The Wine Alliance

Applied Data Science - Coursera

Capstone Project Course

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Business Problem

In May 25th we celebrate the National Wine Day in Brazil. All enthusiasts participates on a two weeks of appreciation, learning sections and winery visits around the country. This event promotes the interchange of producers, wine shops and consumers moving all economy around the wine.
The tourism in the city of São Paulo is in the rout of the event.
Now imagine we want to choose some Wine Bars in the city to organize a large alliance between them to promote the consumers interchange over the Wine shops.
The Wine shops need to be well known and we are looking for somehow connections between them.

Data

The data we choose to select the wine bars that can participate on this alliance are the stores with high recommendations and are part of a network based on the public.

So, we need to answer two questions:

- Which wine bars in São Paulo are best evaluated?
- Is the wine bars connected? Which winery shares the same public?

To answer these questions we can analyze the wine shops listed in the Foursquare API in the city of São Paulo, regarding the following points:

- Check the rank of wine bars (the first 100th)

Wine bar	Ranking
WineBarA	1
WineBarB	2
WineBarC	3
WineBarC	4
WineBar...	...
WineShopX	100

- A network representation can be done connecting stores who shares the same consumer (signalised by the likes or tips).

Wine Store	Conections
WineBarA	WineBarB, WineBarC
WineBarB	WineBarA, WineBarC, WineBarD, WineBarX
WineBarC	...

Import the libraries

In [1]:
```
import numpy as np # library to handle data in a vectorized manner
import pandas as pd # library for data analsysis
import requests as rq# library to handle requests

# Matplotlib and associated plotting modules
import matplotlib.cm as cm
import matplotlib.colors as colors
import matplotlib.pyplot as plt
import folium # map rendering library

#to deal with web sites information
from bs4 import BeautifulSoup

# to clustering data
from sklearn.cluster import KMeans

#to creating and manipulating complex networks
import networkx as nx

# convert an address into latitude and longitude values
from geopy.geocoders import Nominatim

# To work with word clouds
from wordcloud import WordCloud, STOPWORDS
stopwords = set(STOPWORDS)
from PIL import Image # converting images into arrays
```

Get the Wine Shops in São Paulo

In [2]:
```
# the localization of São Paulo and create a DataFrame with the inputs

latitude = -23.5474277
longitude = -46.637165

dfwinebars=pd.DataFrame(data={'City':['São Paulo'], 'Latitude':[latitude], 'Longitude':[longitude], 'Query':['wine']})
dfwinebars
```

Out[2]:

	City	Latitude	Longitude	Query
0	São Paulo	-23.547428	-46.637165	wine

In [3]:
```
# hidden_cell
# credentials to acces the Foursquare API
CLIENT_ID = 'xxx' # your Foursquare ID
CLIENT_SECRET = 'xxx' # your Foursquare Secret
VERSION = '20180605' # Foursquare API version
```

In [4]:
```
# get the top 100 wine bars that are in São paulo  (from the center city 10km radius)
def getNearbyVenues(names, latitudes, longitudes, Query, radius=10000,LIMIT=100):

    venues_list=[]
    for name, lat, lng, quer in zip(names, latitudes, longitudes, Query):
       # print(name)

        # create the API request URL
        url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&query={}&limit={}
            CLIENT_ID,
            CLIENT_SECRET,
            VERSION,
            lat,
            lng,
            radius,
            quer,
            LIMIT
            )
#         print(url)
        # make the GET request
        results = rq.get(url).json()["response"]['groups'][0]['items']

        # return only relevant information for each nearby venue
        venues_list.append([(
            name,
            v['venue']['name'],
            v['venue']['id'],
            v['venue']['location']['lat'],
            v['venue']['location']['lng'],
            v['venue']['categories'][0]['name']) for v in results])

    nearby_venues = pd.DataFrame([item for venue_list in venues_list for item in venue_list])
    nearby_venues.columns = ['City',
                  'Venue',
                  'VenueId',
                  'Latitude',
                  'Longitude',
                  'Category']
    return(nearby_venues)
```

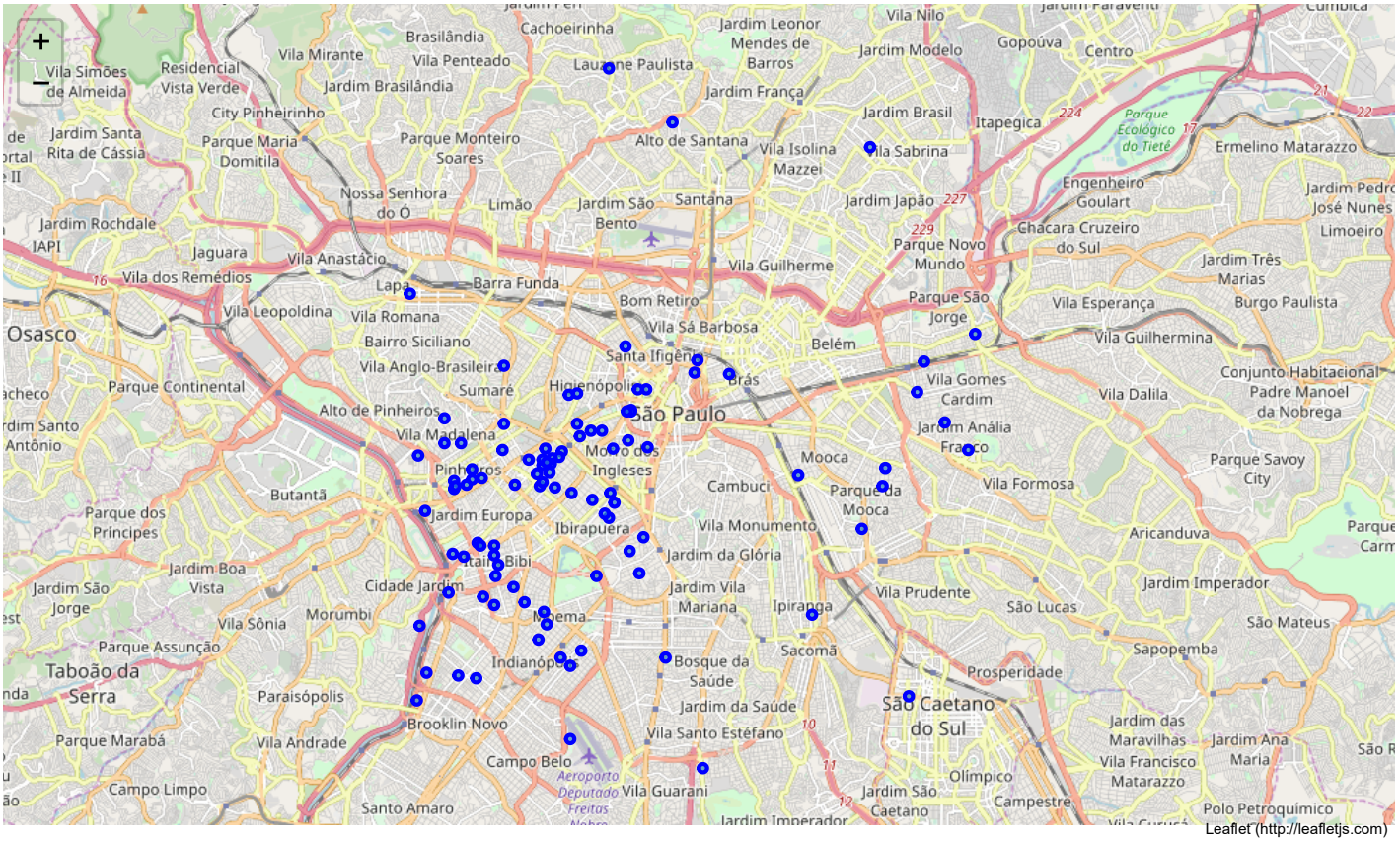
In [5]:
```
SPwinebars = getNearbyVenues(names=dfwinebars['City'],
                                   latitudes=dfwinebars['Latitude'],
                                   longitudes=dfwinebars['Longitude'],
                                   Query=dfwinebars['Query']
                                  )
SPwinebars.head()
```

Out[5]:

	City	Venue	VenueId	Latitude	Longitude	Category
0	São Paulo	Banca do Ramon	4d9750972bd6f04dd4444c50	-23.541517	-46.629454	Wine Shop
1	São Paulo	Mistral	4bd30fae462cb7132169dd07	-23.558903	-46.649762	Wine Shop
2	São Paulo	Adega Central	507dd519e4b085ca2d92e53a	-23.545373	-46.641324	Wine Shop
3	São Paulo	Casa Flora	4d6e898b29586dcb9accb4f1	-23.541938	-46.620670	Wine Bar
4	São Paulo	Empório Frei Caneca	4b5af5f6f964a52068dc28e3	-23.554753	-46.652374	Liquor Store

In [9]:
```
# create map of São Paulo using latitude and longitude values
map_local = folium.Map(location=[latitude, longitude], zoom_start=12)

# add markers to map
for lat, lng, venue, categ in zip(SPwinebars['Latitude'], SPwinebars['Longitude'], SPwinebars['Venue'], SPwinebars['Category']):
    label = '{}, {}'.format(venue, categ)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=3,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7).add_to(map_local)

map_local
```

Out[9]:



Get the likes from foursquare API for each wine shop

In [10]:
```
def getUsersLiked(venue):

    users_list=pd.DataFrame([])
    for ident in (venue):
        url = 'https://api.foursquare.com/v2/venues/{}/likes?&client_id={}&client_secret={}&v={}'.format(
                ident,
                CLIENT_ID,
                CLIENT_SECRET,
                VERSION
               )
        # make the GET request
        req=rq.get(url).json()["response"]["likes"]["items"]
        results = pd.DataFrame.from_dict(data=req).id
        for i, likers in enumerate(results):
            z=pd.DataFrame(data=[results[i]],index=[ident])
            users_list=pd.concat([users_list,z])
    # return only relevant information
    users_list.reset_index(inplace=True)
    users_list.columns=['VenueId','UserId']
    return(users_list)
```

In [11]:
```
users = getUsersLiked(venue=SPwinebars['VenueId'])
users.head()
```

Out[11]:

	VenueId	UserId
0	4d9750972bd6f04dd4444c50	23187623
1	4d9750972bd6f04dd4444c50	8813332
2	4d9750972bd6f04dd4444c50	21654585
3	4bd30fae462cb7132169dd07	86043214
4	4bd30fae462cb7132169dd07	10125361

In [12]:
```
sharedf=[]
sharedf=users.groupby(['UserId'], as_index=False, sort=False).aggregate(lambda x:','.join(x))
sharedf.head()
```

Out[12]:

	UserId	VenueId
0	23187623	4d9750972bd6f04dd4444c50
1	8813332	4d9750972bd6f04dd4444c50
2	21654585	4d9750972bd6f04dd4444c50
3	86043214	4bd30fae462cb7132169dd07,4bbfb381461576b0f5077932
4	10125361	4bd30fae462cb7132169dd07

Note: Due to the limitations of my acount, the Foursquare API limits the number of likers to 2 or 3

As alternative, I decided to take the tips directly from the website

In [13]:
```
# Subroutine to acces the website of venue's Foursquare and filter the relevant information from the code
# Relevant information: Number of tips for each venue, Name of the user who giv the tip and tip description.
def getUsersLikedWeb(venue):
    users_list=pd.DataFrame([])
    users_tips=pd.DataFrame([])

    for ident in (venue):
        foursquare_link='https://pt.foursquare.com/v/{}'.format(ident)
        raw_html= rq.get(foursquare_link).text
        html = BeautifulSoup(raw_html, 'html.parser')
        z=0
        d=False
        for i, a in enumerate(html.select('a')):
            if a.text!='':
                if a.text.find('Dicas ')!=-1:
                        z=int(a.text[a.text.find(' '):].replace(".", ""))
                        num_tips=z
                        if z > 50: z=50
                if a.text.find('login')!=-1:
                    d=True
                    continue
                if a.text.find('Leia mais')!=-1:
                    continue
                if d==True and z > 0:
                    data=[{'VenueId':ident, 'UserName':a.text, 'Venue´s Number of Tips':num_tips}]
                    likesdf=pd.DataFrame(data)
                    users_list=pd.concat([users_list,likesdf])
                    z=z-1
                    if z==0:break

        z=0
        d=False
        for i, a in enumerate(html.select('li')):
            if a.text!='':
                if a.text.find('Dicas ')==0 and len(a.text)<=10:
                        z=int(a.text[a.text.find(' '):].replace(".", ""))
                        num_tips=z
                        if z > 50: z=50
                if a.text.find('Recente')!=-1:
                    d=True
                    continue
                if a.text.find('Sobre')!=-1:
                    continue
                if d==True and z > 0:
                    coment=a.text[a.text.find(',')+6:]
                    data=[{'VenueId':ident, 'Coment Tips':coment}]
                    TipsComents=pd.DataFrame(data)
                    users_tips=pd.concat([users_tips,TipsComents])
                    z=z-1
                    if z==0:break

    return(users_list,users_tips)
```

In [85]:
```
# All data colected is stored in a local csv file. (This step takes some time!!!)
likerslist, likerstips = getUsersLikedWeb(venue=SPwinebars['VenueId'])
likerslist.to_csv('alllikes.csv')
likerstips.to_csv('alltips.csv')
```

In [14]:
```
likerstips=pd.read_csv('alltips.csv').drop('Unnamed: 0',axis=1)
```

In [15]:
```
likerslist=pd.read_csv('alllikes.csv').drop('Unnamed: 0',axis=1)
```

Organizing data

In [16]:
```
# drop duplicated row and merge data frames in  a result dataframe for users
likerslist.drop_duplicates(inplace=True)
likerslist=likerslist.merge(SPwinebars,
                     left_on='VenueId',
                     right_on='VenueId',
                     how='inner').reset_index(drop=True)
likerslist.head()
```

Out[16]:

	UserName	VenueId	Venue´s Number of Tips	City	Venue	Latitude	Longitude	Category
0	Bianca Cerqueira	4d9750972bd6f04dd4444c50	13	São Paulo	Banca do Ramon	-23.541517	-46.629454	Wine Shop
1	Luciana Franco	4d9750972bd6f04dd4444c50	13	São Paulo	Banca do Ramon	-23.541517	-46.629454	Wine Shop
2	Natasha No	4d9750972bd6f04dd4444c50	13	São Paulo	Banca do Ramon	-23.541517	-46.629454	Wine Shop
3	Daniel Nakagawa	4d9750972bd6f04dd4444c50	13	São Paulo	Banca do Ramon	-23.541517	-46.629454	Wine Shop
4	Regina Campos	4d9750972bd6f04dd4444c50	13	São Paulo	Banca do Ramon	-23.541517	-46.629454	Wine Shop

In [17]:
```
#count the number of tips of each user
sharedf=likerslist[['UserName','Venue']]
sharedf=sharedf.groupby(['UserName'], as_index=False).count()
sharedf.rename(columns={'Venue':'VenuesTips'},inplace=True)
sharedf.sort_values('VenuesTips',ascending=False,inplace=True)
sharedf.head()
```

Out[17]:

	UserName	VenuesTips
413	Dani Al	11
1766	Susan Ximenes	11
665	Fernando Kikudome	8
938	Julia Lerro Rocca	7
1804	Thais Mendes do Nascimento	7

In [18]:
```
#Now we can see how each user connects the venues
#Data description
#UserName: User who wrote a tip for the venue
#Venue: list of venues that the UserName have made a tip
#VenuesTips: number of venues connected by that UseName
#VenueID: number of venues connected by that UseName (same Venue but by id code)
result=likerslist[['UserName','Venue']].groupby(['UserName'],
                                as_index=False,
                                sort=True).aggregate(lambda x:','.join(x))
result2=likerslist[['UserName','VenueId']].groupby(['UserName'],
                                as_index=False,
                                sort=True).aggregate(lambda x:','.join(x))
result=result.merge(sharedf,
                     left_on='UserName',
                     right_on='UserName',
                     how='inner').sort_values('VenuesTips',
                                              ascending=False).reset_index(drop=True).merge(result2,
                     left_on='UserName',
                     right_on='UserName',
                     how='inner').sort_values('VenuesTips',
                                              ascending=False).reset_index(drop=True)
result.head()
```

Out[18]:

	UserName	Venue	VenuesTips	VenueId
0	Dani Al	Empório Frei Caneca,Box do Vinho,Rei dos Whisk...	11	4b5af5f6f964a52068dc28e3,4c0e9709b60ed13a72433...
1	Susan Ximenes	Mistral,Empório Frei Caneca,Casa do Porto,Casa...	11	4bd30fae462cb7132169dd07,4b5af5f6f964a52068dc2...
2	Fernando Kikudome	Prestíssimo Pizza Bar,Famiglia Mancini,Empório...	8	4b951865f964a520e78e34e3,4b7c8c03f964a520339a2...
3	Julia Lerro Rocca	Bardega,Adega Santiago,Walter Mancini Ristoran...	7	50808fd0e4b0134247d7055b,50ad6489e4b0602cfa638...
4	Thais Mendes do Nascimento	Casa Santa Luzia,Le Vin Bistro,Saint Vin Saint...	7	4b0b3120f964a520662e23e3,4b5366eaf964a520119b2...

In [19]:
```
result.to_csv('sharelikes.csv')
```

Creating a Network based on common tips

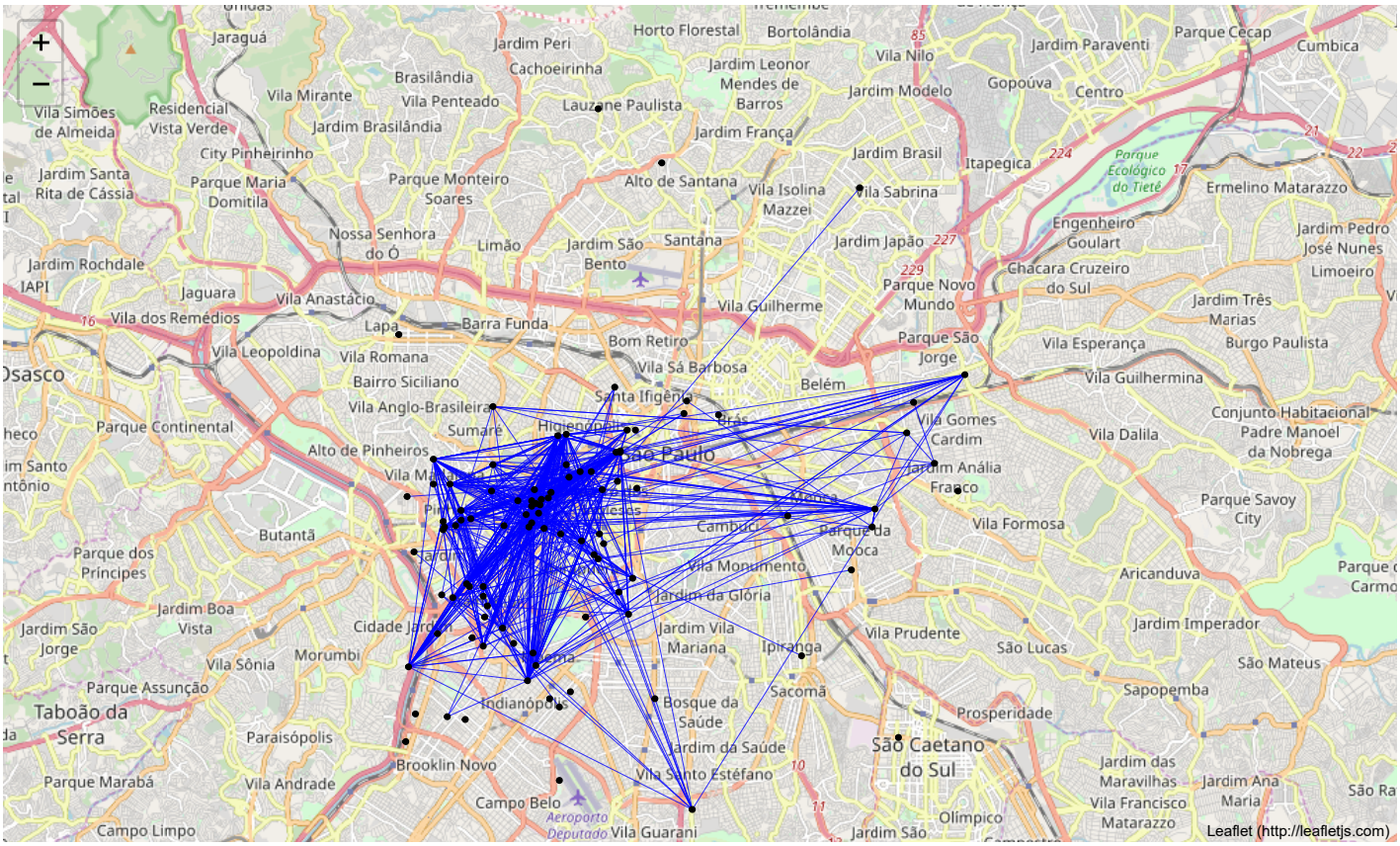
In [20]:

```
# Creating a Graph
G = nx.Graph() # Right now G is empty

# Add the nodes and its atributes (Latitude and Longitude)
ListOfVenues=likerslist[['Venue','Latitude','Longitude','UserName']].groupby(['Venue','Latitude','Longitude'], as_index=False).count
ListOfVenues.head()
for i,venue in enumerate(ListOfVenues['Venue']):
    G.add_node(ListOfVenues.Venue[i], Latitude=ListOfVenues.Latitude[i], Longitude=ListOfVenues.Longitude[i])

# Creating a dictionarie of positions of each note
posLat= nx.get_node_attributes(G,'Latitude')
posLon = nx.get_node_attributes(G,'Longitude')
pos = {key: ([value1, value2]) for key, value1, value2 in zip(posLat.keys(), posLat.values(), posLon.values())}

# Add the edges on the Network
for i,j in enumerate(result.VenuesTips):
    e=result.Venue[i].split(',')
    if j==1:break
    for x in range(0,j):
        e1=e[x]
        for z in range(x+1,j):
            e2=e[z]
            edge=(e1,e2)
            G.add_edge(*edge) # * unpacks the tuple
```

Network visualization

In [21]:
```
#We can visualize the network connections in the map locating each pair of nodes that are connected
map_network = folium.Map(location=[-23.541517, -46.629454], zoom_start=12)

for i,j in enumerate(result.VenuesTips):
    e=result.Venue[i].split(',')
    if j==1:break
    for x in range(0,j):
        e1=pos[e[x]]
        for z in range(x+1,j):
            e2=pos[e[z]]
            folium.ColorLine([e1,e2],
                 colors = [0,0,0],
                 colormap = ['b', 'black'],
                 weight = 0.5,
                 opacity = 0.8).add_to(map_network)
for lat, lng, venue, categ in zip(SPwinebars['Latitude'], SPwinebars['Longitude'], SPwinebars['Venue'], SPwinebars['Category']):
    label = '{}, {}'.format(venue, categ)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=1,
        popup=label,
        color='black',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7).add_to(map_network)

map_network
```

Out[21]:



Network Analysis

Degree

With the Networkx, we can calculate the number of connections for all nodes (It's the number os edges in a venue).

Degree Centrality

One of the most widely used and important conceptual tools for analysing networks. **Centrality aims to find the most important nodes in a network** . Centrality measures themselves have a form of classification.

Network Density

A measure of how many edges a Graph has.
The actual definition will vary depending on type of Graph and the context in which the question is asked. For a complete undirected Graph the Density is 1, while it is 0 for an empty Graph. Graph Density can be greater than 1 in some situations (involving loops)

In [22]:
```
#We can Find the 10th most central WineShops usind the tools of Networkx package
Centrals=nx.algorithms.degree_centrality(G)
Centrals = sorted(Centrals.items(), key=lambda kv: kv[1])
Centrals=pd.DataFrame(data=Centrals, columns=['Venue','Centrality'])
Centrals['Degree']=[G.degree(venue) for venue in Centrals['Venue']]

#Add the number o tips for each venue
Centrals=Centrals.merge(likerslist[['Venue´s Number of Tips','Venue','Latitude','Longitude','VenueId']].drop_duplicates(subset=None,
                    left_on='Venue',
                    right_on='Venue',
                    how='inner').reset_index(drop=True)

# some venues has more than one shop, so we decide to calculate only one Centrality considering se sum of tips,
#but the total of tips for each venue is presented in the table.
Centrals=Centrals.sort_values(['Centrality','Venue´s Number of Tips','Degree'],
                                        ascending=False).reset_index(drop=True)
Centrals.head(5)
```

Out[22]:

	Venue	Centrality	Degree	Venue´s Number of Tips	Latitude	Longitude	VenueId
0	MoDi Gastronomia	0.448276	39	212	-23.546211	-46.658763	5305f7c5498e391fd632d737
1	MoDi Gastronomia	0.448276	39	15	-23.594022	-46.671762	58645a8fac13690a1b6200ba
2	Empório Moema	0.402299	35	361	-23.602477	-46.668226	4bd34d8ecaff9521de90d4f0
3	Famiglia Mancini	0.379310	33	1172	-23.550249	-46.645222	4b7c8c03f964a520339a2fe3
4	Carlota	0.367816	32	211	-23.546694	-46.660780	4b0588c8f964a520f3d922e3

In [23]:
```
nx.density(G) # Average edge density of the Graphs
```

Out[23]:
```
0.14655172413793102
```

Clustering

Now we can cluster the venues based on the number of tips, centrality, degree and location (number of clusters:5)

In [24]:
```
kclusters = 4

Venues_clustering = Centrals.drop(['Venue','VenueId'], 1)

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

# check cluster labels generated for each row in the dataframe
kmeans.labels_[0:10]
```

Out[24]:
```
array([3, 1, 0, 2, 3, 3, 0, 3, 3, 3])
```

In [25]:
```
#Let's create a new dataframe that includes the cluster as well as the top 10 venues for each neighborhood.
Venues_merged = Centrals
# add clustering labels
Venues_merged['Cluster Labels'] = kmeans.labels_
Venues_merged.head()
```

Out[25]:

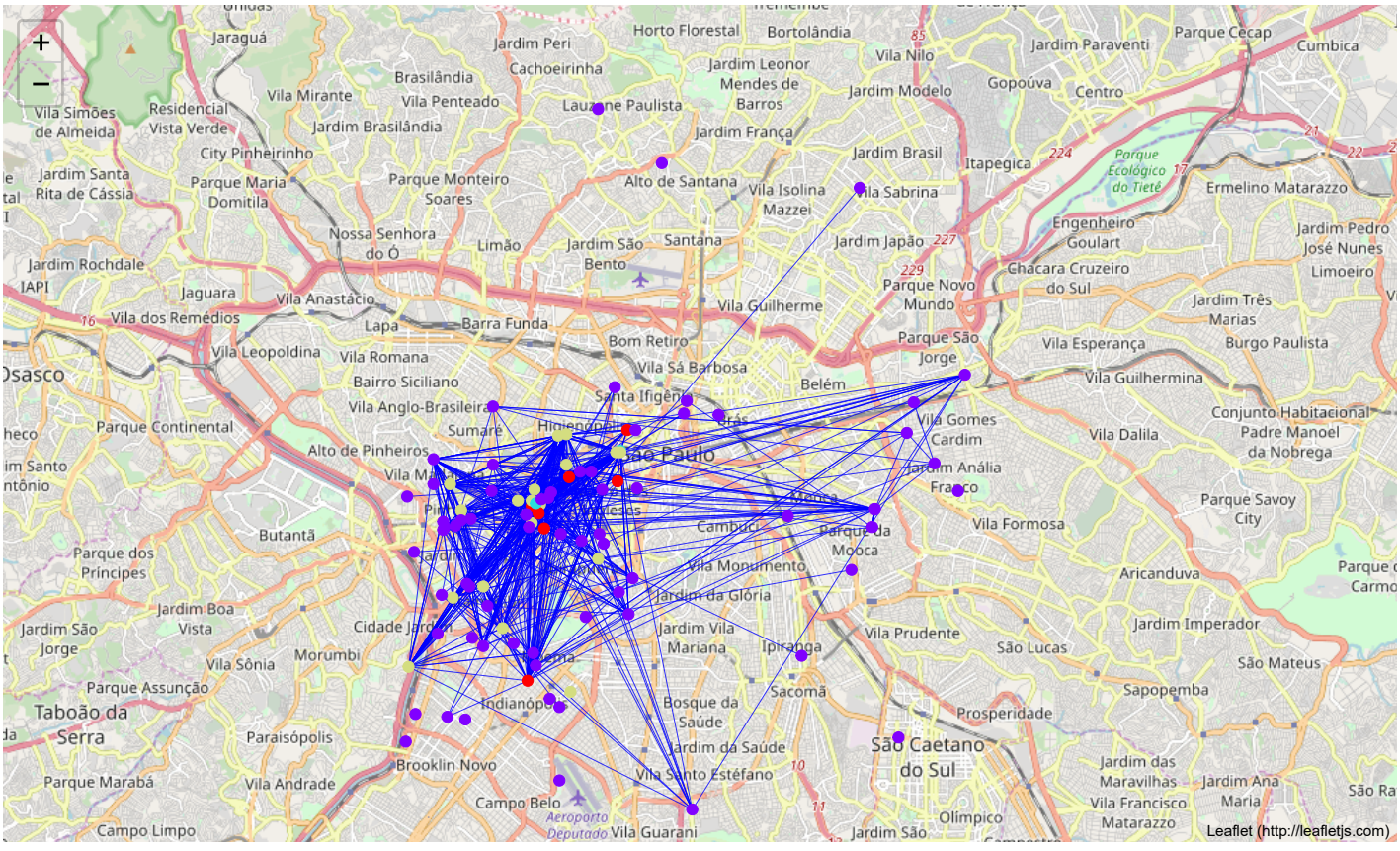
	Venue	Centrality	Degree	Venue´s Number of Tips	Latitude	Longitude	VenueId	Cluster Labels
0	MoDi Gastronomia	0.448276	39	212	-23.546211	-46.658763	5305f7c5498e391fd632d737	3
1	MoDi Gastronomia	0.448276	39	15	-23.594022	-46.671762	58645a8fac13690a1b6200ba	1
2	Empório Moema	0.402299	35	361	-23.602477	-46.668226	4bd34d8ecaff9521de90d4f0	0
3	Famiglia Mancini	0.379310	33	1172	-23.550249	-46.645222	4b7c8c03f964a520339a2fe3	2
4	Carlota	0.367816	32	211	-23.546694	-46.660780	4b0588c8f964a520f3d922e3	3

Updating the visualization

Visualization of the map considering the clustering

In [26]:
```
map_network = folium.Map(location=[-23.541517, -46.629454], zoom_start=12)

# 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]

for i,j in enumerate(result.VenuesTips):
    e=result.Venue[i].split(',')
    if j==1:break
    for x in range(0,j):
        e1=pos[e[x]]
        for z in range(x+1,j):
            e2=pos[e[z]]
            folium.ColorLine([e1,e2],
                 colors = [0,0,0],
                 colormap = ['b', 'black'],
                 weight = 0.5,
                 opacity = 0.8).add_to(map_network)
for lat, lng, venue, degree, centr, cluster in zip(Venues_merged['Latitude'],
                                   Venues_merged['Longitude'],
                                   Venues_merged['Venue'],
                                   Venues_merged['Degree'],
                                   Venues_merged['Centrality'],
                                   Venues_merged['Cluster Labels']):
    label = '{}, Degree:{}, Centrality:{}, Group:{}'.format(venue, degree, centr,cluster)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=4,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        weight = 0.1,
        fill_opacity=1).add_to(map_network)

map_network
```

Out[26]:



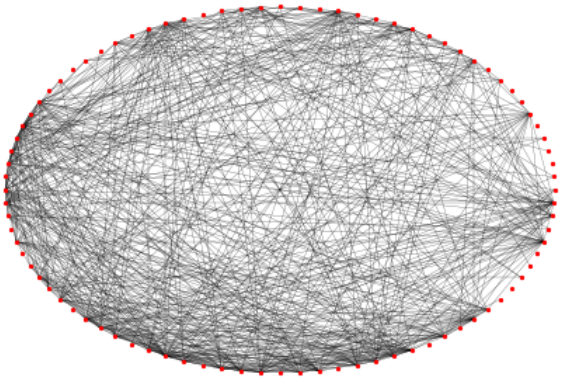
In [43]:
```
#Cluster 0:(67 venues) is a small group with a big number of tips and located in the center city (perhaps the main wine shops)
#Cluster 1:(7 venues) is the group of Venues with low degree and low number of tips around all city
#Cluster 2:(2 venues) a high number of tips and majoritary located in the center city
#Cluster 3:(18 venues) High number of tips and located and high centrality

Venues_merged.loc[Venues_merged['Cluster Labels'] == 2, Venues_merged.columns[[0,1,2,3,4,5]]]
```

Out[43]:

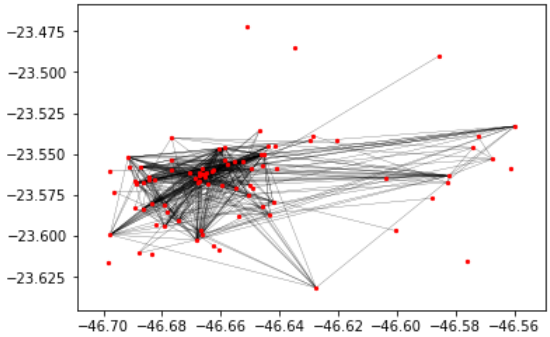
	Venue	Centrality	Degree	Venue´s Number of Tips	Latitude	Longitude
3	Famiglia Mancini	0.379310	33	1172	-23.550249	-46.645222
40	Paris 6 Bistrô	0.183908	16	1502	-23.562089	-46.666108

More network visualizations

In [37]:
```
#with a shell or circle drawing we can see haw dense are the network
nx.draw_shell(G,
                with_labels=False,
                node_size=5,
                width=0.2,
                edge_color='black'
                )
```



In [38]:
```
#retake the position of each venue.
#Naturaly, we can see the central venues are more dense, but there are 4 or 5 not celtral that are very dense
pos = {key: ([value1,value2]) for key, value1, value2 in zip(posLat.keys(), posLon.values(), posLat.values())}
#Draw the network
nx.draw_networkx(G,
                pos=pos,
                with_labels=False,
                node_size=5,
                width=0.2,
                edge_color='black'
                )
```



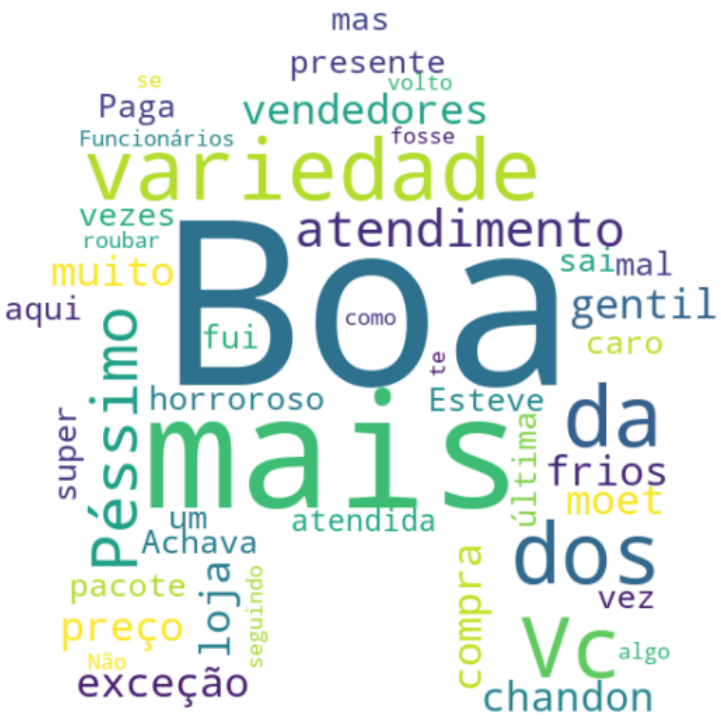
Miscellaneous

- work cloud A work cloud can be genereted based on the tips that all user did for a venue.

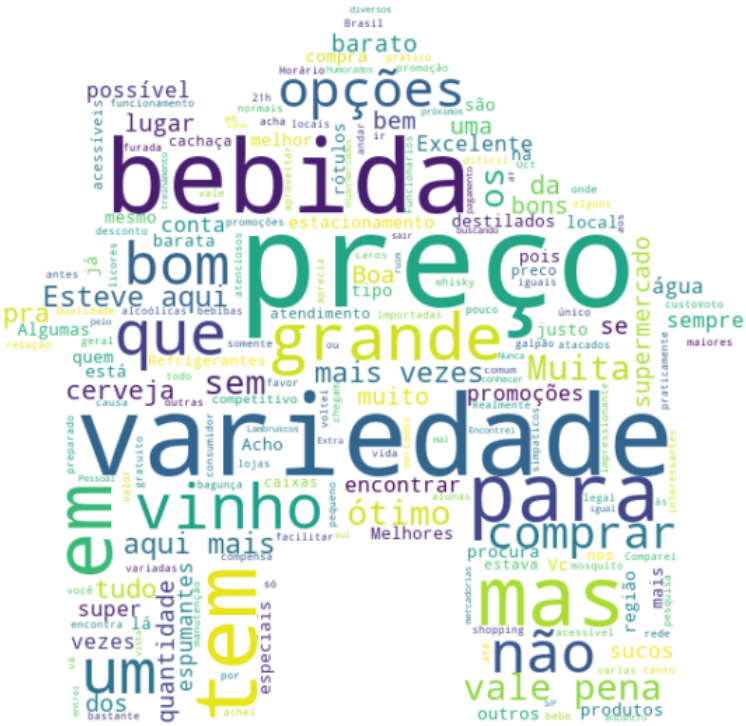
In [39]:
```
likerstips=likerstips.groupby(['VenueId'],
                              as_index=False,
                              sort=True).aggregate(lambda x:','.join(x))
```

In [40]:
```
tipstocloud=likerstips.merge(Venues_merged,
                    left_on='VenueId',
                    right_on='VenueId',
                    how='inner').reset_index(drop=True)
```

In [45]:
```
stopwords.add('de') # add the words said to stopwords
stopwords.add('ma') # add the words said to stopwords

# save mask to a bottle
Venue_mask = np.array(Image.open('yellow-house-hi.png'))


# instantiate a word cloud object
Venue_wc = WordCloud(background_color='white', mask=Venue_mask, stopwords=stopwords)

# generate the word cloud
Venue_wc.generate(tipstocloud['Coment Tips'][40]) # this is a very contraversal venue (Paris 6 Bistrô).

# display the word cloud
fig = plt.figure()
fig.set_figwidth(10) # set width
fig.set_figheight(10) # set height

plt.imshow(Venue_wc, interpolation='bilinear')
plt.axis('off')
plt.show()
```



In [46]:
```
# instantiate a word cloud object
Venue_wc = WordCloud(background_color='white', mask=Venue_mask, stopwords=stopwords)

# generate the word cloud
Venue_wc.generate(tipstocloud['Coment Tips'][33]) # this is a good one.(Famiglia Mancini)

# display the word cloud
fig = plt.figure()
fig.set_figwidth(10) # set width
fig.set_figheight(10) # set height

plt.imshow(Venue_wc, interpolation='bilinear')
plt.axis('off')
plt.show()
```



End

In [ ]:
```
```