Step 1: Import Packages & Spotify Authentication

In [1]:

```
import sys
import spotipy
import spotipy.util as util
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

scope = 'user-library-read'
token = util.prompt_for_user_token("11100316938",scope,client_id='bddfdc9233b5493899809dcc42ca5cc3',client_secret='d97a1e581b5f4b4b9da348d6a0529e02',redirect_uri='http://localhost:5000/callback')
spotify = spotipy.Spotify(auth = token)
```

Functions

getPlaylistFeatures()

returns an array with DataFrame of Tracks and Name of playlist in the following tuple

- (playlistDF, playlistName)

In [2]:

```
def getPlaylistFeatures(playlistURI, playlistNum):

    userPlaylistResponse = spotify.user_playlist("11100316938", playlistURI)
    playlistName = userPlaylistResponse["name"]

    #tracks are returned in this JSON response
    tracksResponse = spotify.user_playlist_tracks("11100316938", playlistURI)
    tracks = tracksResponse["items"]

    #instantiate an empty array and place the Tracks URI in this array
    tracksArray = []
    for track in tracks:
        URI = track["track"]["id"]
        tracksArray.append(URI)

    dfArray = [] #empty array the DataFrame will intake
    dfColumns = ["trackURI", "danceability", "energy", "speechiness", "acousti
cness", "instrumentalness", "liveness", "valence", "playlistNum"] #columns tha
t make DataFrame

    #code to iterate through each track URI and get its respective features
    for trackURI in tracksArray:
        trackFeatures = spotify.audio_features(trackURI)

        danceability = trackFeatures[0]["danceability"]
        energy = trackFeatures[0]["energy"]
        speechiness = trackFeatures[0]["speechiness"]
        acousticness = trackFeatures[0]["acousticness"]
        instrumentalness = trackFeatures[0]["instrumentalness"]
        liveness = trackFeatures[0]["liveness"]
        valence = trackFeatures[0]["valence"]

        tempArray = [trackURI, danceability, energy, speechiness, acousticness
, instrumentalness, liveness, valence, playlistNum]
        dfArray.append(tempArray)

    playlistDF = pd.DataFrame(dfArray, columns = dfColumns)
    return (playlistDF, playlistName)
```

mostDissimilarFeatures(playlist1,playlist2)

- returns a dataframe with the most dissimilar features in descending order
- the dissimilarity is computed with Euclidean Distance between the means of each features respective to their playlist

In [3]:

```
def mostDissimilarFeatures(playlist1DF, playlist2DF):
#     playlist1 = getPlaylistFeatures(playlist1, 1)
#     playlist2 = getPlaylistFeatures(playlist2, 2)

    playlist1Mean = pd.DataFrame(playlist1DF[["danceability", "energy", "speec
hiness", "acousticness", "instrumentalness", "liveness", "valence"]].mean(), c
olumns = ["playlist1"])
    playlist2Mean = pd.DataFrame(playlist2DF[["danceability", "energy", "speec
hiness", "acousticness", "instrumentalness", "liveness", "valence"]].mean(), c
olumns = ["playlist2"])

    mergedMeans = playlist1Mean.join(playlist2Mean)

    differenced = mergedMeans.assign(absoluteDifference = lambda x: np.absolut
e(mergedMeans["playlist1"] - mergedMeans["playlist2"]))
    differenced = differenced.sort_values("absoluteDifference", ascending = Fa
lse)

    display(differenced)
    playlist1Mean.plot(kind='bar')
    playlist2Mean.plot(kind='bar')

    topDissimilar = differenced.index

    return topDissimilar
```

plotPlaylists(playlist1, playlist2)

- plots the top two dissimilar features amongsts the two playlist to help us visualize how different or similar they are

In [4]:

```
def plotPlaylists(playlist1, playlist2, feature1, feature2):
#     feature1 = "acousticness"
#     feature2 = "instrumentalness"

    playlist1DF = playlist1[0]
    playlist2DF = playlist2[0]

    playlist1Name = playlist1[1]
    playlist2Name = playlist2[1]

    plt.scatter(playlist1DF[feature1], playlist1DF[feature2], c = "r")
    plt.scatter(playlist2DF[feature1], playlist2DF[feature2], c = "g")
    plt.xlabel(feature1)
    plt.ylabel(feature2)
    plt.legend(labels = [playlist1Name, playlist2Name])
    plt.show
```

KNNPredict(songURI, kNeighbors)

- this function will take a user input a song and tell you which playlist the song best belongs to using K-Nearest Neighbors Algorithm that is built into SciKit Learn
- Model is fitted from a dataFrame that contains the following:
  - Input: [feature1, feature2]
  - Output: Classification ... or which playlist those features belong to

In [5]:

```
def KNNPredict(kNeighbors, playlist1, playlist2, feature1, feature2, songFeatu
res):

    merge = [playlist1[0],playlist2[0]]
    dfMerge = pd.concat(merge)

    features = dfMerge[[feature1,feature2]]
    classification = dfMerge['playlistNum']

    model = KNeighborsClassifier(n_neighbors=kNeighbors)
    model.fit(features, classification)

#     return(model)
    return(model.predict([songFeatures]))
```

getSongFeatures(songURI)

- gets the features from the song to analyze and then eventually predict.
- returns a DataFrame of song features

In [6]:

```
def getSongFeature(songURI):
    features = spotify.audio_features(songURI)
    features = features[0]

    display(features)

    danceability = features["danceability"]
    energy = features["energy"]
    speechiness = features["speechiness"]
    acousticness = features["acousticness"]
    instrumentalness = features["instrumentalness"]
    liveness = features["liveness"]
    valence = features["valence"]

    dfArray = [danceability, energy, speechiness, acousticness, instrumentalne
ss, liveness, valence] #empty array the DataFrame will intake
    dfColumns = ["danceability", "energy", "speechiness", "acousticness", "ins
trumentalness", "liveness", "valence"] #columns that make DataFrame

    trackFeatures = pd.DataFrame(dfArray, index = dfColumns)
    trackFeatures = trackFeatures.transpose()
    return(trackFeatures)
```

getSongName(songURI)

In [7]:

```
def getSongName(songURI):
    trackName = (spotify.track(songURI)["name"])
    return(trackName)
```

Step 2: Input Playlist to Analyze

- Using two Spotify featured playlists' playlistID's

In [8]:

```
playlist1Input = '296W1tgCGPvAjyCSSdiUsG' #slow rock
playlist2Input = '37i9dQZF1DXcZDD7cfEKhW' #dance pop
```

Step 3: Retrieve Playlists Information

- Call the function to retrieve the tracks from each playlists and their features
- We also get the playlist's name

In [9]:

```
playlist1 = getPlaylistFeatures(playlist1Input, 1)
playlist2 = getPlaylistFeatures(playlist2Input, 2)

#the variables above contain both a DataFrame and the name. We access them by
parsing through the returned tuple
playlist1DF = playlist1[0]
playlist1Name = playlist1[1]

playlist2DF = playlist2[0]
playlist2Name = playlist2[1]
```

In [10]:

```
display(playlist1Name)
display(playlist1DF.head())

display(playlist2Name)
display(playlist2DF.head())
```

'Slow Rock (Greatest Hits)'

	trackURI	danceability	energy	speechiness	acousticness	instrumen
0	4YJ4n7DsZhR5hrnsMfn6zV	0.446	0.409	0.0368	0.2870	0
1	6Z435tBPT5JamUR9dN7y8y	0.486	0.487	0.0341	0.4450	0
2	2yX3h3NRoMWGfnXxZlF92X	0.334	0.188	0.0289	0.9320	0
3	5CQ30WqJwcep0pYcV4AMNc	0.338	0.340	0.0339	0.5800	0
4	4glXFaeaoBGLrh0lbe5Dgk	0.411	0.452	0.2220	0.0387	0

'Dance Pop'

	trackURI	danceability	energy	speechiness	acousticness	instrume
0	6e0CvGZf7CouOpYF8toXHC	0.744	0.726	0.0463	0.0399	(
1	1hZ7LSB05aNMX2Nw73DFiR	0.968	0.677	0.2070	0.0306	(
2	3TjLsDgL0bTbSQIF6M5Ki8	0.678	0.747	0.1650	0.0395	(
3	3jwQwGVERUXo7eaAgL1xAo	0.493	0.773	0.1570	0.4290	(
4	7Feaw9WAEREY0DUOSXJLOM	0.726	0.722	0.0456	0.1730	(

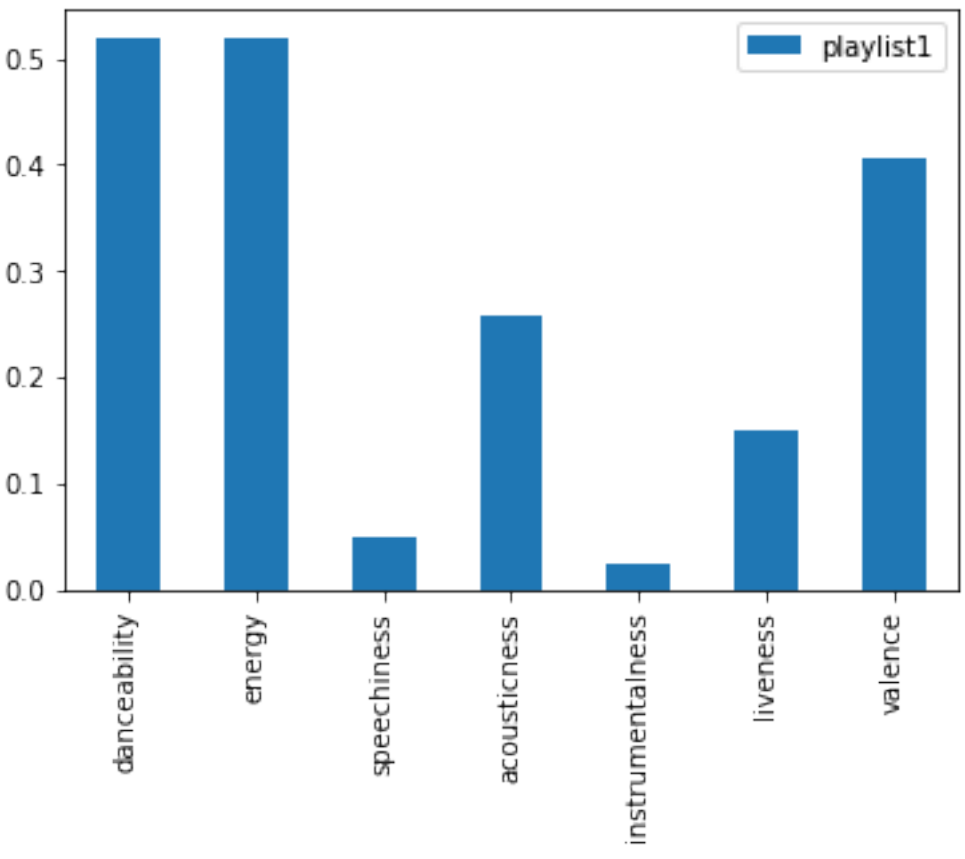
Step 3: Identify Most Dissimilar Features

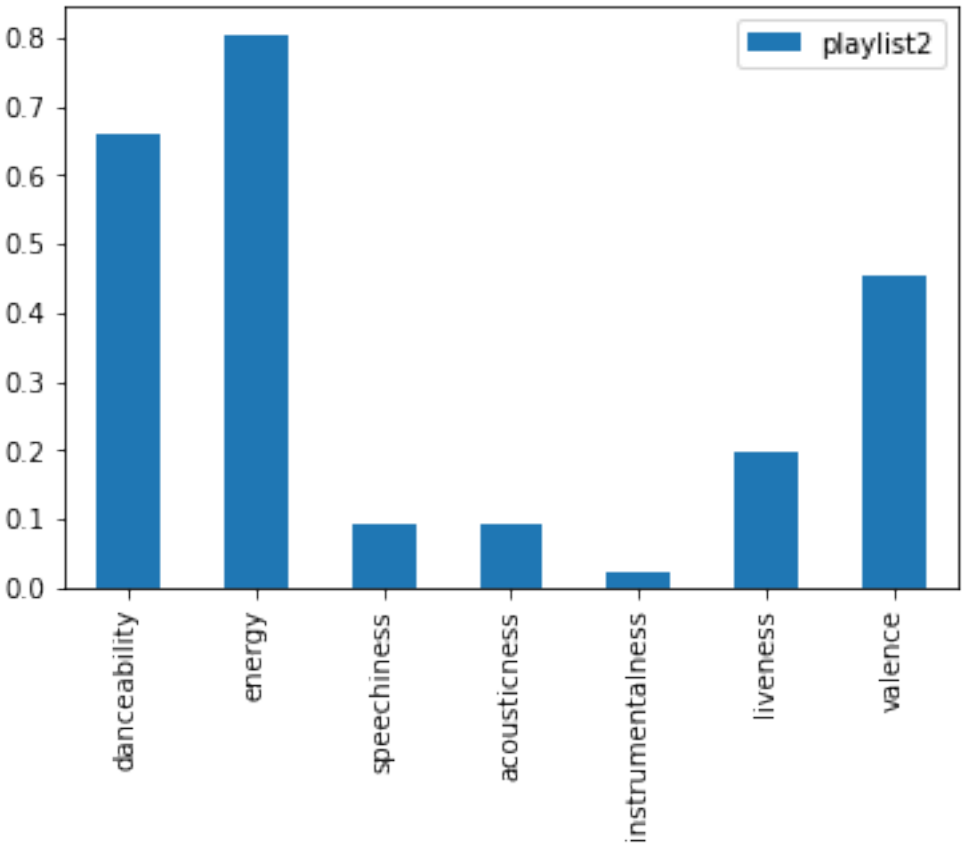
In [11]:

```
# we input the DataFrames for each playlist into the function
mostDissimilar = mostDissimilarFeatures(playlist1DF, playlist2DF)

# we only want the top 2 dissimilar features
top2Dissimilar = mostDissimilar.values.tolist() #conver to list to access
feature1 = top2Dissimilar[0]
feature2 = top2Dissimilar[1]
```

	playlist1	playlist2	absoluteDifference
energy	0.519283	0.804549	0.285267
acousticness	0.258716	0.092297	0.166420
danceability	0.519228	0.661692	0.142464
valence	0.405374	0.454725	0.049351
liveness	0.150155	0.197941	0.047785
speechiness	0.050800	0.091090	0.040290
instrumentalness	0.023639	0.021233	0.002406

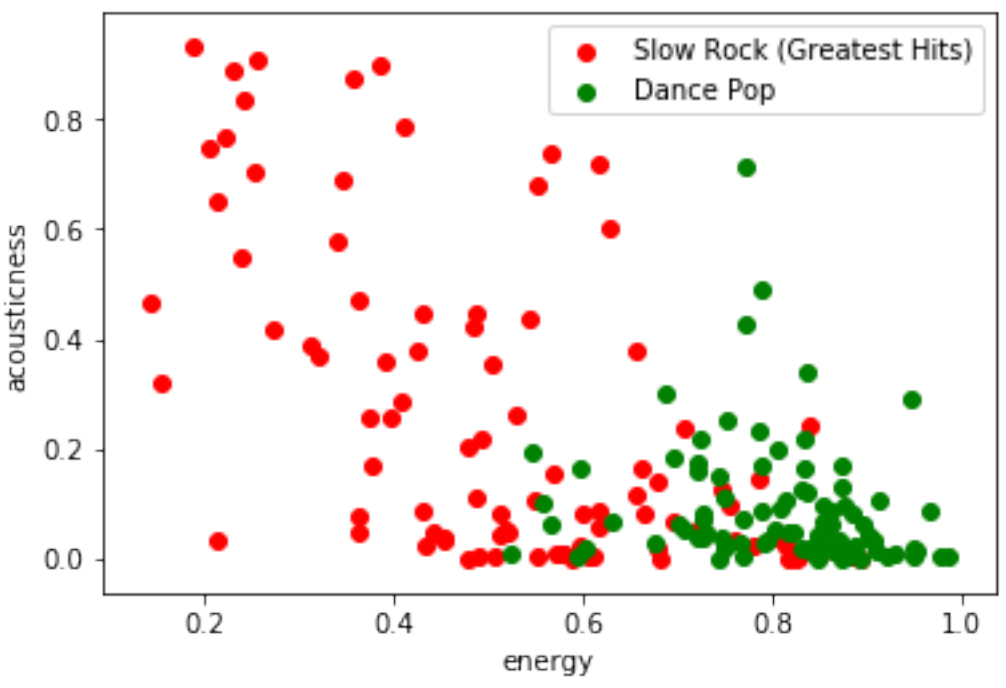




Step 4: Plot Dissimilar Features

In [12]:

```
plotPlaylists(playlist1, playlist2, feature1, feature2)
```



Step 5: Get Song Features

- get the features of the song that we want to see where it belongs

In [13]:

```
from sklearn.neighbors import KNeighborsClassifier
song = '46X0rddXGD4C5CJOBmHQqD' #Cem Karaca - Tamirci Ciragi

trackFeatures = getSongFeature(song)
trackName = getSongName(song)
trackFeature1 = trackFeatures.loc[0, feature1]
trackFeature2 = trackFeatures.loc[0, feature2]
#this array contains the values of our top two dissimilar features
trackFeatureValues = [trackFeature1, trackFeature2]
```

```
{'danceability': 0.299,
 'energy': 0.526,
 'key': 8,
 'loudness': -12.091,
 'mode': 0,
 'speechiness': 0.323,
 'acousticness': 0.558,
 'instrumentalness': 5.57e-05,
 'liveness': 0.0801,
 'valence': 0.663,
 'tempo': 197.677,
 'type': 'audio_features',
 'id': '46X0rddXGD4C5CJOBmHQqD',
 'uri': 'spotify:track:46X0rddXGD4C5CJOBmHQqD',
 'track_href': 'https://api.spotify.com/v1/tracks/46X0rddXGD4C5CJO
BmHQqD',
 'analysis_url': 'https://api.spotify.com/v1/audio-analysis/46X0rd
dXGD4C5CJOBmHQqD',
 'duration_ms': 298253,
 'time_signature': 3}
```

Step 6: Make the actual prediction using KNN

- make the prediction using K-Nearest Neighbors Algorithm and store that model into a variable *myModel*
- then proceed to output the prediciton

In [14]:

```
myModel = KNNPredict(25, playlist1, playlist2, feature1, feature2, trackFeatur
eValues)
```

In [15]:

```
if(myModel[0] == 1 ):
    print(trackName + "' best belongs in '" + playlist1Name + "' playlist")
else:
    print(trackName + "' best belongs in '" + playlist2Name + "' playlist")
```

```
Tamirci Çırağı' best belongs in 'Slow Rock (Greatest Hits)' playli
st
```

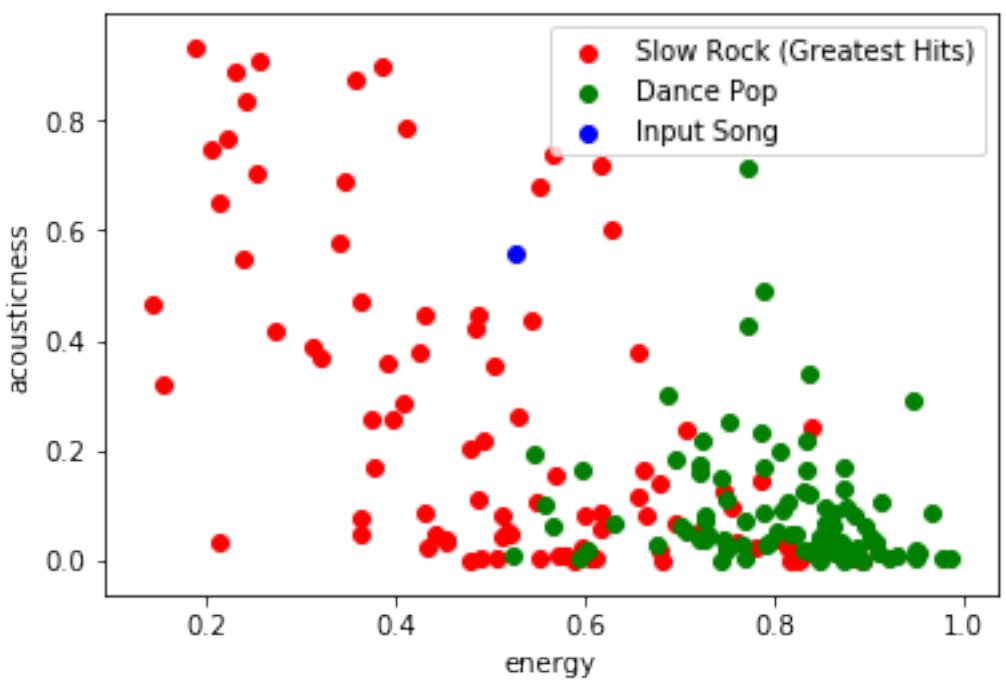
Plotting

In [16]:

```
myPlot = plotPlaylists(playlist1, playlist2, feature1, feature2)
trackFeatureValues
plt.scatter(trackFeatureValues[0], trackFeatureValues[1], c = "b")
plt.legend([playlist1Name, playlist2Name,"Input Song"])
```

Out[16]:

```
<matplotlib.legend.Legend at 0x1a1a3fd940>
```



Step 7: Homemade prediction

- Calculate the difference of 3 most dissimilar features of playlist1 and playlist2 with the input song's 3 most dissimilar features

In [17]:

```
differenceFromPlaylist1 = [0,0,0,0,0,0,0]
differenceSum = 0
for x in range(0, 7):
    differenceFromPlaylist1[x] = abs(playlist1DF.mean().values[x] - trackFeatu
res.mean().values[x])
    differenceSum += differenceFromPlaylist1[x]
print(differenceFromPlaylist1)
print(differenceSum)
```

```
[0.22022826086956532, 0.006717391304347897, 0.2722, 0.299283619565
21754, 0.023583106739130423, 0.07005543478260867, 0.25762608695652
156]
1.1496939002173914
```

In [18]:

```
differenceFromPlaylist2 = [0,0,0,0,0,0,0]
differenceSum2 = 0
for x in range(0, 7):
    differenceFromPlaylist2[x] = abs(playlist2DF.mean().values[x] - trackFeatu
res.mean().values[x])
    differenceSum2 += differenceFromPlaylist2[x]
print(differenceFromPlaylist2)
print(differenceSum2)
```

```
[0.3626923076923079, 0.27854945054945, 0.23190989010989013, 0.4657
0338461538463, 0.021176867032967 03, 0.11784065934065932, 0.2082747
2527472535]
1.6861472846153847
```

In [25]:

```
SimilarityToPlaylist1 = ((7-differenceSum)*100)/7
print(trackName + ': Similarity to "' + playlist1Name + '" ' + str(SimilarityT
oPlaylist1) + '%')
```

```
Tamirci Çırağı: Similarity to "Slow Rock (Greatest Hits)" 83.57580
142546583%
```

In [26]:

```
SimilarityToPlaylist2 = ((7-differenceSum2)*100)/7
print(trackName + ': Similarity to "' + playlist2Name + '" ' + str(SimilarityT
oPlaylist2) + '%')
```

```
Tamirci Çırağı: Similarity to "Dance Pop" 75.91218164835165%
```

In [ ]: