In [202]:
```
#Cleaning House

import pandas as pd
import numpy as np

with open('lyrics.csv', 'r', encoding = 'utf8') as f:
    lyrics = f.readlines()

lyrics_df = pd.read_csv('lyrics.csv')
#dropping rows which do not have lyrics by first assigning nan to blank rows
lyrics_df['lyrics'] = lyrics_df['lyrics'].replace(' ', np.nan)
lyrics_df = lyrics_df.dropna(axis=0, subset=['lyrics'])
```

In [203]:
```
lyrics_df.head(357)
```

Out[203]:

	index	song	year	artist	genre	lyrics
0	0	ego-remix	2009	beyonce-knowles	Pop	Oh baby, how you doing?\nYou know I'm gonna cu...
1	1	then-tell-me	2009	beyonce-knowles	Pop	playin' everything so easy,\nit's like you see...
2	2	honesty	2009	beyonce-knowles	Pop	If you search\nFor tenderness\nIt isn't hard t...
3	3	you-are-my-rock	2009	beyonce-knowles	Pop	Oh oh oh I, oh oh oh I\n[Verse 1:]\nIf I wrote...
4	4	black-culture	2009	beyonce-knowles	Pop	Party the people, the people the party it's po...
...	...	...	...	...	...	...
391	391	oh	2006	daliah-lavi	Not Available	Montag Dienstag Mittwoch\nDonnerstag Freitag S...
392	392	weisst-du	2006	daliah-lavi	Not Available	Weit du? Weit du\nwas du für mich bist?\nWeit ...
393	393	wer-hat-mein-lied-so-zerstrthrt	2006	daliah-lavi	Not Available	Wer hat mein Lied so zerstört\nMa\nWer hat mei...
404	404	hourglass	2004	borialis	Rock	A lot of cats are hatin', slandering makin' ba...
407	407	why-oh-why	2004	borialis	Rock	Somebody tell me why we landed here on the pla...

357 rows × 6 columns

In [204]:
```
lyrics_df['lyrics'] = lyrics_df['lyrics'].str.replace('\n', ' ', regex=True)
```

In [205]:
```
#adpated from https://stackoverflow.com/questions/44476881/replacing-non-alphabet-characters-from-pa
ndas-column
lyrics_df['lyrics'] = lyrics_df['lyrics'].str.replace('[^a-zA-Z]', ' ', regex=True)
```

In [206]:
```
#Observe changes using .head()

lyrics_df.head(65)
```

Out[206]:

	index	song	year	artist	genre	lyrics
0	0	ego-remix	2009	beyonce-knowles	Pop	Oh baby how you doing You know I m gonna cut...
1	1	then-tell-me	2009	beyonce-knowles	Pop	playin everything so easy it s like you seem...
2	2	honesty	2009	beyonce-knowles	Pop	If you search For tenderness It isn t hard to ...
3	3	you-are-my-rock	2009	beyonce-knowles	Pop	Oh oh oh I oh oh oh I Verse If I wrote a...
4	4	black-culture	2009	beyonce-knowles	Pop	Party the people the people the party it s po...
...	...	...	...	...	...	...
60	60	partition	2013	beyonce-knowles	Pop	Part Yonc Intro Let me hear you say ...
61	61	ghost	2013	beyonce-knowles	Pop	Intro Presenter The winner is Beyonce Knowl...
62	62	xo	2013	beyonce-knowles	Pop	Verse Your love is bright as ever Even in ...
63	63	single-ladies-put-a-ring-on-it	2013	beyonce-knowles	Pop	All the single ladies All the single ladies ...
64	64	on-the-run	2013	beyonce-knowles	Pop	Intro Beyonc Who wants that perfect love ...

65 rows × 6 columns

In [207]:
```
import nltk
from nltk.stem import WordNetLemmatizer
from nltk.tokenize import word_tokenize
lemmatizer = WordNetLemmatizer()
```

In [208]:
```
def token(text):
    return word_tokenize(text)

def lem(word):
    return lemmatizer.lemmatize(word)

#Source: https://stackoverflow.com/questions/47557563/lemmatization-of-all-pandas-cells
#Worked in part with Erik Lovece
def lemmatize_text(text):
    text = [lem(w) for w in token(text)]
    text = ' '.join(text)
    return text
```

In [209]:
```
#This code takes quite a while to run to avoid re-running each time...
#lyrics_df['lyrics'] = lyrics_df.lyrics.apply(lemmatize_text)
```

In [210]:
```
#Convert updated data frame into a csv file.
lyrics_df.to_csv('clean_lyrics.csv', encoding = 'utf8', index = False)
```

In [214]:
```
#Reading clean_lyrics.csv file
with open('clean_lyrics.csv', 'r', encoding = 'utf8') as f:
    lyrics = f.readlines()

lyrics_df = pd.read_csv('clean_lyrics.csv')
```

In [ ]:
```
# Harvard IV-4 Cleaning
```

In [252]:
```
#Reading inquireraugmented excel file
#Source: https://www.geeksforgeeks.org/reading-excel-file-using-python/
import pandas as pd
#Insert complete path to excel file
path='C:\\Users\\15713\\Documents\\inquireraugmented.xls'
IA_df = pd.read_excel(path)
```

In [253]:
```
#Removing non-alphabetical characters from the columns
IA_df['Positiv'] = IA_df['Positiv'].str.replace('[^a-zA-Z]', ' ', regex=True)
IA_df['Negativ'] = IA_df['Negativ'].str.replace('[^a-zA-Z]', ' ', regex=True)
```

In [582]:
```
#Filter for necessary columns "Entry," "Positiv," "Negativ"
IA_DF1 = IA_df[['Entry','Positiv','Negativ']].filter(regex ='Positiv')
```

In [297]:
```
IA_DF1
```

Out[297]:

	Entry	Positiv	Negativ
0	NaN	NaN	NaN
1	A	NaN	NaN
2	ABANDON	NaN	Negativ
3	ABANDONMENT	NaN	Negativ
4	ABATE	NaN	Negativ
...	...	...	...
11784	ZENITH	Positiv	NaN
11785	ZERO	NaN	NaN
11786	ZEST	Positiv	NaN
11787	ZINC	NaN	NaN
11788	ZONE	NaN	NaN

11789 rows × 3 columns

In [298]:
```
#Filter for only "Positiv" in "Positiv" column and create a separate data frame. This will help impr
ove processing time.
IA_pos = IA_DF1.loc[IA_DF1['Positiv'] == 'Positiv']
```

In [299]:
```
#Filter for "Negativ" from a smaller data frame to improve processing time when applying function on
large dataset.
IA_neg = IA_DF1.loc[IA_DF1['Negativ'] == 'Negativ']
```

In [300]:
```
IA_pos
```

Out[300]:

	Entry	Positiv	Negativ
8	ABIDE	Positiv	NaN
9	ABILITY	Positiv	NaN
11	ABLE	Positiv	NaN
18	ABOUND	Positiv	NaN
41	ABSOLVE	Positiv	NaN
...	...	...	...
11703	WORTH-WHILE	Positiv	NaN
11704	WORTHINESS	Positiv	NaN
11706	WORTHY	Positiv	NaN
11784	ZENITH	Positiv	NaN
11786	ZEST	Positiv	NaN

1915 rows × 3 columns

In [624]:
```
# insert the name of the column as a string in brackets to create positive and negative list.
pos_list = list(IA_pos['Entry'][2:][(IA_pos['Positiv'].notnull())])
neg_list = list(IA_neg['Entry'][2:][(IA_neg['Negativ'].notnull())])
```

In [302]:
```
#Sentiment score function
#Worked in part with Erik Lovece
#Create sentiment score function
def sentiment_scorer(text_input, sentiment_list):
    text_words = text_input.upper().split() #.upper to match words in pos and neg list
    sentiment_score = 0.

    #For loop to count words
    for word in text_words:
        if word in sentiment_list: sentiment_score += 1.
    #Count vectorization of positive and negative words  by counting presence positive and negative w
ords in lyrics
    #and dividing by total length of lyrics
    sentiment_score = sentiment_score / len(text_words)

    return sentiment_score
```

In [514]:
```
#Create an output list to find all genres in dataset.
genre_List = []
for genre in lyrics_df.genre:
    if genre not in genre_List: genre_List.append(genre)

genre_List
```

Out[514]:
```
['Pop',
 'Hip-Hop',
 'Not Available',
 'Rock',
 'Metal',
 'Other',
 'Country',
 'Jazz',
 'Electronic',
 'Folk',
 'R&B',
 'Indie']
```

In [277]:
```
#Apply the positive and negative score function to the lyrics data frame.
#lyrics_df['positive_sentiment'] = lyrics_df.lyrics.apply(pos_score)
#lyrics_df['negative_sentiment'] = lyrics_df.lyrics.apply(neg_score)
```

In [592]:
```
#Subset lyrics data frame based on genre
#Source: https://stackoverflow.com/questions/19237878/subsetting-a-python-dataframe
#Worked with Erik
Pop = lyrics_df[lyrics_df.genre == 'Pop']
HipHop = lyrics_df[lyrics_df.genre == 'Hip-Hop']
NA = lyrics_df[lyrics_df.genre == 'Not Available']
Rock = lyrics_df[lyrics_df.genre == 'Rock']
Metal = lyrics_df[lyrics_df.genre == 'Metal']
Other = lyrics_df[lyrics_df.genre == 'Other']
Country = lyrics_df[lyrics_df.genre == 'Country']
Jazz = lyrics_df[lyrics_df.genre == 'Jazz']
Electronic = lyrics_df[lyrics_df.genre == 'Electronic']
Folk = lyrics_df[lyrics_df.genre == 'Folk']
RB = lyrics_df[lyrics_df.genre == 'R&B']
Indie = lyrics_df[lyrics_df.genre == 'Indie']
```

In [224]:
```
#Apply pos and neg score to each subset of genre and create positive and negative sentiment column
# Source: https://pandas.pydata.org/pandas-docs/stable/reference/api/pandas.DataFrame.loc.html
#Indie.loc[:, 'negative_sentiment'] = 0.
#Indie.negative_sentiment = Indie.lyrics.apply(neg_score)
#Indie.loc[:, 'positive_sentiment'] = 0.
#Indie.positive_sentiment = Indie.lyrics.apply(pos_score)

#Pop.loc[:, 'negative_sentiment'] = 0.
#Pop.negative_sentiment = Pop.lyrics.apply(neg_score)
#Pop.loc[:, 'positive_sentiment'] = 0.
#Pop.positive_sentiment = Pop.lyrics.apply(pos_score)

#NA.loc[:, 'positive_sentiment'] = 0.
#NA.positive_sentiment = NA.lyrics.apply(pos_score)
#NA.loc[:, 'negative_sentiment'] = 0.
#NA.negative_sentiment = NA.lyrics.apply(neg_score)

#HipHop.loc[:, 'positive_sentiment'] = 0.
#NA.positive_sentiment = HipHop.lyrics.apply(pos_score)
#HipHop.loc[:, 'negative_sentiment'] = 0.
#NA.negative_sentiment = HipHop.lyrics.apply(neg_score)


#Rock.loc[:, 'negative_sentiment'] = 0.
#Rock.negative_sentiment = Rock.lyrics.apply(neg_score)
#Rock.loc[:, 'positive_sentiment'] = 0.
#Rock.positive_sentiment = Rock.lyrics.apply(pos_score)


#Metal.loc[:, 'negative_sentiment'] = 0.
#Metal.negative_sentiment = Metal.lyrics.apply(neg_score)
#Metal.loc[:, 'positive_sentiment'] = 0.
#Metal.positive_sentiment = Metal.lyrics.apply(pos_score)

#Other.loc[:, 'negative_sentiment'] = 0.
#Other.negative_sentiment = Other.lyrics.apply(neg_score)
#Other.loc[:, 'positive_sentiment'] = 0.
#Other.positive_sentiment = Other.lyrics.apply(pos_score)

#Country.loc[:, 'negative_sentiment'] = 0.
#Country.negative_sentiment = Country.lyrics.apply(neg_score)
#Country.loc[:, 'positive_sentiment'] = 0.
#Country.positive_sentiment = Country.lyrics.apply(pos_score)


#Jazz.loc[:, 'negative_sentiment'] = 0.
#Jazz.negative_sentiment = Jazz.lyrics.apply(neg_score)
#Jazz.loc[:, 'positive_sentiment'] = 0.
#Jazz.positive_sentiment = Jazz.lyrics.apply(pos_score)


#Electronic.loc[:, 'negative_sentiment'] = 0.
#Electronic.negative_sentiment = Electronic.lyrics.apply(neg_score)
#Electronic.loc[:, 'positive_sentiment'] = 0.
#Electronic.positive_sentiment = Electronic.lyrics.apply(pos_score)


#Folk.loc[:, 'negative_sentiment'] = 0.
#Folk.negative_sentiment = Folk.lyrics.apply(neg_score)
#Folk.loc[:, 'positive_sentiment'] = 0.
#Folk.positive_sentiment = Folk.lyrics.apply(pos_score)


#RB.loc[:, 'negative_sentiment'] = 0.
#RB.negative_sentiment = RB.lyrics.apply(neg_score)
#RB.loc[:, 'positive_sentiment'] = 0.
#RB.positive_sentiment = RB.lyrics.apply(pos_score)
```

In [ ]:
```
#Create score column on each data frame that takes the sum of positive and negative score
#sum = Indie["score"] =  Indie.positive_sentiment + Indie.negative_sentiment
#sum = Pop["score"] = Pop.positive_sentiment + Pop.positive_sentiment
#sum = NA["score"] = NA.positive_sentiment + NA.positive_sentiment
#sum = HipHop["score"] = HipHop.positive_sentiment + HipHop.positive_sentiment
#sum = Rock["score"] = Rock.positive_sentiment + Rock.positive_sentiment
#sum = Other["score"] = Other.positive_sentiment + Other.positive_sentiment
#sum = Country["score"] = Country.positive_sentiment + Country.positive_sentiment
#sum = Jazz["score"] = Jazz.positive_sentiment + Jazz.positive_sentiment
#sum = Electronic["score"] = Electronic.positive_sentiment + Electronic.positive_sentiment
#sum = Folk["score"] = Folk.positive_sentiment + Folk.positive_sentiment
#sum = RB["score"] = RB.positive_sentiment + RB.positive_sentiment
```

In [590]:
```
#To avoid re-running code save all changes made to the data frames by converting to csv file.
Indie.to_csv('Indie.csv', encoding = 'utf8', index = False)
Pop.to_csv('Pop.csv', encoding = 'utf8', index = False)
NA.to_csv('NA.csv', encoding = 'utf8', index = False)
HipHop.to_csv('HipHop.csv', encoding = 'utf8', index = False)
Rock.to_csv('Rock.csv', encoding = 'utf8', index = False)
Other.to_csv('Other.csv', encoding = 'utf8', index = False)
Country.to_csv('Country.csv', encoding = 'utf8', index = False)
Jazz.to_csv('Jazz.csv', encoding = 'utf8', index = False)
Electronic.to_csv('Electronic.csv', encoding = 'utf8', index = False)
Folk.to_csv('Folk.csv', encoding = 'utf8', index = False)
RB.to_csv('RB.csv', encoding = 'utf8', index = False)
```

In [495]:
```
#Concatenate all genres into one data frame
pdAgg = pd.concat([Indie, Pop, HipHop, Rock, Other, Country, Jazz, Electronic, Folk, RB ]).reset_ind
ex(drop=True)
```

In [496]:
```
pdAgg
```

Out[496]:

	index	song	year	artist	genre	lyrics	negative_sentiment	positive_sentiment	score
0	1643.0	losing-you	2014.0	dead-ceremony	Indie	Don t feel so bad It s just the way the wheel ...	0.009174	0.000000	0.009174
1	1988.0	wild-dreams	2014.0	desert-noises	Indie	Place outside where I pas to waste my time In ...	0.032086	0.010695	0.042781
2	1989.0	run-through-the-woods	2014.0	desert-noises	Indie	Fixin to run through the wood Leaving cause I ...	0.006289	0.006289	0.012579
3	1991.0	angels	2014.0	desert-noises	Indie	Play Twenty seven way To get outta town today ...	0.022989	0.022989	0.045977
4	1992.0	keys-on-the-table	2014.0	desert-noises	Indie	Left the key on the table Cause I know I could...	0.018349	0.004587	0.022936
...	...	...	...	...	...	...	...	...	...
218853	361034.0	you-re-the-one	2016.0	death-threat	R&B	I wish I wish that I had known I would ve neve...	0.013043	0.000000	0.000000
218854	361204.0	my-only	2016.0	goodnight-nurse	R&B	What happened to you and me One moment changed...	0.017241	0.057471	0.114943
218855	361209.0	this-is-it	2016.0	goodnight-nurse	R&B	Let s take it all away Replace it with everyth...	0.000000	0.000000	0.000000
218856	361211.0	details	2016.0	goodnight-nurse	R&B	I m consumed by the idol of you In my head i w...	0.015873	0.003968	0.007937
218857	361213.0	suffer	2016.0	goodnight-nurse	R&B	Its time to punch the clock To get back on the...	0.022556	0.045113	0.090226

218858 rows × 9 columns

In [626]:
```
#Create output list to see years in lyrics_df
year_List = []
for year in lyrics_df.year:
    if year not in year_List:
        year_List.append(year)

year_List
```

Out[626]:
```
[2009,
 2007,
 2013,
 2010,
 2012,
 2006,
 2016,
 2011,
 2015,
 2008,
 2014,
 1998,
 2002,
 1995,
 2004,
 1972,
 2005,
 1978,
 1970,
 1981,
 1994,
 1997,
 1993,
 1982,
 1983,
 1986,
 1992,
 1977,
 1989,
 1979,
 1996,
 2001,
 1990,
 1987,
 2003,
 1975,
 1973,
 1991,
 1999,
 1974,
 2000,
 1980,
 1984,
 1976,
 702,
 1971,
 1985,
 1988,
 112,
 1968,
 67]
```

In [497]:
```
#Group by genre and year and comput mean score.
pdfinal = pdAgg.groupby(['genre','year'])['score'].mean().to_frame('score').reset_index()
```

In [498]:
```
#Clean 'year' column
pdfinal['year'] = pdfinal['year'].astype(str).replace('\.0', '', regex=True)
```

In [503]:
```
pdtest = pdfinal.copy()
```

In [504]:
```
#Create yearList to increase years by increment of 5.
yearList = ["1968","1969","1970"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "1970"

yearList = ["1971","1972","1973","1974","1975"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "1975"

yearList = ["1976","1977","1978","1979","1980"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "1980"

yearList = ["1981","1982","1983","1984","1985"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "1985"

yearList = ["1986","1987","1988","1989","1990"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "1990"

yearList = ["1991","1992","1993","1994","1995"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "1995"

yearList = ["1996","1997","1998","1999","2000"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "2000"

yearList = ["2001","2002","2003","2004","2005"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "2005"


yearList = ["2006","2007","2008","2009","2010"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "2010"

yearList = ["2011","2012","2013","2014","2015"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "2015"

yearList = ["2016","2017","2018","2019","2020"]
pdtest.loc[pdtest.year.isin(yearList) == True, 'year']= "2020"
```

In [613]:
```
#Group by 'genre' and 'year' to compute mean score for plot of year by score for each genre
pdAgg = pdtest.groupby(['genre','year'])['score'].mean().to_frame('score').reset_index()
```

In [614]:
```
pdAgg
```

Out[614]:

	genre	year	score
0	Country	1970	0.058415
1	Country	1975	0.043673
2	Country	1980	0.046084
3	Country	1985	0.019968
4	Country	1990	0.026797
...	...	...	...
94	Rock	2000	0.024412
95	Rock	2005	0.026638
96	Rock	2010	0.024120
97	Rock	2015	0.023283
98	Rock	2020	0.022510

99 rows × 3 columns

In [615]:
```
pdfinal = pdAgg.copy()
```

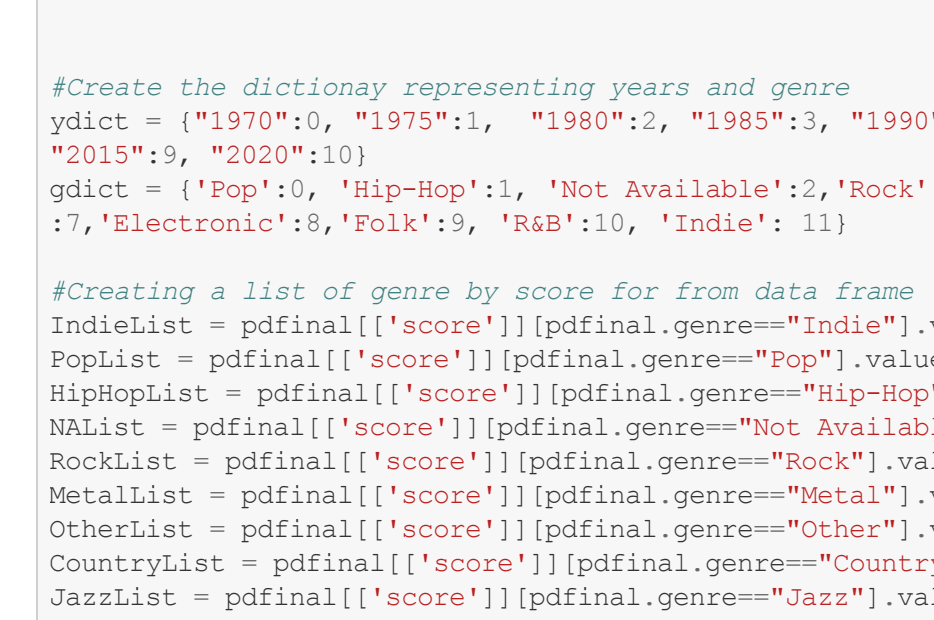
In [556]:
```
#Group by 'year' to compute mean score for plot of year by score regarless of genre
#http://www.datasciencemadesimple.com/group-dataframe-python-pandas-group-function-pandas/
pdfinal1 = pdAgg.groupby(['year'])['score'].mean().to_frame('score').reset_index()
```

In [617]:
```
#Remove unwanted values from 'year' column
pdfinal1 = pdfinal1[pdfinal1.year != '112']
pdfinal1 = pdfinal1[pdfinal1.year != '67']
pdfinal1 = pdfinal1[pdfinal1.year != '702']
```

In [620]:
```
#Create year by score plot regardless of genre
import matplotlib.pyplot as plt
import pandas as pd

plt.scatter(pdfinal1.year, pdfinal1.score, s = 35, c = "red")

plt.xlabel('year')
plt.ylabel('sentiment score')
plt.title('Sentiment Score Averaged over Years')
plt.show()
```



In [627]:
```
import matplotlib.pyplot as plt
#Source: https://matplotlib.org/

#Create the plot function using years and genre list
years = [ "1970","1975","1980","1985", "1990", "1995", "2000", "2005", "2010", "2015", "2020"]
genre = ['Pop','Hip-Hop','Not Available','Rock','Metal','Other','Country','Jazz','Electronic','Folk'
, 'R&B', 'Indie']


#Create the dictionay representing years and genre
ydict = {"1970":0, "1975":1,  "1980":2, "1985":3, "1990":4, "1995":5, "2000":6, "2005":7, "2010":8,
"2015":9, "2020":10}
gdict = {'Pop':0, 'Hip-Hop':1, 'Not Available':2,'Rock':3, 'Metal':4, 'Other':5, 'Country':6, 'Jazz'
:7,'Electronic':8,'Folk':9, 'R&B':10, 'Indie': 11}

#Creating a list of genre by score for from data frame
IndieList = pdfinal[['score']][pdfinal.genre=="Indie"].values
PopList = pdfinal[['score']][pdfinal.genre=="Pop"].values
HipHopList = pdfinal[['score']][pdfinal.genre=="Hip-Hop"].values
NAList = pdfinal[['score']][pdfinal.genre=="Not Available"].values
RockList = pdfinal[['score']][pdfinal.genre=="Rock"].values
MetalList = pdfinal[['score']][pdfinal.genre=="Metal"].values
OtherList = pdfinal[['score']][pdfinal.genre=="Other"].values
CountryList = pdfinal[['score']][pdfinal.genre=="Country"].values
JazzList = pdfinal[['score']][pdfinal.genre=="Jazz"].values
ElectronicList = pdfinal[['score']][pdfinal.genre=="Electronic"].values
FolkList = pdfinal[['score']][pdfinal.genre=="Folk"].values
RBList = pdfinal[['score']][pdfinal.genre=="R&B"].values

#Creating Matrix of lists
testdata = np.array([IndieList, PopList, HipHopList, NAList, RockList, MetalList, OtherList, Country
List, JazzList, ElectronicList, FolkList, RBList])

def myPlot (data,genre_List):
    #Define color and marker shape
    Col = {"Indie": "b","Pop": "r","Hip-Hop": "g", "Not Available": "y", "Rock": "c", "Metal": "m",
"Other": "k", "Country": "y", "Jazz": "g",
           "Electronic": "b", "Folk": "m", "R&B": "r"}
    Mrk = {"Indie": "h","Pop": "s","Hip-Hop": ".", "Not Available": ",", "Rock": "o", "Metal": ">",
"Other": "<", "Country": "1", "Jazz": "2",
           "Electronic": "3", "Folk": "+", "R&B": "D"}
    #Creating plot
    for genre in genre_List:
        plt.plot(data[gdict[genre]],c=Col[genre],ls='',marker=Mrk[genre],ms='7',label=genre),
        plt.legend(loc='upper left',bbox_to_anchor=(1,1)),
        plt.xticks(list(range(0,11)),years,rotation='vertical'),
        plt.ylim(0,.04),
    #Lable plot
    plt.xlabel('year')
    plt.ylabel('sentiment score')
    plt.title('Sentiment Score Averaged over Years by Genre')
    plt.figure(figsize=(10,10))
    plt.show()
```