lab4

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0.1 IDs: 313429607, 317225993

[4]:
```
# -*- coding: utf-8 -*-
"""
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@author: ravros
"""
import numpy as np
import re
from sklearn.cluster import KMeans
import matplotlib.pyplot as plt
from sklearn.metrics import silhouette_samples, silhouette_score
```

[5]:
```
#functions defonotion
def readFile(fileName):
    file = open(fileName,'r',encoding="cp437")
    fileStr = ""
    for line in file:
        fileStr += line
    return fileStr

# Remove extra spaces
# Remove non-letter chars
# Change to lower
def preProcess(fileStr):
    fileStr = re.sub(" +"," ", fileStr)
    fileStr = re.sub("[^a-zA-Z ]","", fileStr)
    fileStr = fileStr.lower()
    return fileStr

#Divide the file in chuncks of the same size wind
def partition_str(fileStr, wind):
    n = wind
    chunks = [fileStr[i:i+n] for i in range(0, (len(fileStr)//n)*n, n)]
    #print(chunks)
    count = len(chunks)
    return chunks, count;
```

1 result 1 + 2

[6]:
```
fileContant = preProcess(readFile("text1.txt"))
#wind - chunks size
wind = 5000
#Divide the each file into chunks of the size wind
chunks, count = partition_str(fileContant, wind)
wordsSet =  set(fileContant.split())
stopWordsSet = set(readFile('stopwords_en.txt').split())
dictionary = wordsSet.difference(stopWordsSet)
```

[7]:
```
# Count the number of dictionary words in files - Frequency Matrix
wordFrequency = np.empty((count,len(dictionary)),dtype=np.int64)
for i in range(count):
    print(i)
    for j,word in enumerate(dictionary):
        wordFrequency[i,j] = len(re.findall(word,chunks[i]))
```

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[10]:
```
# find the distance matrix between the text files - Distance Matrix
dist = np.empty((count,count))
for i in range(count):
    for j in range(count):
```

```
        # calculate the distance between the frequency vectors
        dist[i,j] = np.linalg.norm(wordFrequency[i,:]-wordFrequency[j,:])
# find the sum of the frequency colomns and select colomns having sum > 100
minSum = 100
sumArray =  wordFrequency.sum(axis=0)
indexArray = np.where(sumArray > minSum)

indexArraySize = len(indexArray[0])
wordFrequency1 = np.empty((count,indexArraySize),dtype=np.int64)

# generate a frequencey file with the selected coloumns
for j in range(indexArraySize):
    wordFrequency1[:,j] = wordFrequency[:,indexArray[0][j]]

 # find the another distance matrix between the text files
dist1 = np.empty((count,count))
for i in range(count):
    for j in range(count):
        dist1[i,j] = np.linalg.norm(wordFrequency1[i,:]-wordFrequency1[j,:])

np.save('dist2',dist1,allow_pickle = True)
```

2 result 4

[11]:
```
#finction clust
def clust(dist,n_cl):

#cluster the data into k clusters, specify the k
    kmeans = KMeans(n_clusters = n_cl)
    kmeans.fit(dist)
    #labels_ = best_label // its the symbol for each point (vector) to which␣
 ↪center
    #from couple of seeds and its detail the number cluster
    labels = kmeans.labels_ +1
    # its will be shaped like [1,46(data vectors)] something like this yes
#show the clustering results
    fig = plt.figure()
    # defines the size of the plot in squares where [0,0,1,1] will be a regular␣
 ↪plot
    ax = fig.add_axes([0,0,1,1])
    ax.bar(range(len(labels)),labels)
    plt.show()

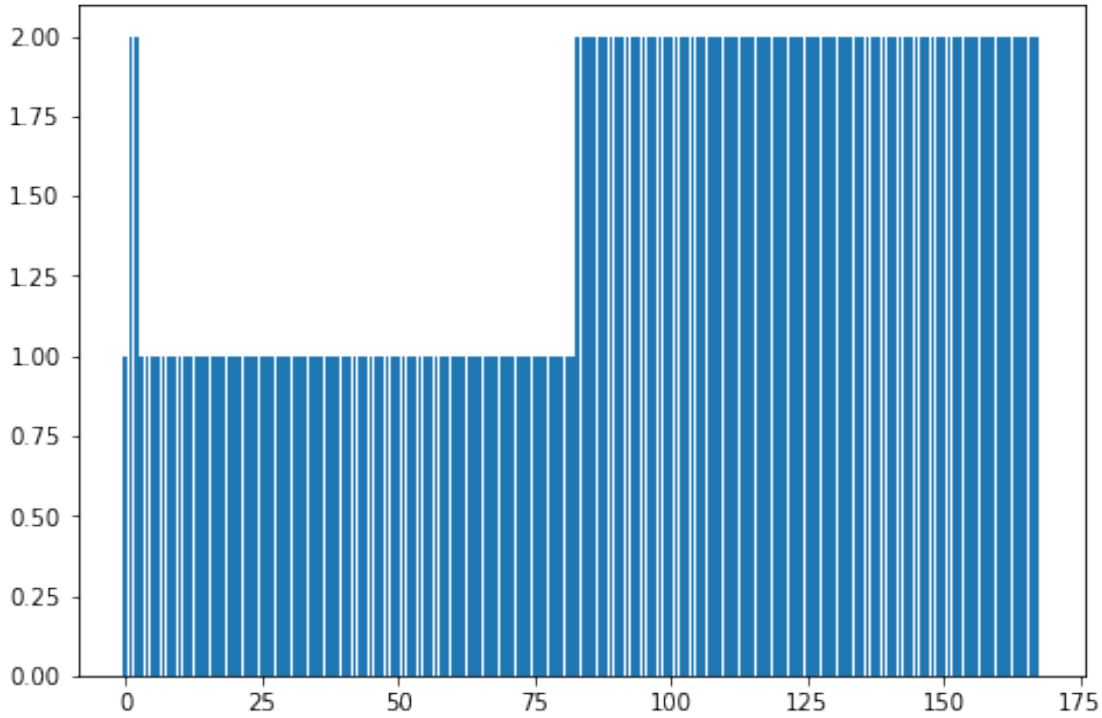
# calculate the silhouette values
    silhouette_avg_ = silhouette_score(dist, labels)
    sample_silhouette_values_ = silhouette_samples(dist, labels)
```

```
    print(silhouette_avg_)
# show the silhouette values
    plt.plot(sample_silhouette_values_)
    plt.plot([silhouette_avg_]*46, 'r--') #useless line
    plt.title("The silhouette plot for the various vectors.")
    plt.xlabel("data number ")
    plt.ylabel("silhouette value for each value")
    y=silhouette_avg_
    xmin=0
    xmax=len(labels)
# The vertical line for average silhouette score of all the values
    plt.hlines(y, xmin, xmax, colors='red', linestyles="--")
    plt.show()

    print("For n_clusters =", n_cl,
      "The average silhouette_score is:", silhouette_avg_)
    return labels
```

3 result 5 + 6

[16]:
```
dist = np.load('dist2.npy')
labels = clust(dist1, 2)
lab = labels
```



```
0.4712231608404145
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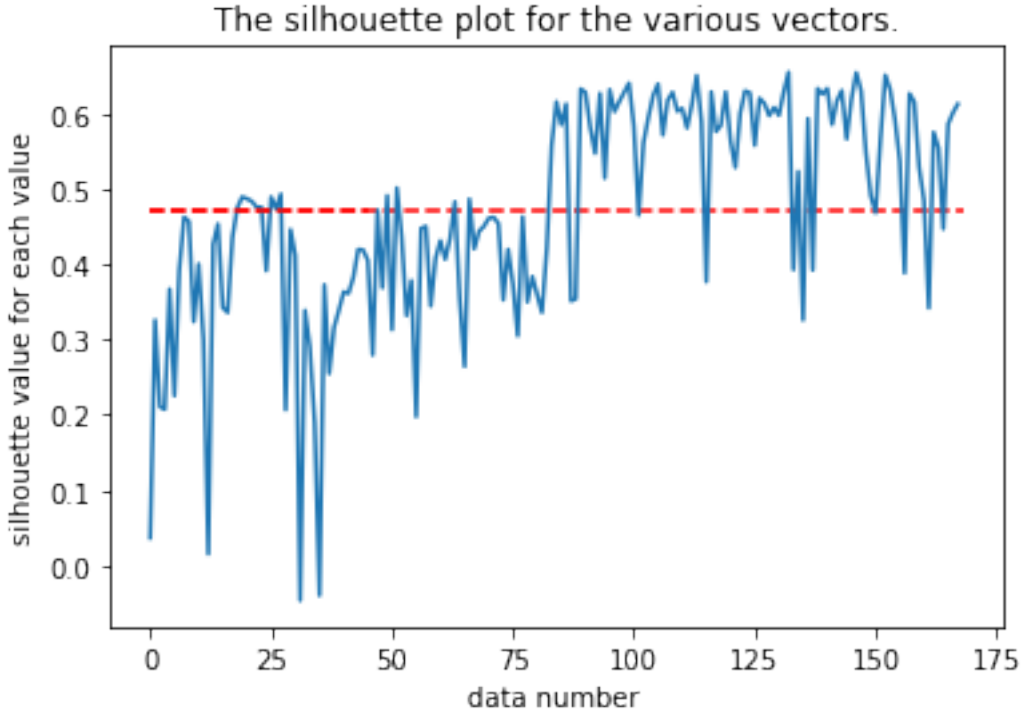
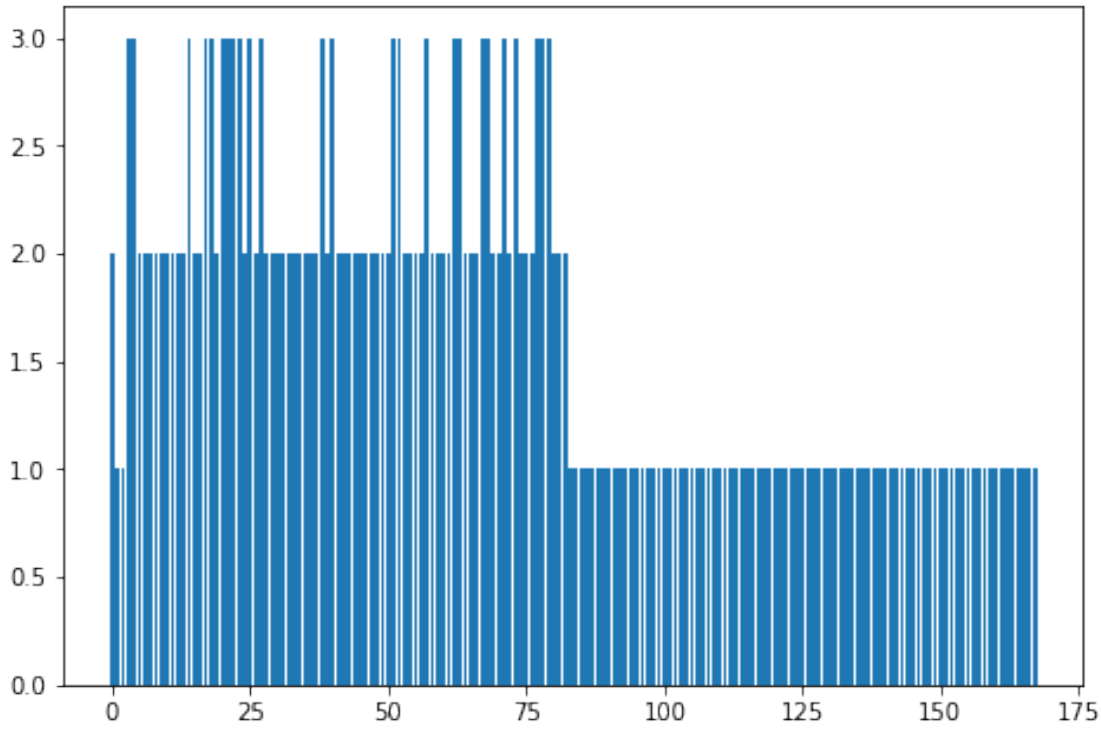



```
For n_clusters = 2 The average silhouette_score is: 0.4712231608404145
```

[13]:
```
labels = clust(dist1, 3)
```




```
0.4006021543430056
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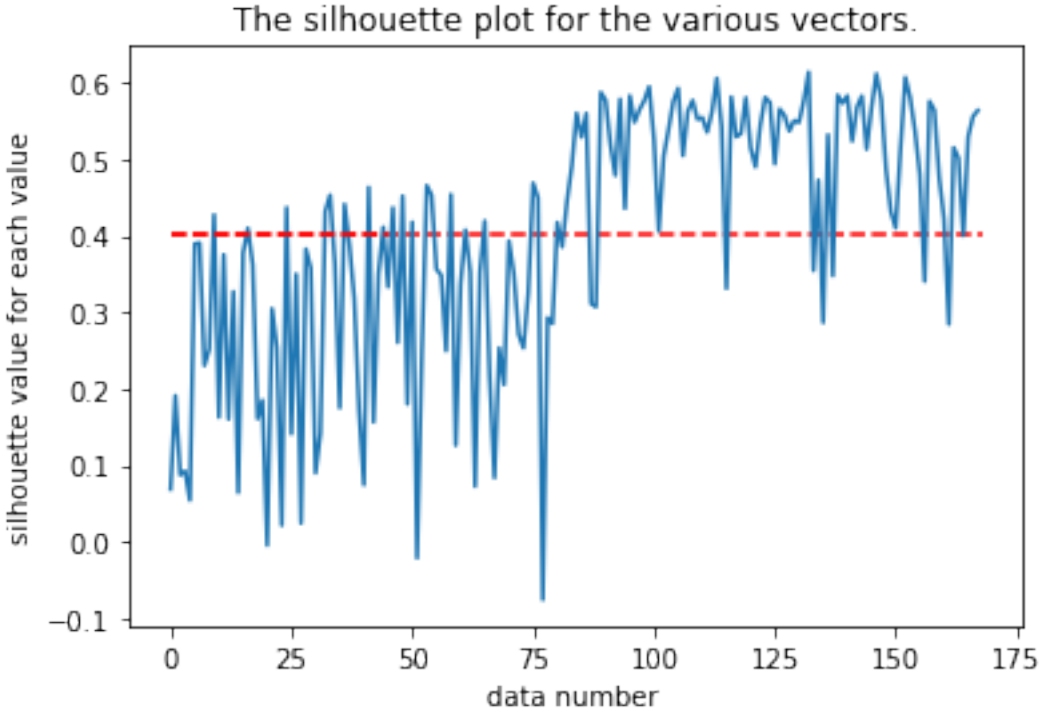
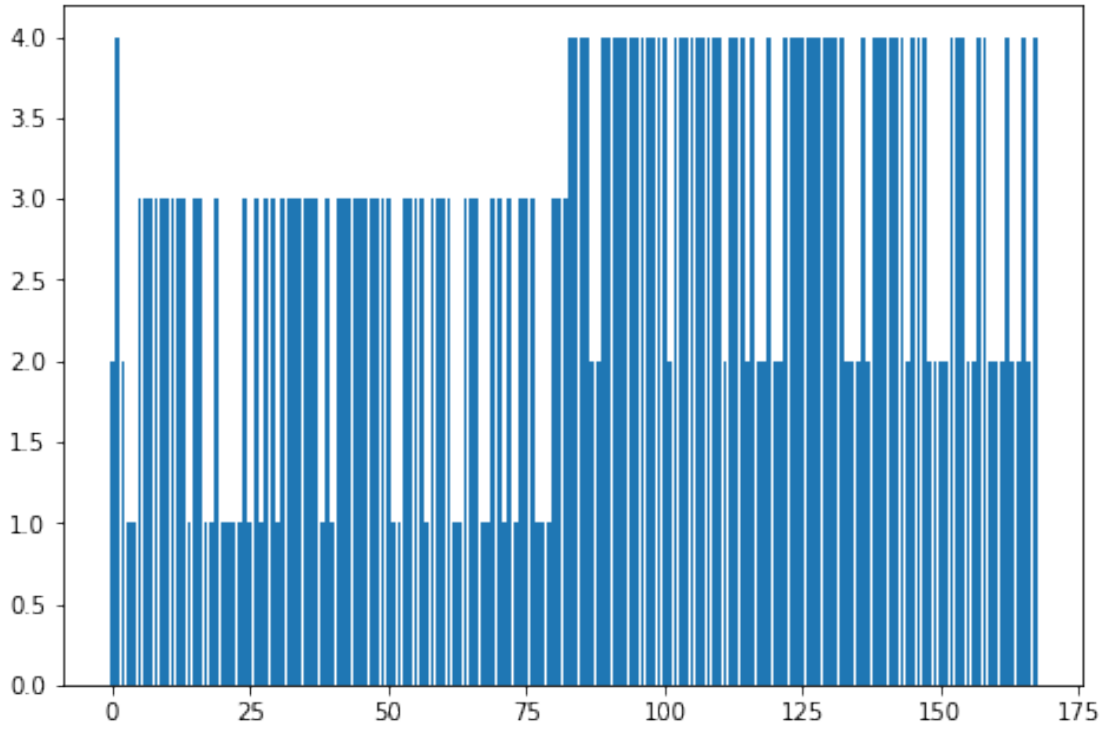


```
For n_clusters = 3 The average silhouette_score is: 0.4006021543430056
```

[14]:
```
labels = clust(dist1, 4)
```

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0.26073156331512976
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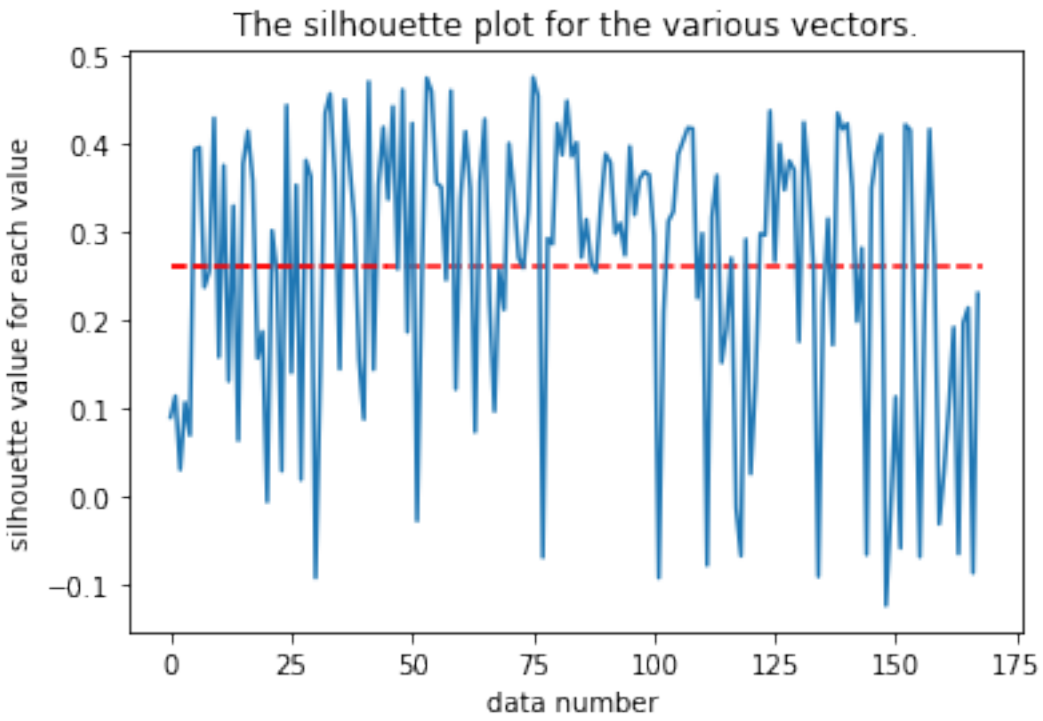


```
For n_clusters = 4 The average silhouette_score is: 0.26073156331512976
```

4 result 7

after looking at the results we noticed that k=2 has an avg_silhoute = ~0.47 which is the highest among the Ks that we tested.
that's why there are probably 2 books.

5 result 8

in chunk 83 was the first time we noticed the begining of the second book and after 415000 charecters

[27]:
```
strin = ""
for j,item in enumerate(lab):
   print("("+str(j)+","+str(item)+")")
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[20]:
```
83*5000
```

[20]:
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415000
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6 result 9

[51]:
```
def bookDetection(wind):
    prev = lab[0]
    counter = 0
    l = []
    prev_index = 0
    for j,item in enumerate(lab):
        if item != prev:
            counter += 1
        else:
            counter = 0
        if counter == 5:
            l.append((prev_index*wind,(j - 4)*wind))
            prev_index = j-4
            counter = 0
            prev = item
    l.append((prev_index*wind,j*wind))
    return l
```

[53]:
```
bookDetection(wind)
```

[53]:
```
[(0, 415000), (415000, 835000)]
```

the function returns list of tuples where each tuple has two elements , the first one is the begining of the book and the second one is the ending of the book

and we can see that the function doesn't even need the k we found and can automaticly detect each book section and return a list of books.