Algorithmic Methods of Data Mining, HW3

December 3, 2017

1 Algorithmic Methods of Data Mining

1.1 Homework 3

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```
In [1]: from bs4 import BeautifulSoup
        from collections import defaultdict
        from collections import Counter
        from collections import deque
        import copy
        from cmath import log
        from heapq import nlargest
        import matplotlib.pyplot as plt
        import nltk
        from nltk.corpus import stopwords
        from nltk.stem.lancaster import LancasterStemmer
        from operator import itemgetter
        import pandas as pd
        from os import listdir
        from os.path import isfile, join
        import numpy
        from numpy import linalg as LA
        import re
        import requests
        import statistics
        import string
        from sklearn.cluster import KMeans
        import json
        import time
        from wordcloud import WordCloud
```

1.2 Data Collection

```
In [2]: # First identify and save the folder where we have stored all the html files

        mypath = "C:/Users/danie/OneDrive/Università/Data Science/Algorithmics (Aris-Yoannis)/
        onlyfiles = [f for f in listdir(mypath) if isfile(join(mypath, f))]
```

```
In [3]: # Now we can parse the pages and take for each all the information we need, like artis

        complete_dictionary=defaultdict(list)
        stringa="https://www.azlyrics.com/"
        for i in onlyfiles:
            file = open("C:/Users/danie/OneDrive/Università/Data Science/Algorithmics (Aris-Yoa
            soup = BeautifulSoup(file, 'lxml')

            artist = soup.findAll("span",{ "class" : "item-header-color" })

            title = soup.findAll("h1")
            lyric = soup.findAll("div", { "class" : "dn" })

            try:
                l = str(lyric[0]).replace('<br/>', ' ')
                l=l.replace("\", '')
                l=l.replace("\'", '')
                testo = str(l[31:-6])
                t = str(title[0])
                T = t[4:-12]
                a = str(artist[2])
                A = a[32:-14]
                url=stringa+"lyrics/"+A.replace(" ","").lower()+"/"+T.replace(" ","").lower()+

                complete_dictionary[A,T].append([url, A, T, testo])


            except:
                pass

In [4]: # In order to remove the internet problem, we have also make  a local copy of the dict
        # we choce to use numpy for his speed

        numpy.save("dizionario completo", complete_dictionary)

In [3]: # If needed we can load the file with this command

        complete_dictionary=dict(numpy.load("dizionario completo.npy").item())

In [15]: # Create dict_of_songs, this will contein a list of dictionaries

         dict_of_songs = []
         for [x,y] in complete_dictionary.keys():

             a = complete_dictionary[x,y]
             x=[]
             x.append(a[0][0]) #url
             x.append(a[0][1]) #artist
             x.append(a[0][2]) #song name
             x.append(a[0][3]) #lyrics
             tempdict = {"url": x[0],
                         "artist": x[1],
                         "song-name": x[2],
                         "lyrics": x[3]
                     }
             dict_of_songs.append(tempdict)
```

```
In [18]: # Store the parsed songs as documents in MongoDB database, one document per song,
         # using MongoDB Hosting: Database-as-a-Service by mLab
         # To reduce the problems of the internet and speed up site response time, we decided
         # It's necessary use time sleep of 3 second for a correct count on mlab and for skip

         # We use 158.31 MB of mlab's space

         params = {'apiKey': 'jJFk7bsNFjagIf9nvxRQzq4AhVot1kkK'}
         dbname = 'prova'
         collection = 'Algorithmic_Methods_of_Data_Mining_Hw3'
```

```
In [ ]: for i in range(0,len(dict_of_songs),10000):
            url = 'https://api.mlab.com/api/1/databases/' + dbname + '/collections/' + collect
            headers = {'content-type': 'application/json'}
            data = json.dumps(dict_of_songs[i:i+10000])
            response = requests.post(url, data=data, params=params, headers=headers)
            time.sleep(3)
```

```
In [31]: # Get back documents
         # l=<limit> - specify the limit for the number of results (default is 1000)

         l='l=900000'
         url = 'https://api.mlab.com/api/1/databases/' + dbname + '/collections/' + collection
         query= url
         response=requests.get(query)
         data=(response.text)
         dataset = json.loads(data)
```

```
In [9]: # Create a list with the Artist Name

        artists_name=[]
        for aa in dataset:
            artists_name.append(aa["artist"])
```

```
In [7]: # Create a list of list with song

        song_list=[]
        for ab in dataset:
            so=[]
            so.append(ab["lyrics"])
            song_list.append(so)
```

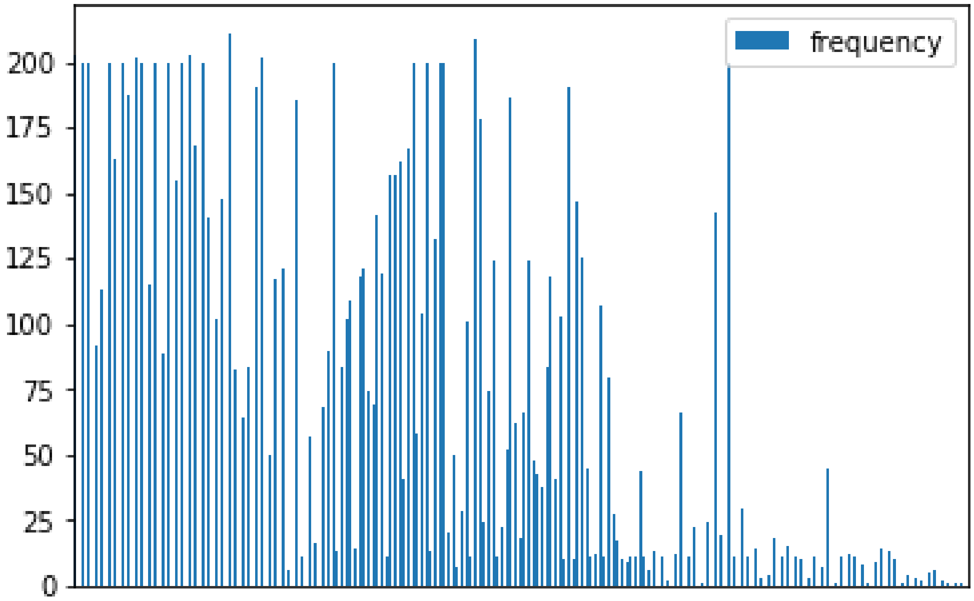
```
In [8]: # Create a list with the songs-name

        song_name=[]
        for ac in dataset:
            song_name.append(ac["song-name"])
```

2 Song Statistics

2.1 Identify Artist with most songs and create a histogram of the number of songs per Artist

```
In [36]: # Find the number of songs for each artist

         provaa=(Counter(artists_name))
         prova=dict(Counter(artists_name))
         listaditupl=[(v, k) for v, k in prova.items()]
```

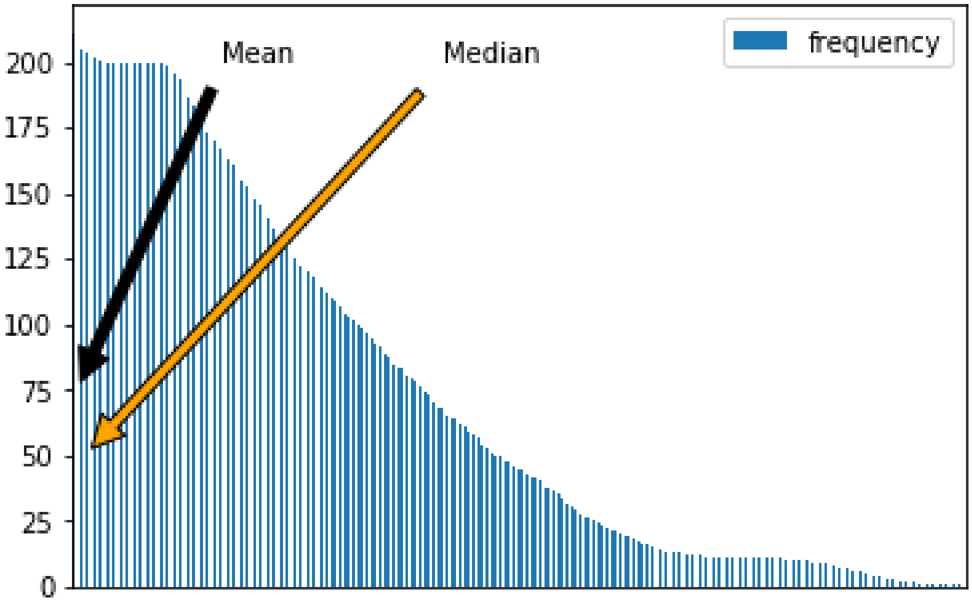
```
In [37]: # Print the histogram of the number of songs for artist

         df = pd.DataFrame(listaditupl, columns=['Artist Name', 'frequency'])
         frame1=df.plot(kind='bar', x='Artist Name')
         frame1.axes.get_xaxis().set_visible(False)
         plt.show()
```



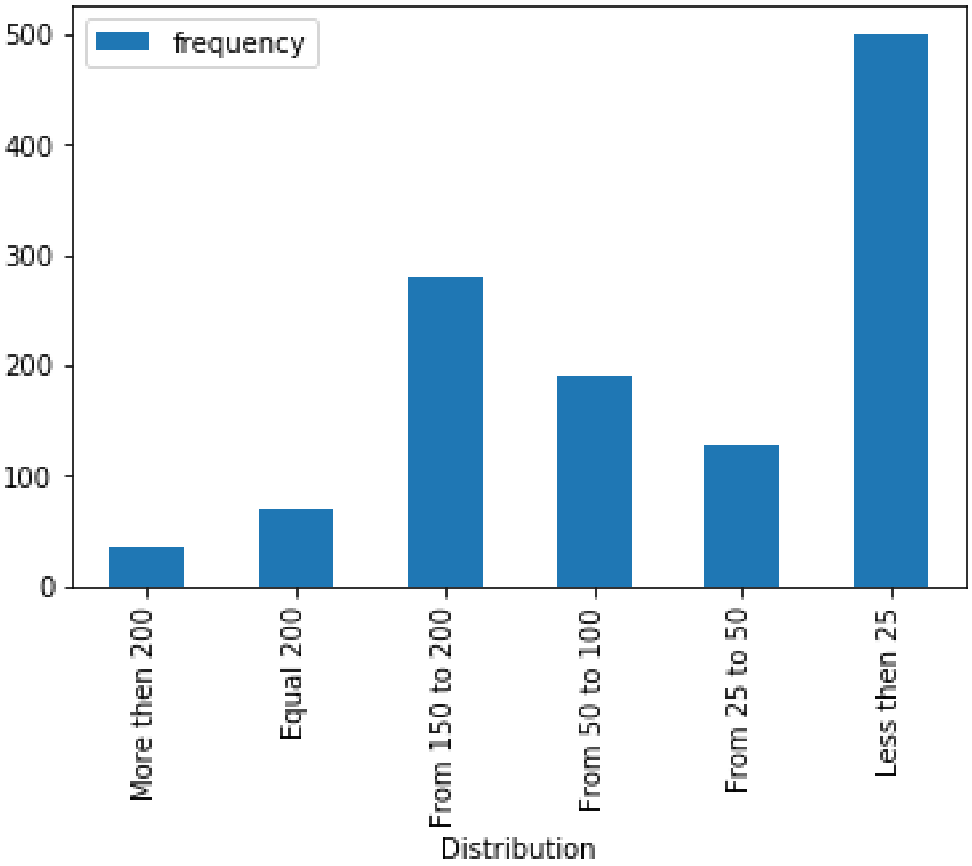
```
In [38]: # Find the mean

         media=statistics.mean([x[1] for x in listaditupl])
```

```
In [39]: # Find the median

         mediana=statistics.median([x[1] for x in listaditupl])
```

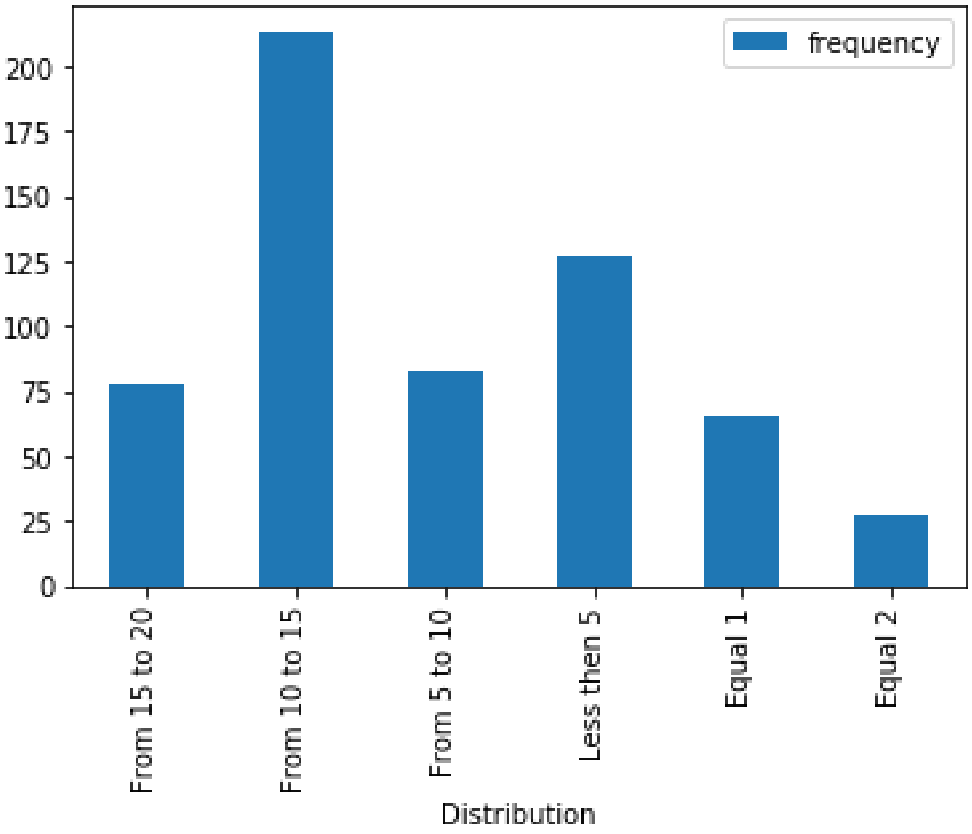
```
In [42]: # We can also create an histogram ordered by number of songs written

         ordered_list=provaa.most_common()
         df = pd.DataFrame(ordered_list, columns=['Artist Name', 'frequency'])
         frame1=df.plot(kind='bar', x='Artist Name')
         frame1.axes.get_xaxis().set_visible(False)

         plt.annotate('Mean', xy=(0,media), xytext=(200, 200),
                     arrowprops=dict(facecolor='black', shrink=0.05),
                     )
         plt.annotate('Median', xy=(0,mediana), xytext=(500, 200),
                     arrowprops=dict(facecolor='orange', shrink=0.05),
                     )
         plt.show()
```



```
In [43]: # Divide the list into this group and print the new plot

         more_200 = ("More then 200",sum(Counter([t[1] for t in ordered_list if t[1] > 200]).va
         equal200=("Equal 200",sum(Counter([t[1] for t in ordered_list if t[1] == 200]).values
         a_150_to_200 = ("From 150 to 200",sum(Counter([t[1] for t in ordered_list if t[1] >=
         a_50_to_100 = ("From 50 to 100",sum(Counter([t[1] for t in ordered_list if t[1] >= 50
         a_25_to_50 = ("From 25 to 50",sum(Counter([t[1] for t in ordered_list if t[1] >= 25 an
         less_20 = ("Less then 25",sum(Counter([t[1] for t in ordered_list if t[1]  < 25]).valu
         distribution=[more_200,equal200,a_150_to_200,a_50_to_100,a_25_to_50,less_20]
         df = pd.DataFrame(distribution, columns=['Distribution', 'frequency'])
         frame1=df.plot(kind='bar', x='Distribution')
         plt.show()
```



In [44]:
```
# Inside Less then 25 group we have the following situation

a_15_to_25 = ("From 15 to 20",sum(Counter([t[1] for t in ordered_list if t[1] >= 15 a
a_10_to_15 = ("From 10 to 15",sum(Counter([t[1] for t in ordered_list if t[1] >= 10 a
a_5_to_10 = ("From 5 to 10",sum(Counter([t[1] for t in ordered_list if t[1] >= 5 and
less_5 = ("Less then 5",sum(Counter([t[1] for t in ordered_list if t[1]  < 5]).values
equal2=("Equal 2",sum(Counter([t[1] for t in ordered_list if t[1] == 2]).values()))
equal1=("Equal 1",sum(Counter([t[1] for t in ordered_list if t[1] == 1]).values()))
distribution=[a_15_to_25,a_10_to_15,a_5_to_10,less_5,equal1,equal2]
df = pd.DataFrame(distribution, columns=['Distribution', 'frequency'])
frame1=df.plot(kind='bar', x='Distribution')
plt.show()
```



```
In [45]: # Find who wrote more songs

         print(ordered_list[0])
```

```
('David Bowie', 211)
```

```
In [46]: # we can also find the top 10 artist who have written more songs

         print(ordered_list[0:10])
```

```
[('David Bowie', 211), ('Lil Wayne', 211), ('Eminem', 210), ('Various Artists', 209), ('Dolly
```

```
In [47]: # And also the first 25

         print(ordered_list[0:25])
```

```
[('David Bowie', 211), ('Lil Wayne', 211), ('Eminem', 210), ('Various Artists', 209), ('Dolly
```

Looking at the data we can first see the difference between mean (about 72) and median (45) so we can suppose to have some anomalous values. We have in fact that 501 Artist wrote less then 25 songs (of which 65 wrote just 1 song) ed just 37 wrote more then 200 songs, without these excesses we have that 191 artist wrote from 150 to 200 songs (262 artist if we include also the number 200 songs).

In the top 10 most productive artist (excluding "Various Artist") we have just 1 band (Rolling Stones) and also looking at the first 25 we found just 2 other bad (U2 and Bee Gees), perhaps band's members have more frequently opposing views on songs and for this reason they write less or they melt.

Interestingly also note how in the top 10 most productive artist (excluding "Various Artist") we have even 5 rapper.

In the top 10 we also have 3 deceased artists (David Bowie, Frank Sinatra and Elvis Presley), searching for each the years active we have

- Elvis Presley: 24 years
- Bee Gees: 47 years
- Bob Dylan: 58 years
- Wiz Khalifa: 13 years
- Paul McCartney: 60 years
- Rolling stone: 55 years
- Snoop Dogg: 25 years
- Chris Brown: 12 years
- Elton John: 53 years
- Frank Sinatra: 63 years
- Dolly Parton: 58 years
- Eminem: 25 years
- David Bowie: 54 years
- Lil Wayne: 20 years

So the new ranking based on the number of songs written and years of activity is

- Chris Brown: 17.25
- Wiz Khalifa: 15.76
- Lil Wayne: 10.55
- Elvis Presley: 8:54
- Eminem: 8.40
- Snoop Dogg: 8.24
- Bee Gees: 4.36
- Elton John: 3.92
- David Bowie: 3.90
- Rolling stone: 3.74
- Dolly Parton: 3.60

- Bob Dylan: 3.53
- Paul McCartney: 3.41
- Frank Sinatra: 3.13

And again we can observe how rappers write many more songs than authors of other types of music

2.2 Identify the 20 most popular words (exclude stopwords) and comment

```
In [5]: # Create a new list with songs without the most common stopwords of 17 different lengu
        # we have also edited the "english" file adding the the following words:
        # "dont", "cant", "youre", "aint"
        # we have also decided to add the condition len(word) >=2 to delete other non-included

        stp1=stopwords.words('arabic')
        stp2=stopwords.words('danish')
        stp3=stopwords.words('dutch')
        stp4=stopwords.words('english')
        stp5=stopwords.words('finnish')
        stp6=stopwords.words('french')
        stp7=stopwords.words('german')
        stp8=stopwords.words('hungarian')
        stp9=stopwords.words('italian')
        stp10=stopwords.words('kazakh')
        stp11=stopwords.words('norwegian')
        stp12=stopwords.words('portuguese')
        stp13=stopwords.words('romanian')
        stp14=stopwords.words('russian')
        stp15=stopwords.words('spanish')
        stp16=stopwords.words('swedish')
        stp17=stopwords.words('turkish')
        other_words=["dont", "cant", "youre", "aint"]
        stp4=stp4+other_words
```

```
In [10]: vuota=[]
         for i in song_list:
             for line in i:
                 prima=[]
                 text=' '.join([word for word in line.lower().translate(str.maketrans('', '', s
                               if len(word) >=2 and word not in stp1
                               and word not in stp2
                                and word not in stp3
                                and word not in stp4
                                and word not in stp5
                                and word not in stp6
                                and word not in stp7
                                and word not in stp8
                                and word not in stp9
                                and word not in stp10
                                and word not in stp11
                                and word not in stp12
                                and word not in stp13
                                and word not in stp14
                                and word not in stp15
                                and word not in stp16
                                and word not in stp17])
                 prima.append(text)
                 vuota.append(prima)
```

```
In [82]: # Found the most common words

         dicty = {}
         for k in vuota:
             for sentence in k:
                 for word in re.split('\s', sentence): # split with whitespace
                     try:
                         dicty[word] += 1
                     except KeyError:
                         dicty[word] = 1
```

```
In [83]: # Order the dictionaries

         ordered=sorted(dicty.items(), key=lambda x: x[1], reverse=True)
```

```
In [84]: # Print the 20 most common words

         print(ordered[0:20])
```

```
[('love', 131338), ('know', 108479), ('like', 100784), ('oh', 87311), ('got', 80794), ('get', 
```

We found that the most used word is "love", probably this primacy is attributable to the songs written in the 80's, considered by many the "decades of love", but it is also due to pop songs that often make use of it. The 80s, with their protests, can probably also be found in the word "never" (in twelfth position). The influence of the songs of the 70's may, however, be found in the word "baby" (in tithe position), which in those years begins to become a loving nickname, while we can assume that word "like" (in third position) is attributable almost entirely to our days, probably because of "like on Facebook".

2.3 Identify the 10 most common singer names (e.g, "Alice," "Bob," "Frank") and see whether singers whose name is the same tend to publish more songs than others

```
In [62]: # remove the duplicate
         non=Counter(artists_name)
         nuovaprova=list(non.keys())
```

```
In [63]: # Create a nested list with name and suppose that the name of the artist is always th

         wo=[]
         for i in nuovaprova:
             words = re.findall(r'\w+', i)
             wo.append(words)
         lst = [item[0] for item in wo]
```

```
In [64]: # Find the 10 most common name

         lst2=Counter(lst).most_common(10)
         print(lst2)
```

```
[('The', 26), ('X', 13), ('Tom', 6), ('Queen', 6), ('Steve', 5), ('Q', 5), ('David', 5), ('Pete
```

```
In [65]: # We have also "The", "X", "Queen" and "Q" in the most common name, so we have decide

         lst2=Counter(lst).most_common(14)
         use=[x[0] for x in lst2]
         use.remove('The')
         use.remove("X")
         use.remove("Q")
         use.remove("Queen")
         print(use)
```

```
['Tom', 'Steve', 'David', 'Peter', 'John', 'Will', 'Johnny', 'James', 'George', 'Jimmy']
```

```
In [66]: # Remember the top 25 productive artist and find their name

         aba=ordered_list[0:25]
         woo=[]
         for i in [x[0] for x in aba]:
             words = (re.findall(r'\w+', i))
             woo.append(words)

         test=[x[1] for x in aba]

         a=[x for x in zip(woo, test)]
```

```
In [67]: # Concatenate and find if there are some of the top Common Name in the top 25 most pr

         for i in use:
             print((i,[item for item in a if item[0][0] == i]))
```

```
('Tom', [])
('Steve', [])
('David', [(['David', 'Bowie'], 211)])
```

```
('Peter', [])
('John', [(['John', 'Denver'], 204)])
('Will', [])
('Johnny', [])
('James', [])
('George', [])
('Jimmy', [])
```

We found that 2 of the most common name ("David", "John") is in the top 25 of the most productive artist:

- David Bowie: 211
- John Denver: 204

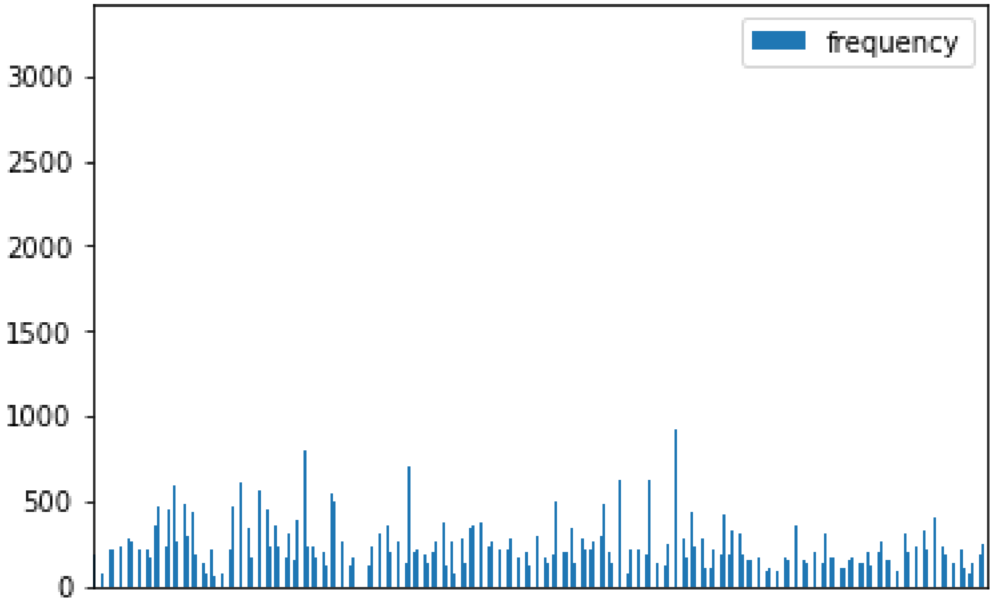
2.4 Create a histogram of song lengths

```
In [ ]: # Create a list with the songs

        song=[]
        for ab in dataset:
            song.append(ab["lyrics"])
```

```
In [68]: # Count number of words in each songs

         num_words = [len(sentence.split()) for sentence in [value for value in song]]
```

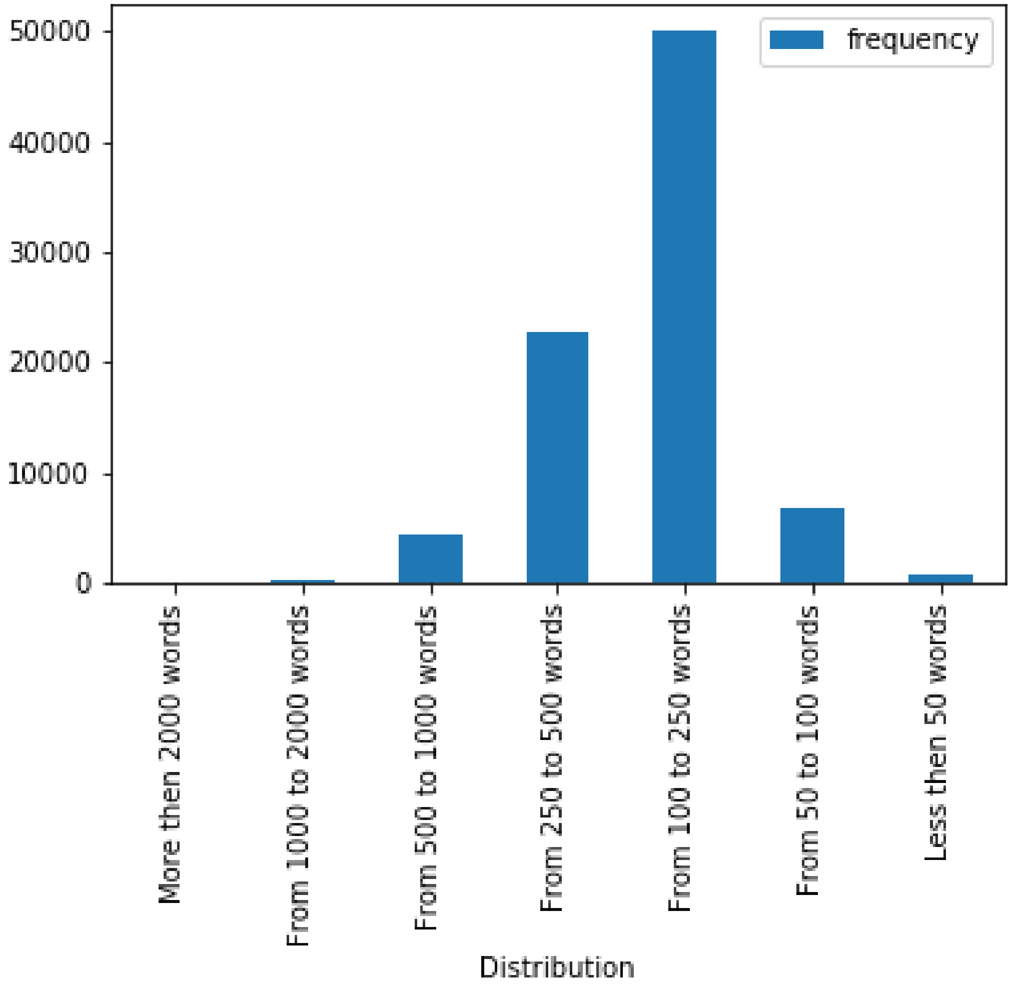
```
In [69]: # Concatenate
         unitaa=[x for x in zip(song_name, num_words)]
```

```
In [70]: # Print the histogram

         df = pd.DataFrame(unitaa, columns=['Artist Name', 'frequency'])
         frame1=df.plot(kind='bar', x='Artist Name')
         frame1.axes.get_xaxis().set_visible(False)
         plt.show()
```



```
In [71]: # order the list by song's length

         ordered_unitaa=sorted(unitaa,key=lambda x: x[1], reverse=True)
```

```
In [72]: # Divide the list into this group and print the new plot

         more_2000 = ("More then 2000 words",sum(Counter([t[1] for t in ordered_unitaa if t[1]
         a_1000_to_2000 = ("From 1000 to 2000 words",sum(Counter([t[1] for t in ordered_unitaa
         a_500_to_1000 = ("From 500 to 1000 words",sum(Counter([t[1] for t in ordered_unitaa i
         a_250_to_500 = ("From 250 to 500 words",sum(Counter([t[1] for t in ordered_unitaa if t
         a_100_to_250 = ("From 100 to 250 words",sum(Counter([t[1] for t in ordered_unitaa if t
         a_50_to_100 = ("From 50 to 100 words",sum(Counter([t[1] for t in ordered_unitaa if t[
         less_50 = ("Less then 50 words",sum(Counter([t[1] for t in ordered_list if t[1]  < 50]
         distribution=[more_2000,a_1000_to_2000,a_500_to_1000,a_250_to_500,a_100_to_250,a_50_to
         df = pd.DataFrame(distribution, columns=['Distribution', 'frequency'])
         frame1=df.plot(kind='bar', x='Distribution')
         plt.show()
         print("We found this values %s" %distribution)
```



```
We found this values [('More then 2000 words', 11), ('From 1000 to 2000 words', 175), ('From 5
```

3 Search Engine

3.1 Index Program

```
In [4]: # Create a list of list of id value

        prova=[]
        for i in dataset:
            prima=[]
            for k in (i['_id'].values()):
                prima.append(k)
            prova.append(prima)
```

```
In [ ]: # We already have text without stopwords and punctuation
        # list name = vuota

In [11]: # Find stem

         st = LancasterStemmer()
         vuotaa=[]
         for i in vuota:
             documents = [[st.stem(word) for word in sentence.split(" ")] for sentence in i]
             vuotaa.append(documents)

In [12]: # Create new dictionaries with id, stemmed list of song and make a list of dictionary

         dizionario=[]
         for i,j in zip(prova,vuotaa):
             riprova=dict(zip(i,j))
             dizionario.append(riprova)

In [13]: frequenze=[]
         for i in vuotaa:
             for j in i:
                 common=Counter(j)
                 frequenze.append(common)

In [14]: ook=[]
         for i in frequenze:
             ok=[]
             a=dict(i)
             ok.append(a)
             ook.append(ok)

In [15]: dizionario=[]
         for i,j in zip(prova,ook):
             riprova=dict(zip(i,j))
             dizionario.append(riprova)

In [16]: # In order to remove the internet problem, we have also make  a local copy of the dic
         # we choce to use numpy for his speed

         numpy.save("dizionario", dizionario)

In [ ]: # If needed we can load the file with this command

        dizionario=list(numpy.load("dizionario.npy"))

In [ ]: #Find all the words used

        parole=[]
        for i in dizionario:
            for j in i.values():
                for k in j:
                    parole.append(k)

In [ ]: # Delete duplicate words

        parole = list(set(parole))

In [ ]: # Create the vocabulary

        vocabulary=dict(zip(parole,parole))

In [ ]: # Build the inverted index

        caricare=[]
        for words in vocabulary.values():
            for i in dizionario:
                for j in i.values():

                    if words in j:
                        nuovo_dizionario={}
                        nuovo_dizionario[words]=((*i.keys(),j[words]))
                        caricare.append(dict(nuovo_dizionario))

In [ ]: index = {}
        for d in caricare:
            for k,v in d.items():
                index.setdefault(k, []).append(v)
        index=[{k:v} for k,v in index.items()]

In [ ]: # In order to remove the internet problem, we have also make  a local copy of the dict
        # we choce to use numpy for his speed

        numpy.save("index", index)

In [ ]: # If needed we can load the file with this command

        index=list(numpy.load("index.npy")

In [ ]: # Store Vocabulary and Index as documents in MongoDB database,
        # using MongoDB Hosting: Database-as-a-Service by mLab
        # To reduce the problems of the internet and speed up site response time, we decided t
        # It's necessary use time sleep of 3 second for a correct count on mlab and for skip "

        # For this upload we needed 376.46 MB of free space on mlab, so we have used other acc

        params = {'apiKey': 'LQ6h51NkbYPZMkll06pUmSxguV4wvX0c'}
        dbname = 'prova'
        collection = 'Index'
```

```
In [ ]: url = 'https://api.mlab.com/api/1/databases/' + dbname + '/collections/' + collection
        headers = {'content-type': 'application/json'}
        data = json.dumps(vocabulary)
        response = requests.post(url, data=data, params=params, headers=headers)
```

```
In [ ]: for i in range(0,len(index),10000):
            url = 'https://api.mlab.com/api/1/databases/' + dbname + '/collections/' + collecti
            headers = {'content-type': 'application/json'}
            data = json.dumps(index[i:i+10000])
            response = requests.post(url, data=data, params=params, headers=headers)
            time.sleep(3)
```

3.2 Search Program

```
In [ ]: # Create a list of id value

        lista_id=[]
        for i in dataset:
            lista_id.append(*i['_id'].values())
```

```
In [ ]: # Create a list with the songs-name

        song_name=[]
        for ac in dataset:
            song_name.append(ac["song-name"])
```

```
In [ ]: # Concatenate

        song_id=[x for x in zip(lista_id, song_name)]
```

```
In [ ]: # Create a new index with also tf and idf

        lista_molti=[]
        for word in index:
            for i in word.values():
                for yt in [x[1] for x in i]:
                    lista_molti.append((yt,(log(len(dizionario)/(len([x[1] for x in i]))).real

        prova=[]
        cont=0
        for word in index:
            provaa=[]
            for chiave in word:
                k=dict(word[chiave])

                for elem in k.keys():
                    k[elem]=lista_molti[cont]
                    cont+=1
                provaa.append(k)
            prova.append((provaa))

        indexx=copy.deepcopy(index)

        looper = 0
        for dic in indexx:
            for key in dic.keys():
                dic[key] = prova[looper]
                looper += 1
```

```
In [ ]: numpy.save('indexx',indexx)
```

```
In [ ]: indexx_idf={}
        parole=[]
        for i in indexx:
            for ii in i.values():
                for iii in ii:
                    G = str(i.keys())[12:-3]
                    indexx_idf[G]=([x[1] for x in iii.values()][0])
```

```
In [ ]: def query_1():
            # find stem in queryy

            query=[st.stem(i) for i in queryy]

            # find docs with query and weight
            print('Be patient, we are searching for the documents')
            dq = deque()
            doc= deque()
            moltiplicare= deque()
            for i in index:
                for j in i:
                    if any(query[o] == j for o in range(len(query))):
                        dq.append(i)
                        for n in i.values():
                            moltiplicare.append((log(len(dizionario)/(len(n)))).real)
                            doc.append([x[0] for x in n])


            docs=list(set([j for i in doc for j in i]))
            L=len(docs)
            print('Done... found %s documents'%len(docs))
            if L == 0:
                print('No documents')
                return

            # calculate cosine similarity
            print('Be patient, we are calculating the cosine similarity')
```

```
dict_v = {}
listone=deque()
for i in docs:
    vettori=deque()
    for j in range(len(dizionario)):
        G = str(dizionario[j].keys())[12:-3]
        if i == G:
            C = dizionario[j][G]
    q_v = dict.fromkeys(C, 0)
    for q in query:
        for j in C:
            if j ==q:
                q_v[j] += 1

        vettori.append(q_v)

    b1=deque()
    b2=deque()
    for k in C.keys():
        try:
            b2.append(indexx_idf[k])
        except:
            b2.append(0)
    for k in C.values():
        b1.append(k)
    b1=numpy.array(b1)
    b2=numpy.array(b2)
    b=b1*b2


    Query=deque()
    for l in vettori:
        a=deque()
        for h in l.values():
            a.append(h)
        a=numpy.array(a)
        Query.append(a)
    listone.append(Query)


    for x in listone:
        R=0
        for j in range(len(x)):
            try:
                R+=x[j]*moltiplicare[j]
            except:
                print('Invalid query: one or more words are not in the database')
                return
        dict_v[i] = numpy.dot(R,b) / (LA.norm(R)*LA.norm(b))

        if L <100:
            if len(dict_v)%10==0:
                print("Done %s on %s " %(len(dict_v),L))
        else:
            if len(dict_v)%100==0:
                print("Done %s on %s " %(len(dict_v),L))


    # find top 10 docs
    top10_values = nlargest(10, dict_v.values())
    classifica=deque()
    for i in top10_values:
        for b in dict_v.values():
            if i == b:
                classifica.append(list(dict_v.keys())[list(dict_v.values()).index(b)])
    lista_finale=deque()
    for i in song_id:
        for m in classifica:
            if m == i[0]:
                lista_finale.append(i[1])
    print('These are the song name:',list(lista_finale))

    return
```

```
In [1]: def query_2():
            # find stem in queryy
            query=[st.stem(i) for i in queryy]
            print('Be patient, we are searching for the documents')

            dq = []
            for i in index:
                for j in i:
                    if any(query[o] == j for o in range(len(query))):
                        dq.append(i)
            aa=[]
            for i in dq:
                for k in i.values():
                    aa.append([x[0] for x in k])
            aa=[j for i in aa for j in i]

            # Find the documents that contein all the query term
            comuni=list(set([x for x in aa if aa.count(x) >= len(query)]))
```

```
L=len(comuni)
if L == 0:
    print('No documents')
    return

print('Found %s documents , give a value' %len(comuni))
k=int(input())

# vvv will contain a dictionary for each doc that matches the query, with words an
vvv = []
# vocabolario will contain all the words of the union of all the documents taken o
vocabolario = set()

for i in comuni:
    vettori=[]
    for j in range(len(dizionario)):
        G = str(dizionario[j].keys())[12:-3]
        if i == G:
            C = dizionario[j][G]
    Query=[]
    b1=[]
    b2=[]
    for kk in C.keys():
        vocabolario.add(kk)
        try:
            b2.append(indexx_idf[kk])
        except:
            b2.append(0)
    for kk in C.values():
        b1.append(kk)
    b1=numpy.array(b1)
    b2=numpy.array(b2)
    b=b1*b2

    f = {}
    KEY = []
    bb= [float(i)/numpy.linalg.norm(b) for i in b]
    for w in C.keys():
        KEY.append(w)
    for t in range(len(b)):
        f[KEY[t]] = bb[t]
    vvv.append(f)
Q = []
for i in range(len(comuni)):
    #vector that will contain the values related to the words, with the order in w
    V = []
    for j in vocabolario:
        if j not in vvv[i]:
            V.append(0)
        if j in vvv[i]:
            V.append(vvv[i][j])
    Q.append(V)
kmeans = KMeans(n_clusters = k, init = 'random')
kmeans.fit(Q)
pred = kmeans.predict(Q)

#Associate the number of the cluster to each document
dict_cluster = dict(zip(comuni,pred))

# Regroup by n clusters
inv_map = {}
for l, v in dict_cluster.items():
    inv_map[v] = inv_map.get(v, [])
    inv_map[v].append(l)
artist=[]
for ok in inv_map.values():
    artisti=[]
    for j in ok:
        for i in range(len(dataset)):
            if dataset[i]['_id']['$oid'] == j:
                artisti.append(dataset[i]['artist'])
    artist.append(artisti)

song_name=[]
for ok in inv_map.values():
    canzoni=[]
    for j in ok:
        for i in range(len(dataset)):
            if dataset[i]['_id']['$oid'] == j:
                canzoni.append(dataset[i]['song-name'])
    song_name.append(canzoni)

lyrics=[]
for ok in inv_map.values():
    testi=[]
    for j in ok:
        for i in range(len(dataset)):
            if dataset[i]['_id']['$oid'] == j:
                testi.append(dataset[i]['lyrics'])
    lyrics.append(testi)

# Remove stopwords
stp1=stopwords.words('arabic')
stp2=stopwords.words('danish')
stp3=stopwords.words('dutch')
stp4=stopwords.words('english')
```

```
stp5=stopwords.words('finnish')
stp6=stopwords.words('french')
stp7=stopwords.words('german')
stp8=stopwords.words('hungarian')
stp9=stopwords.words('italian')
stp10=stopwords.words('kazakh')
stp11=stopwords.words('norwegian')
stp12=stopwords.words('portuguese')
stp13=stopwords.words('romanian')
stp14=stopwords.words('russian')
stp15=stopwords.words('spanish')
stp16=stopwords.words('swedish')
stp17=stopwords.words('turkish')
other_words=["dont", "cant", "youre", "aint"]
stp4=stp4+other_words

vuota=[]
for i in lyrics:
    for line in i:
        prima=[]
        text=' '.join([word for word in line.lower().translate(str.maketrans('', '
                      if len(word) >=2 and word not in stp1
                      and word not in stp2
                       and word not in stp3
                       and word not in stp4
                       and word not in stp5
                       and word not in stp6
                       and word not in stp7
                       and word not in stp8
                       and word not in stp9
                       and word not in stp10
                       and word not in stp11
                       and word not in stp12
                       and word not in stp13
                       and word not in stp14
                       and word not in stp15
                       and word not in stp16
                       and word not in stp17])
        prima.append(text)
    vuota.append(prima)

prova=[]
for kkk in vuota:
    canzone=[]
    for sentence in kkk:
        for word in re.split('\s', sentence): # split with whitespace
            canzone.append(word)
    prova.append(canzone)
```

```
            lyri=[]
            for i in prova:
                lst2=Counter(i).most_common(10)
                lyri.append([x[0] for x in lst2])

            aaa=artist+song_name+lyri
            cloud=[]
            for i in range(0,k):
                cloud.append(aaa[i]+aaa[i+k]+aaa[i+k+k])

            for i in cloud:
                str1=' '.join(i)
                wordcloud=WordCloud(background_color='green',
                                    width=1200,
                                    height=1000).generate(str1)
                plt.imshow(wordcloud)
                plt.axis('off')
                plt.show()

            return

In [ ]: print('enter set of words')
        queryy=(input().split())

        # Stem query
        query=[]
        for i in queryy:
            documents = st.stem(i)
            query.append(documents)

        print("Choose query 1 or 2")
        n=int(input())
        if n==1:
            start_time=time.time()
            query_1()
        elif n==2:
            start_time=time.time()
            query_2()
        else:
            print('Wrong digit')
            for i in (3,2,1):
                print('Computer will self-destruct %s seconds '%i)
                time.sleep(1)
            print('Boom')

        print(' used %s second' %(time.time()-start_time))
```