 'display', 'lat': 50.85000815498056...	558	NaN	
15	[{'label': 'display', 'lat': 50.85055421845506...	457	1000	
16	[{'label': 'display', 'lat': 50.84929482825448...	692	NaN	
17	[{'label': 'display', 'lat': 50.85007651033101...	580	NaN	
18	[{'label': 'display', 'lat': 50.85003243623329...	568	1000	
19	[{'label': 'display', 'lat': 50.83858273896332...	899	1000	
20	[{'label': 'display', 'lat': 50.84226440493376...	741	1000	
21	[{'label': 'display', 'lat': 50.84632478345071...	1238	NaN	
22	[{'label': 'display', 'lat': 50.83918274990292...	1158	1000	
23	[{'label': 'display', 'lat': 50.84560844269968...	1265	1000	

24	[{'label': 'display', 'lat': 50.83849518857244...	909	NaN
25	[{'label': 'display', 'lat': 50.8465928891217,...	84	1000
26	[{'label': 'display', 'lat': 50.83978718325646...	1039	NaN
27	[{'label': 'display', 'lat': 50.85103582746153...	1032	NaN
28	[{'label': 'display', 'lat': 50.83968032276375...	1150	NaN
29	[{'label': 'display', 'lat': 50.84056518319231...	1624	1000
30	[{'label': 'display', 'lat': 50.8393137, 'lng'...	1174	NaN
31	[{'label': 'display', 'lat': 50.84398868852938...	1491	1040
32	[{'label': 'display', 'lat': 50.83944648458615...	1346	NaN
33	[{'label': 'display', 'lat': 50.85649458075187...	1397	NaN
34	[{'label': 'display', 'lat': 50.836258, 'lng':...	1661	NaN
35	[{'label': 'display', 'lat': 50.84917123675441...	1812	NaN
36	[{'label': 'display', 'lat': 50.86199, 'lng': ...	1911	NaN
37	[{'label': 'display', 'lat': 50.84791504136915...	403	NaN
38	[{'label': 'display', 'lat': 50.85632998876549...	1132	1210
39	[{'label': 'display', 'lat': 50.827173, 'lng':...	2204	NaN
40	[{'label': 'display', 'lat': 50.84872727073902...	517	NaN
41	[{'label': 'display', 'lat': 50.84755940558577...	392	1000
42	[{'label': 'display', 'lat': 50.85173708171644...	1406	1210
43	[{'label': 'display', 'lat': 50.84919869326253...	710	NaN
44	[{'label': 'display', 'lat': 50.86421200583674...	1967	1000
45	[{'label': 'display', 'lat': 50.84900902656098...	618	NaN
46	[{'label': 'display', 'lat': 50.83662945913397...	2387	1040
47	[{'label': 'display', 'lat': 50.8613016360698,...	1671	1080
48	[{'label': 'display', 'lat': 50.84886801830134...	646	1000
49	[{'label': 'display', 'lat': 50.84657290153998...	569	NaN

	cc	city	state	country \
0	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
1	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
2	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
3	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
4	BE	NaN	NaN	België
5	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
6	BE	Brussel (Schaarbeek)	Brussels Hoofdstedelijk Gewest	België
7	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
8	BE	Brussel	NaN	België
9	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
10	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
11	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
12	BE	NaN	NaN	België
13	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
14	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
15	BE	Brussel	Brussels Hoofdstedelijk Gewest	België
16	BE	NaN	NaN	België
17	BE	NaN	NaN	België
18	BE	Brussel	Brussels Hoofdstedelijk Gewest	België

19	BE	Bruxelles		NaN	België
20	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
21	BE	NaN		NaN	België
22	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
23	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
24	BE	NaN		NaN	België
25	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
26	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
27	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
28	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
29	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
30	BE	Elsene		NaN	België
31	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
32	BE	Sint-Gillis	Brussels	Hoofdstedelijk Gewest	België
33	BE	NaN		NaN	België
34	BE	NaN		NaN	België
35	BE	Brussel (Sint-Joost-ten-Node)	Brussels	Hoofdstedelijk Gewest	België
36	BE	Buggenhout		Oost-Vlaanderen	België
37	BE	NaN		NaN	België
38	BE	Sint-Joost / Saint-Josse		NaN	België
39	BE	NaN		NaN	België
40	BE	NaN		NaN	België
41	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
42	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
43	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
44	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België
45	BE	NaN		NaN	België
46	BE	Etterbeek	Brussels	Hoofdstedelijk Gewest	België
47	BE	Molenbeek-Wersbeek		Vlaams-Brabant	België
48	BE	Vlaams-Brabant		Vlaams-Brabant	België
49	BE	Brussel	Brussels	Hoofdstedelijk Gewest	België

```

                                formattedAddress \
0  [Boulevard de Berlaimontlaan 14, 1000 Brussel,...
1  [Boulevard Anspachlaan 1, 1000 Brussel, België]
2  [Kanselarijstraat 17A Rue de la Chancellerie, ...
3  [Nijverheidsstraat 44 Rue de l'Industrie, 1040...
4                                     [België]
5  [Rue Montoyerstraat 10, 1000 Brussel, België]
6  [Vooruitgangstraat 55 Rue du Progres, 1030 Bru...
7  [Warmoesberg 57 Rue Montagne aux Herbes potagè...
8  [Berlaimontlaan, 1000 Brussel, België]
9  [Keizerinlaan 66, 1000 Brussel, België]
10 [Markiesstraat 1 Rue du Marquis, 1000 Brussel,...
11 [Rue des Colonies 11 1000 Brussels (1000 Bruxe...
12                                     [België]
13 [Brussel, België]

```

14 [Warmoesberg 61, Brussel, België]
 15 [Wolvengracht 14 Rue du Fossé aux Loups, 1000 ...
 16 [België]
 17 [België]
 18 [Wolvengracht, 1000 Brussel, België]
 19 [Hoogstraat 139/3 Rue Haute, 1000 Bruxelles, B...
 20 [Boulevard Maurice Lemonnier 126, 1000 City of...
 21 [België]
 22 [Avenue Marnixlaan 13-15, 1000 Brussel, België]
 23 [Wetstraat 28 Rue de la Loi, 1000 Brussel, Be...
 24 [België]
 25 [Grote Markt 16, 1000 Brussel, België]
 26 [Boulevard Du Midi 62, Brussel, België]
 27 [Rue Royale 168, Brussel, België]
 28 [Avenue Marnix 17, Brussel, België]
 29 [Rue montoyer 46, 1000 Brussel, België]
 30 [17 Avenue Marnix, Elsene, België]
 31 [Wetenschapsstraat 41, 1040 Brussel, België]
 32 [Sint-Gillis, België]
 33 [België]
 34 [België]
 35 [Brussel (Sint-Joost-ten-Node), België]
 36 [Kasteelstraat 10, Buggenhout, België]
 37 [België]
 38 [Koning Albert II laan 1 Bld Roi Albert II, 12...
 39 [België]
 40 [België]
 41 [Boulevard de l'Impératrice 56 Keizerinlaan, 1...
 42 [Sterrenkundelaan 23, 1210 Brussel, België]
 43 [Bankstraat / Rue de la Banque, Brussel, België]
 44 [Willebroekkaai 38 Quai de Willebroeck (Place ...
 45 [België]
 46 [Jourdanplein 34 Place Jourdan, 1040 Etterbeek...
 47 [Havenlaan 12 Avenue du Port, 1080 Molenbeek, ...
 48 [Bankstraat, 1000 Vlaams-Brabant, België]
 49 [Brussel, België]

	neighborhood	crossStreet \
0	NaN	NaN
1	NaN	NaN
2	NaN	NaN
3	NaN	NaN
4	NaN	NaN
5	NaN	NaN
6	NaN	NaN
7	NaN	NaN
8	NaN	NaN

9		NaN	NaN
10	Quartier Royal		NaN
11		NaN	1000 Bruxelles
12		NaN	NaN
13		NaN	NaN
14		NaN	NaN
15		NaN	NaN
16		NaN	NaN
17		NaN	NaN
18		NaN	NaN
19		NaN	NaN
20		NaN	NaN
21		NaN	NaN
22	Europese wijk		NaN
23		NaN	NaN
24		NaN	NaN
25		NaN	NaN
26		NaN	NaN
27		NaN	NaN
28		NaN	NaN
29		NaN	NaN
30		NaN	NaN
31		NaN	NaN
32		NaN	NaN
33		NaN	NaN
34		NaN	NaN
35		NaN	NaN
36		NaN	NaN
37		NaN	NaN
38	Bruxelles-Ville, Brussels		NaN
39		NaN	NaN
40		NaN	NaN
41		NaN	NaN
42		NaN	NaN
43		NaN	NaN
44		NaN	Place des Armateurs / Redersplein
45		NaN	NaN
46		NaN	NaN
47		NaN	NaN
48		NaN	NaN
49		NaN	NaN

	id
0	4be7a760c5220f4724e2a8ca
1	4e4cb6c3091afe9bcd673184
2	501a4b8fe4b04946ea130b25
3	4ba0d860f964a520bf8137e3

4 5130c68de4b0f82ce273d16d
5 4ed87d2f7ee506bd298337c0
6 52ef770b498e1da3388522b0
7 51388d2ce4b0922770d57f21
8 52d55834498e074adc54ac5b
9 51e688a7498e383b2686b3e4
10 5a0022dd78782c1f8618cf7e
11 52faf76c11d2e8f612a89306
12 50dda18ae4b01e5ff1b3a17e
13 4e7351237d8b051837e1eacf
14 4dd4b80ed22d8e00fcd0703a
15 542ab5f4498e963179f649a5
16 577f38a2cd1054b94fc37994
17 55fff089498e70097cd89af2
18 4ff41fb1e4b083d14ae483b3
19 4c91d1f02626a1cd8d65356b
20 4efae8af9ab2e6685106543
21 4d1a0a12401db60c00cbfea4
22 4be7bdc99a54a593422d0911
23 4e9929519adffd1f47646e09
24 570bb66c498e08a797f6f5ad
25 4de37c5b52b1d38d298673a4
26 52d51abb498e414780650512
27 55969e8f498ebb611fc6eca5
28 51a5efa9498ef98f3f8ea2ad
29 4ece3a84a17c6864e4db404d
30 4f2a91f7e4b04e33ba896f92
31 4e9e9c172c5b47f3f521ae31
32 4e3595fad1649e45e3d2dc66
33 50ffe27be4b0f9825338c5aa
34 50c09a67e4b0cbe419883aa4
35 4ddcf42e52b177ff2e77bc48
36 4bcd62910687ef3b8fd8e0cc
37 4db6a4dfcda1c57c8286c515
38 4c165d5a82a3c9b65b2e00f9
39 586385111e1de53813d1283f
40 50588721e4b05809b102053b
41 5123775416489a93b4ebafbe
42 4ca95fe7b0b8236a3dfdbce6
43 5002eb7fe4b0b51bff9371c5
44 50dc18a1e4b0e3204382e96a
45 5051b123e4b0253ca511c627
46 563ceaa0cd108d475ee8cf4e
47 4d2d9e9f853ff04de342cada
48 4ffe8a50e4b0970f4d4237ac
49 4e1eea8762840ee807451e89

3 we are now adding markers to show where KBC banks are located in our map, this will allow our customers to have an immediate visual impact on the location of their banks

```
[56]: KBC = dataframe_filtered[dataframe_filtered['name'].str.contains('KBC')]
      KBC_11=KBC[["lat","lng","name"]]
      KBC_11
```

```
[56]:
```

	lat	lng	name
25	50.846593	4.352892	KBC
32	50.839446	4.336193	KBC Bank
37	50.847915	4.357022	KBC
47	50.861302	4.347210	KBC BRUhav12

Let's visualize the banks that are nearby

```
[10]: dataframe_filtered.name
```

```
[10]: 0    National Bank of Belgium (Nationale Bank van B...
      1                bpost banque / bpost bank
      2                The Royal Bank of Scotland RBS
      3                Bank Degroof Petercam
      4                Euroclear Bank - Floor 12
      5                Byblos Bank Belgium
      6                Hello bank!
      7    Musée de la Banque Nationale de Belgique / Mus...
      8                Drukkerij Nationale Bank van België
      9                MeDirect Bank
     10                bpost Bank HQ
     11                Bank Direct FX
     12                Record Bank
     13                Attijariwafa Bank Brussel
     14                Auditorium Nationale Bank
     15                Hello bank! pop-up
     16                Hoofdkas nationale bank van belgië
     17                Restaurant van de nationale bank
     18                Refter Nationale Bank
     19                Triodos Bank
     20                Attijariwafa Bank
     21                Bank Of China
     22                Deutsche Bank Headquarters
     23                Bank Of Baroda
     24                Triodos Bank Bureau de Sécurité
     25                KBC
     26                Chaabi Bank
     27                DHB Bank
     28                The World Bank Group
```

```

29             Bank of New York Mellon
30             World Bank
31             NIBC Bank
32             KBC Bank
33             Chaabi Bank
34             Record Bank
35             AXA Bank
36             ING Bank
37             KBC
38             Euroclear
39             trust merchand bank
40             NBB Personeelsingang
41             Fintro
42             Nagelmackers
43             Bankstraat / Rue de la Banque (Bankstraat)
44             Banque Carrefour de la Sécurité Sociale / Krui...
45             Parking NBB
46             Beers Bank
47             KBC BRUhav12
48             Magazijn Bankstraat NBB
49             Societe Generale Private Banking
Name: name, dtype: object

```

Let's visualize these items on the map around our location

```

[68]: venues_map = folium.Map(location=[latitude, longitude], zoom_start=13) #
      ↪generate map centred around brussels

# add the KBC banks as markers
for lat, lng, label_KBC in zip(KBC_ll.lat, KBC_ll.lng, KBC_ll.name):
    label_KBC = '{}'.format(label_KBC, parse_html=True)
    label_KBC = folium.Popup(label_KBC, parse_html=True)
    folium.Marker([lat, lng], popup=label_KBC).add_to(venues_map)

# add KBC
for lat, lng, label in zip(dataframe_filtered.lat, dataframe_filtered.lng,
      ↪dataframe_filtered.name):
    label = '{}'.format(label)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill = True,
        fill_color='blue',

```

```

        fill_opacity=0.6
    ).add_to(venues_map)

# display map
venues_map

```

[68]: <folium.folium.Map at 0x7f50ec2bf320>

Cluster Neighborhoods Run k-means to cluster the neighborhood into 5 clusters.

```

[12]: # set number of clusters
kclusters = 5

df_ll = dataframe_filtered[["lat","lng"]]
df_names = dataframe_filtered[["name"]]

print(df_ll)
# run k-means clustering
kmeans = KMeans(n_clusters=kclusters, random_state=0).fit(df_ll)

# check cluster labels generated for each row in the dataframe
kmeans.labels_[0:40]

```

	lat	lng
0	50.849009	4.359598
1	50.850077	4.352684
2	50.846103	4.357124
3	50.843820	4.370449
4	50.856575	4.355321
5	50.841557	4.368451
6	50.858809	4.359005
7	50.849849	4.357275
8	50.849990	4.360487
9	50.847730	4.357989
10	50.847111	4.359184
11	50.847373	4.357731
12	50.844021	4.352483
13	50.846018	4.347103
14	50.850008	4.357471
15	50.850554	4.353227
16	50.849295	4.360541
17	50.850077	4.357798
18	50.850032	4.357630
19	50.838583	4.349611
20	50.842264	4.343640
21	50.846325	4.369310

```

22  50.839183  4.363333
23  50.845608  4.369640
24  50.838495  4.349560
25  50.846593  4.352892
26  50.839787  4.341521
27  50.851036  4.364554
28  50.839680  4.363916
29  50.840565  4.372777
30  50.839314  4.363837
31  50.843989  4.372530
32  50.839446  4.336193
33  50.856495  4.339552
34  50.836258  4.368800
35  50.849171  4.377155
36  50.861990  4.339762
37  50.847915  4.357022
38  50.856330  4.356164
39  50.827173  4.358090
40  50.848727  4.358211
41  50.847559  4.357045
42  50.851737  4.369943
43  50.849199  4.360899
44  50.864212  4.353093
45  50.849009  4.359598
46  50.836629  4.381802
47  50.861302  4.347210
48  50.848868  4.360135
49  50.846573  4.359799

```

```

[12]: array([1, 1, 1, 4, 1, 4, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 4,
            2, 4, 0, 1, 0, 1, 2, 4, 2, 4, 0, 3, 2, 4, 3, 1, 1, 2], dtype=int32)

```

Let's create a new dataframe that includes the cluster as well as the top 10 venues for each neighborhood.

```

[13]: # add clustering labels
df_names.insert(0, 'Cluster Labels', kmeans.labels_)
print(df_names)
banks_merged = dataframe_filtered[["name", "lat", "lng"]]

# merge df_names with banks_merged to add latitude/longitude for each bank
banks_merged = banks_merged.join(df_names.set_index('name'), on='name')

banks_merged.head() # check the last columns!

```

	Cluster Labels	name
0	1	National Bank of Belgium (Nationale Bank van B...
1	1	bpost banque / bpost bank

2	1	The Royal Bank of Scotland RBS
3	4	Bank Degroof Petercam
4	1	Euroclear Bank - Floor 12
5	4	Byblos Bank Belgium
6	1	Hello bank!
7	1	Musée de la Banque Nationale de Belgique / Mus...
8	1	Drukkerij Nationale Bank van België
9	1	MeDirect Bank
10	1	bpost Bank HQ
11	1	Bank Direct FX
12	1	Record Bank
13	0	Attijariwafa Bank Brussel
14	1	Auditorium Nationale Bank
15	1	Hello bank! pop-up
16	1	Hoofdkas nationale bank van België
17	1	Restaurant van de nationale bank
18	1	Refter Nationale Bank
19	0	Triodos Bank
20	0	Attijariwafa Bank
21	4	Bank Of China
22	2	Deutsche Bank Headquarters
23	4	Bank Of Baroda
24	0	Triodos Bank Bureau de Sécurité
25	1	KBC
26	0	Chaabi Bank
27	1	DHB Bank
28	2	The World Bank Group
29	4	Bank of New York Mellon
30	2	World Bank
31	4	NIBC Bank
32	0	KBC Bank
33	3	Chaabi Bank
34	2	Record Bank
35	4	AXA Bank
36	3	ING Bank
37	1	KBC
38	1	Euroclear
39	2	trust merchand bank
40	1	NBB Personeelsingang
41	1	Fintro
42	4	Nagelmackers
43	1	Bankstraat / Rue de la Banque (Bankstraat)
44	3	Banque Carrefour de la Sécurité Sociale / Krui...
45	1	Parking NBB
46	4	Beers Bank
47	3	KBC BRUhav12
48	1	Magazijn Bankstraat NBB
49	1	Societe Generale Private Banking

```
[13]:
```

	name	lat	lng	\
0	National Bank of Belgium (Nationale Bank van B...	50.849009	4.359598	
1	bpost banque / bpost bank	50.850077	4.352684	
2	The Royal Bank of Scotland RBS	50.846103	4.357124	
3	Bank Degroef Petercam	50.843820	4.370449	
4	Euroclear Bank - Floor 12	50.856575	4.355321	

Cluster Labels	
0	1
1	1
2	1
3	4
4	1

Finally, let's visualize the resulting clusters

```
[67]: # create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i + x + (i*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(banks_merged['lat'], banks_merged['lng'],
    ↪banks_merged['name'], banks_merged['Cluster Labels']):
    label = '{}'.format(poi)
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters)

# add the KBC banks as markers
for lat, lng, label_KBC in zip(KBC_ll.lat, KBC_ll.lng, KBC_ll.name):
    label_KBC = '{}'.format(label_KBC)
    label_KBC = folium.Popup(str(label_KBC) + ' Cluster ' + str(cluster),
    ↪parse_html=True)
    folium.Marker([lat, lng], popup=label_KBC).add_to(map_clusters)
```



```
map_clusters
```

```
[67]: <folium.folium.Map at 0x7f50ec064240>
```

```
[ ]:
```

```
[ ]:
```