

finalnotebook_section4_ajit_sans

June 5, 2021

```
[1]: pip install spotipy --upgrade
```

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: spotipy in
/home/aselvaku/.local/lib/python3.8/site-packages (2.18.0)
Requirement already satisfied: six>=1.15.0 in /opt/conda/lib/python3.8/site-
packages (from spotipy) (1.15.0)
Requirement already satisfied: urllib3>=1.26.0 in
/home/aselvaku/.local/lib/python3.8/site-packages (from spotipy) (1.26.5)
Requirement already satisfied: requests>=2.25.0 in
/home/aselvaku/.local/lib/python3.8/site-packages (from spotipy) (2.25.1)
Requirement already satisfied: idna<3,>=2.5 in /opt/conda/lib/python3.8/site-
packages (from requests>=2.25.0->spotipy) (2.8)
Requirement already satisfied: chardet<5,>=3.0.2 in
/opt/conda/lib/python3.8/site-packages (from requests>=2.25.0->spotipy) (3.0.4)
Requirement already satisfied: certifi>=2017.4.17 in
/opt/conda/lib/python3.8/site-packages (from requests>=2.25.0->spotipy)
(2019.11.28)
Note: you may need to restart the kernel to use updated packages.
```

```
[2]: import spotipy
import spotipy.util as util
from spotipy.oauth2 import SpotifyOAuth
from spotipy.oauth2 import SpotifyClientCredentials
import spotipy.oauth2 as oauth2

import pandas as pd
import numpy as np
import ast # for dictionary

from numpy import unique
from numpy import where
from sklearn.datasets import make_classification
from sklearn.cluster import AgglomerativeClustering
from matplotlib import pyplot
```

```
[3]: CLIENT_ID      = 'df768b43d2cd406a9605cd8261680906'
CLIENT_SECRET = '0db4a7ce151f424eb51e0da9fbc4985f'
REDIRECT_URI  = 'https://localhost'

credentials = oauth2.SpotifyClientCredentials(
    client_id=CLIENT_ID,
    client_secret=CLIENT_SECRET)

spotify = spotipy.Spotify(auth_manager=credentials)

#scope = "playlist-read-private"
#credentials = SpotifyOAuth(client_id=CLIENT_ID, client_secret=CLIENT_SECRET,
    ↪ redirect_uri=REDIRECT_URI, scope=scope)
#spotify = spotipy.Spotify(auth_manager=credentials)
```

0.0.1 Spotipy API functions

```
[4]: #gets track ids from playlist id
def get_playlist_track_ids(playlist_id):
    res = spotify.playlist_tracks(playlist_id)
    track_ids = []
    artists = []
    tracks = []

    for i in range(len(res['items'])):
        tracks.append(res['items'][i]['track']['name']) # song name
        artists.append(res['items'][i]['track']['artists'][0]['name']) # artist
        ↪ name
        track_ids.append(res['items'][i]['track']['id']) # track_id

    return tracks, artists, track_ids

#get ids based on artist name and track
def get_track_ids(artists, track):
    track_ids = []
    for i in range(len(artists)):
        res = spotify.search(q='artist:' + artists[i] + ' track:' + track[i],
        ↪ type="track", limit=1)
        track_id = res['tracks']['items'][0]['id']
        track_ids.append(track_id)
    return track_ids

# clean data
```

```

# remove non-qualitative features
def get_track_features(track_ids):
    track_features = []

    for i in range(len(track_ids)):

        features = spotify.audio_features(track_ids[i])
        features[0].pop('type')
        features[0].pop('id')
        features[0].pop('uri')
        features[0].pop('track_href')
        features[0].pop('analysis_url')

        track_features.append(list(features[0].values()))

    df = pd.DataFrame(np.array(track_features), columns=list(features[0].
→keys()))
    df.insert(0, 'id', np.array(track_ids))
    #TODO: append column for artist name

    return df

```

1 Load Sample Data

```

[5]: df = pd.read_csv('data_by_artist_o.csv')
sample_df = df.drop(columns=['genres', 'popularity', 'count', 'artists'])

sample = sample_df.to_numpy()
sample_df.head()

```

```

[5]:
acousticness  danceability  duration_ms  energy  instrumentalness \
0      0.590111      0.467222  250318.555556  0.394003      0.011400
1      0.862538      0.441731  287280.000000  0.406808      0.081158
2      0.856571      0.348286  328920.000000  0.286571      0.024593
3      0.884926      0.425074  262890.962963  0.245770      0.073587
4      0.510714      0.467143  270436.142857  0.488286      0.009400

liveness  loudness  speechiness  tempo  valence  key  mode
0  0.290833 -14.448000      0.210389  117.518111  0.389500   5    1
1  0.315215 -10.690000      0.176212  103.044154  0.268865   5    1
2  0.325786 -15.230714      0.118514   77.375857  0.354857   0    1
3  0.275481 -15.639370      0.123200   88.667630  0.372030   0    1
4  0.195000 -10.236714      0.098543  122.835857  0.482286   5    1

```

2 Implement PCA

```
[6]: import scipy.io as sio
import matplotlib
import matplotlib.pyplot as plt
from numpy.matlib import repmat
from sklearn.preprocessing import normalize

%matplotlib inline
```

```
[7]: def eigsort(V, eigvals):

    # Sort the eigenvalues from largest to smallest. Store the sorted
    # eigenvalues in the column vector lambd.
    lohival = np.sort(eigvals)
    lohiindex = np.argsort(eigvals)
    lambd = np.flip(lohival)
    index = np.flip(lohiindex)
    Dsort = np.diag(lambd)

    # Sort eigenvectors to correspond to the ordered eigenvalues. Store sorted
    # eigenvectors as columns of the matrix vsort.
    M = np.size(lambd)
    Vsort = np.zeros((M, M))
    for i in range(M):
        Vsort[:,i] = V[:,index[i]]
    return Vsort, Dsort

# normc(M) normalizes the columns of M to a length of 1.
def normc(Mat):
    return normalize(Mat, norm='l2', axis=0)

def PCA_(data):

    m,n = data.shape

    mean = np.mean(data, 0)
    Z = data - mean
    C = np.dot(Z.T, Z)

    D, V = np.linalg.eig(C)
    Vsort, Dsort = eigsort(V, D)
    U = np.dot(Z, Vsort)
    U = normc(U)
```

```
    return U, Vsort, Dsort, Z
#use first * columns of Z as input for algo
```

3 Run PCA

```
[8]: U, Vsort, Dsort, Z = PCA_(sample)
```

```
[9]: eigenvalues = []
    for i in range(12):
        eigenvalues.append(Dsort[i,i])

    eigenvalues
```

```
[9]: [420804751995824.75,
    17966169.90668353,
    880522.7041980289,
    346870.45638083183,
    5232.672596639826,
    2581.0627245786814,
    2115.9808646581946,
    1581.3448672598574,
    656.848869111608,
    468.610678908101,
    293.7826557205403,
    209.29361740664388]
```

```
[10]: c = np.dot(U.T, Z)

    # project data into new coordinate space, consisting of top 4 eigenvectors
    proj_data = np.dot( U[:,0:4], c[0:4] ) + np.mean(sample, 0)

    proj_data.shape
```

```
[10]: (28680, 12)
```

```
[11]: import plotly.express as px
```

```
[12]: # visualizes all the original dimensions
    features = sample_df.columns
    fig = px.scatter_matrix(sample_df, dimensions=features)
    fig.update_traces(diagonal_visible=False)
    fig.show()
```

```
[13]: # visualizes all the principal components
    fig = px.scatter_matrix(
        U,
```

```

        labels=tuple(features),
        dimensions=range(12),
    )
    fig.update_traces(diagonal_visible=False)
    fig.show()

```

```

[14]: # visualizes first four principal components
fig = px.scatter_matrix(
    U,
    labels=tuple(features),
    dimensions=range(4),
)
fig.update_traces(diagonal_visible=False)
fig.show()

```

```

[15]: ### THOUGHT: you can view this graph from a certain angle, which will represent
      ↪ the principle components above
a = proj_data[:,0]
b = proj_data[:,1]
c = proj_data[:,2]
cc = proj_data[:,3]

fig = px.scatter_3d(x=a, y=b, z=c, color=cc)
fig.show()

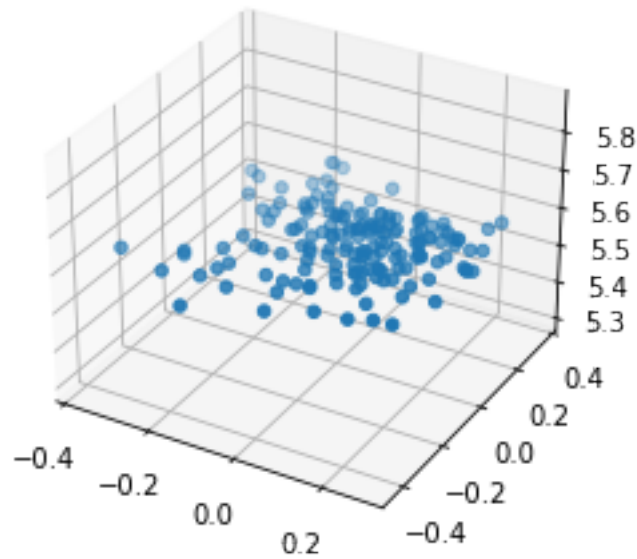
```

4 Agglomerative (hierarchal) Clustering

```

[153]: # agglomerative clustering
# define the model
model = AgglomerativeClustering(n_clusters=10)
# fit model and predict clusters
yhat = model.fit_predict(Z[:,0:3])
# retrieve unique clusters
clusters = unique(yhat)
# create scatter plot for samples from each cluster
for cluster in clusters:
    #get row indexes for samples with this cluster
    row_ix = where(yhat == cluster)
    #create scatter of these samples
    #pyplot.scatter(Z[:,0:2][row_ix, 0], Z[:,0:2][row_ix, 1])
    ax = plt.axes(projection='3d')
    ax.scatter3D(Z[:,0:3][row_ix, 0], Z[:,0:3][row_ix, 1], Z[:,0:3][row_ix, 2])
# show the plot
pyplot.show()

```



```
[249]: yhat
```

```
[249]: array([8, 8, 7, ..., 3, 1, 0])
```

```
[155]: songs_clusters = where(yhat == 4)
songs_clusters
```

```
[155]: (array([ 19,  36,  45,  74,  77,  82, 106, 112, 113, 122, 130,
        158, 160, 162, 186, 191, 207, 258, 261, 265, 270, 283,
        297, 301, 302, 324, 359, 365, 367, 382, 402, 418, 496,
        510, 517, 518, 537, 544, 556, 594, 603, 605, 607, 612,
        615, 632, 643, 648, 665, 667, 674, 676, 681, 683, 693,
        704, 716, 740, 757, 770, 790, 792, 807, 819, 832, 837,
        851, 854, 859, 884, 886, 888, 897, 926, 977, 980, 995,
        999, 1000, 1040, 1054, 1067, 1092, 1112, 1126, 1141, 1168, 1191,
        1199, 1200, 1224, 1233, 1241, 1242, 1264, 1296, 1342, 1346, 1355,
        1359, 1362, 1369, 1381, 1383, 1388, 1394, 1400, 1404, 1405, 1441,
        1455, 1470, 1474, 1493, 1503, 1505, 1519, 1536, 1538, 1576, 1610,
        1615, 1621, 1631, 1632, 1638, 1641, 1654, 1668, 1680, 1691, 1694,
        1719, 1751, 1758, 1769, 1771]),)
```

5 Genre Analysis

```
[164]: df['genres']
```

```
[164]: 0          ['show tunes']
      1          []
      2          []
      3          []
      4          []
      ...
      28675         []
      28676    ['c-pop', 'classic cantopop', 'classic mandopo...
      28677         []
      28678          ['chinese indie', 'chinese indie rock']
      28679          ['classic korean pop']
      Name: genres, Length: 28680, dtype: object
```

```
[168]: df['genres'][29]
```

```
[168]: "['alternative metal', 'christian rock', 'nu metal', 'post-grunge', 'rap rock']"
```

```
[224]: my_dict = dict()
      my_dict['x'] = 1
      'y' in my_dict

      strlist = '[1,2]'
      ast.literal_eval(strlist)
```

```
[224]: [1, 2]
```

6 Genre Analysis Function for Agglomerative

```
[283]: genre_dict = dict()
      q = where(yhat == 4)
      for i in q:
          for j in df['genres'][i]:
              res_list = ast.literal_eval(j)
              print(res_list)
              for genre in res_list:
                  if genre in genre_dict:
                      genre_dict[genre] += 1
                  else:
                      genre_dict[genre] = 1

      dict(sorted(genre_dict.items(), key=lambda item: item[1]))
      #         for elem in j:
      #             print(j)
```

```
[]
['boy band', 'dance pop', 'europop', 'pop']
```


['alternative rock', 'dance-punk', 'double drumming', 'indie rock', 'modern rock', 'post-hardcore']
 []
 ['bachata', 'latin', 'tropical']
 []
 ['new wave pop', 'pop rock']
 ['detroit trap', 'rap', 'southern hip hop', 'trap']
 ['hardcore', 'hardcore punk', 'melodic hardcore', 'punk', 'skate punk', 'straight edge', 'thrash core']
 ['grunge', 'riot grrrl']
 ['asian american hip hop', 'pop']
 ['lo-fi beats']
 ['boy band', 'dance pop']
 []
 ['baltimore hip hop', 'drill', 'underground hip hop', 'vapor trap']
 ['hip hop', 'rap', 'southern hip hop', 'trap', 'vapor trap']
 []
 []
 []
 ['trap soul']
 []
 ['modern rock']
 ['la indie', 'modern alternative rock', 'modern rock', 'pop rock', 'rock', 'stomp pop']
 ['gruperas inmortales', 'nu-cumbia', 'regional mexican']
 ['focus']
 ['motown', 'soul']
 ['contemporary country', 'country', 'country road', 'modern country rock', 'texas country']
 []
 []
 ['dance rock', 'double drumming', 'new romantic', 'new wave', 'new wave pop', 'post-punk', 'punk', 'ska']
 ['alternative country', 'roots americana', 'roots rock', 'texas country']
 ['american contemporary classical']
 ['latin jazz']
 ['classical mezzo-soprano', 'classical performance', 'opera']
 ['celtic', 'new age', 'string folk']
 ['barockinterpreten', 'baroque ensemble', 'choral', 'classical performance', 'historically informed performance']
 ['jazz trio']
 []
 ['album rock', 'art rock', 'classic rock', 'classic uk pop', 'country rock', 'folk', 'folk rock', 'mellow gold', 'progressive rock', 'soft rock', 'symphonic rock']
 []
 ['chanson', 'french indie pop', 'french pop', 'french rock', 'nouvelle chanson francaise']

['electro house']
 ['blues', 'blues rock', 'classic rock', 'electric blues', 'memphis soul', 'soul blues', 'traditional blues']
 ['classic italian pop', 'swing italiano', 'vintage italian pop']
 ['grupera', 'regional mexican']
 []
 ['pop']
 ['alternative country', 'country rock', 'folk', 'heartland rock', 'new americana', 'pub rock', 'roots rock']
 ['bachata', 'bachata dominicana', 'latin', 'merengue', 'tropical']
 ['smooth jazz']
 ['berlin minimal techno']
 ['funky tech house', 'tech house']
 ['cosmic american', 'experimental', 'folk rock', 'outsider', 'psychedelic rock']
 []
 ['disco', 'funk', 'minneapolis sound', 'new jack swing', 'post-disco', 'quiet storm', 'soul', 'urban contemporary']
 []
 ['dance pop', 'electropop', 'pop dance', 'romanian pop']
 ['axe', 'pagode']
 ['chill r&b']
 []
 ['canadian hip hop', 'pop']
 []
 ['alternative metal', 'alternative rock', 'grunge', 'hard rock', 'nu metal', 'rock']
 ['lo-fi beats']
 ['indie rock', 'modern alternative rock', 'modern blues rock', 'neo-psychedelic', 'space rock', 'stoner rock']
 ['dance rock', 'europop', 'new romantic', 'new wave', 'new wave pop', 'synthpop']
 []
 ['latin', 'latin arena pop', 'latin pop', 'spanish pop', 'spanish pop rock']
 ['hollywood', 'pop']
 ['french opera', 'french romanticism', 'late romantic era']
 ['hip hop', 'underground hip hop']
 ['big beat', 'drill and bass', 'electronica', 'intelligent dance music', 'jazztronica', 'ninja', 'nu jazz', 'trip hop']
 ['acoustic pop', 'indie folk', 'lilith', 'neo mellow', 'new americana', 'pop rock', 'stomp and holler']
 ['baroque ensemble', 'classical performance']
 ['chamber orchestra', 'string orchestra']
 ['fado']
 ['grupera', 'latin', 'mexican pop', 'regional mexican']
 ['background music', 'background piano', 'calming instrumental', 'focus', 'neo-classical']
 ['sitar', 'world fusion']
 []

[]
 ['blues rock', 'country rock', 'deep new americana', 'funk', 'jam band',
 'louisiana blues', 'modern blues', 'modern blues rock', 'new americana', 'new
 orleans blues', 'roots rock']
 ['easy listening']
 ['easy listening']
 ['spytrack']
 ['classical performance', 'orchestral performance']
 []
 ['native american']
 []
 []
 ['british classical piano']
 ['dark jazz', 'soundtrack']
 []
 ['anti-folk', 'buffalo ny indie', 'ectofolk', 'folk', 'lilith', 'pop rock',
 'singer-songwriter', "women's music"]
 ['cumbia', 'cumbia salvadorena']
 []
 ['classical performance', 'violin']
 ['latin christian', 'mariachi cristiano']
 []
 ['boy band', 'new jack swing']
 ['classic uk pop', 'merseybeat']
 ['late romantic era', 'russian romanticism']
 ['bachata dominicana', 'dominican pop', 'latin', 'tropical']
 ['bhajan', 'classic bollywood', 'desi pop', 'filmi', 'ghazal', 'modern
 bollywood', 'sufi']
 ['meditation']
 ['alternative country', 'deep new americana', 'modern southern rock', 'new
 americana', 'roots americana', 'roots rock', 'southern americana', 'texas
 country']
 ['caucasian classical', 'classical', 'early modern classical', 'russian modern
 classical']
 []
 ['uk alternative pop']
 []
 []
 ['atl hip hop', 'conscious hip hop', 'hip hop', 'rap']
 ['classic soul', 'motown', 'rhythm and blues', 'soul', 'southern soul']
 []
 ['late romantic era', 'operetta', 'victorian britain']
 ['historic orchestral performance']
 []
 ['classical performance', 'classical piano', 'italian classical piano']
 []
 ['christian alternative rock', 'christian rock']
 ['classic opm', 'manila sound', 'opm']

[]

[]

['alternative metal', 'melodic metalcore', 'metalcore', 'nu metal', 'pop punk',
'rap rock', 'screamo']

[283]: {'dance-punk': 1,
 'post-hardcore': 1,
 'detroit trap': 1,
 'hardcore': 1,
 'hardcore punk': 1,
 'melodic hardcore': 1,
 'skate punk': 1,
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 'thrash core': 1,
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'french indie pop': 1,
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'french rock': 1,
'nouvelle chanson francaise': 1,
'electro house': 1,
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'psychedelic rock': 1,
'disco': 1,
'minneapolis sound': 1,
'post-disco': 1,
'quiet storm': 1,
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'electropop': 1,
'pop dance': 1,
'romanian pop': 1,
'axe': 1,
'pagode': 1,
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'neo-psychedelic': 1,
'space rock': 1,
'stoner rock': 1,
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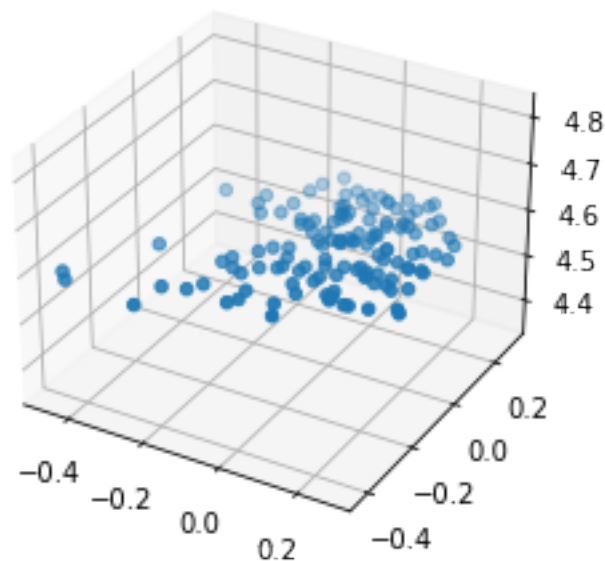
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'dark jazz': 1,
'soundtrack': 1,
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'uk alternative pop': 1,
'atl hip hop': 1,
'conscious hip hop': 1,
'classic soul': 1,
'rhythm and blues': 1,
'southern soul': 1,
'operetta': 1,
'victorian britain': 1,
'historic orchestral performance': 1,
'classical piano': 1,
'italian classical piano': 1,
'christian alternative rock': 1,
'christian rock': 1,
'classic opm': 1,
'manila sound': 1,
'opm': 1,
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'metalcore': 1,
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'indie rock': 2,
'bachata': 2,
'southern hip hop': 2,
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'punk': 2,
'grunge': 2,
'lo-fi beats': 2,
'underground hip hop': 2,
'vapor trap': 2,
'modern alternative rock': 2,

'rock': 2,
'focus': 2,
'motown': 2,
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'new wave': 2,
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'blues rock': 2,
'grupera': 2,
'bachata dominicana': 2,
'funk': 2,
'new jack swing': 2,
'alternative metal': 2,
'nu metal': 2,
'modern blues rock': 2,
'lilith': 2,
'deep new americana': 2,
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'dance pop': 3,
'modern rock': 3,
'tropical': 3,
'new wave pop': 3,
'rap': 3,
'hip hop': 3,
'regional mexican': 3,
'soul': 3,
'texas country': 3,
'alternative country': 3,
'country rock': 3,
'folk': 3,
'late romantic era': 3,
'pop rock': 4,
'roots rock': 4,
'new americana': 4,
'pop': 5,
'latin': 5,
'classical performance': 6}

7 BIRCH Clustering

```
[285]: # birch clustering
from sklearn.cluster import Birch
# define the model
model = Birch(threshold=0.01, n_clusters=10)
# fit the model
model.fit(Z[:,0:3])
# assign a cluster to each example
yhat1 = model.predict(Z[:,0:3])
# retrieve unique clusters
clusters = unique(yhat1)
# create scatter plot for samples from each cluster
for cluster in clusters:
    # get row indexes for samples with this cluster
    row_ix = where(yhat1 == cluster)
    # create scatter of these samples
    ax = plt.axes(projection='3d')
    ax.scatter3D(Z[:,0:3][row_ix, 0], Z[:,0:3][row_ix, 1], Z[:,0:3][row_ix, 2])
# show the plot
pyplot.show()
```



8 Genre Analysis Function for BIRCH

```
[286]: my_dict = dict()
my_dict['x'] = 1
'y' in my_dict

strlist = '[1,2]'
ast.literal_eval(strlist)

genre_dict = dict()
q = where(yhat1 == 4)
for i in q:
    for j in df['genres'][i]:
        res_list = ast.literal_eval(j)
        print(res_list)
        for genre in res_list:
            if genre in genre_dict:
                genre_dict[genre] += 1
            else:
                genre_dict[genre] = 1

dict(sorted(genre_dict.items(), key=lambda item: item[1]))

['dark trap', 'meme rap']
['k-pop', 'k-pop girl group']
['dub', 'east coast reggae', 'reggae', 'reggae rock', 'roots reggae']
['japanese city pop']
['atl hip hop', 'dirty south rap', 'southern hip hop', 'trap']
['bow pop', 'cello', 'classify']
['dance pop', 'k-pop', 'k-pop girl group', 'pop dance']
['g funk', 'gangster rap', 'hip hop', 'rap', 'west coast rap']
['sad rap']
['dance pop', 'electropowerpop', 'pop', 'pop punk', 'pop rap', 'post-teen pop']
['anime rock', 'vocaloid']
['oi', 'punk', 'ska']
['dirty south rap', 'dirty texas rap', 'gangster rap', 'houston rap']
['miami bass']
['dirty south rap', 'gangster rap', 'memphis hip hop', 'rap', 'southern hip hop', 'trap']
[]
['emo rap']
[]
['bubblegum dance', 'europop']
[]
['ambient', 'chamber psych', 'compositional ambient', 'drift', 'drone', 'neo-classical', 'post-rock']
[]
```

['broadway', 'show tunes', 'west end']
 ['deep indian pop', 'filmi']
 ['hindustani classical', 'hindustani instrumental', 'indian classical', 'tabla']
 []
 ["preschool children's music"]
 ['duranguense', 'regional mexican']
 ['classic opm', 'opm']
 []
 ['future bass', 'traprun']
 ['dance pop', 'hip hop', 'hip pop', 'neo soul', 'pop', 'pop rap', 'r&b', 'urban
 contemporary']
 []
 ['soundtrack']
 ['classic bollywood', 'filmi']
 ['vocal jazz']
 []
 []
 ['dirty south rap', 'gangster rap', 'hip hop', 'miami hip hop', 'pop rap',
 'rap', 'southern hip hop', 'trap']
 ['abstract hip hop', 'alternative hip hop', 'hip hop', 'turntablism',
 'underground rap']
 ['british jazz', 'smooth jazz']
 []
 ['country rap', 'military rap', 'redneck']
 ['broadway', 'hollywood', 'show tunes']
 ['latin', 'salsa', 'salsa venezolana', 'tropical']
 []
 []
 ['classic hardstyle', 'euphoric hardstyle', 'hardstyle', 'rawstyle']
 []
 ['movie tunes']
 ['musica para ninos']
 ['classical soprano']
 []
 ['deep indian pop', 'filmi', 'mollywood']
 ['funk', 'neo soul', 'new jack swing', 'quiet storm', 'r&b', 'urban
 contemporary']
 ['chicano punk', 'crossover thrash', 'hardcore', 'hardcore punk', 'nyhc', 'oi',
 'old school thrash', 'punk', 'straight edge']
 ['electronica', 'microhouse', 'minimal techno', 'new french touch', 'organic
 house', 'tech house']
 ['cumbia peruana', 'pop peruano']
 ['chilean rock']
 ['bolero']
 []
 []
 ['background music']
 ['otacore']

['east coast hip hop', 'hardcore hip hop', 'queens hip hop']
 ['japanese soundtrack', 'japanese vgm', 'video game music']
 ['blues', 'blues rock', 'classic rock', 'country rock', 'electric blues', 'folk
 rock', 'psychedelic rock', 'rock keyboard']
 ['corrido', 'duranguense', 'regional mexican']
 ['chanson', 'ye ye']
 ['library music', 'operetta']
 ['disco house', 'filter house', 'nu disco']
 []
 ['classical performance', 'orchestral performance']
 []
 ['library music', 'spytrack']
 ['free folk']
 ['classic canadian rock', 'new wave pop']
 []
 []
 []
 []
 ['rebetiko']
 []
 ['canadian contemporary r&b', 'canadian pop', 'dance pop', 'pop', 'pop dance',
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 ['classical piano', 'italian classical piano']
 ['latin christian', 'latin worship', 'mariachi cristiano', 'reggaeton
 cristiano']
 []
 ['alternative r&b', 'chill r&b', 'indie r&b', 'indie soul', 'neo soul', 'pop
 r&b']
 ['vallenato moderno']
 ['latin', 'reggaeton', 'reggaeton flow', 'trap latino']
 ['historic orchestral performance']
 ['country rap', 'redneck']
 []
 ['classical performance', 'classical piano', 'french classical piano']
 ['french classical piano', 'historic piano performance']
 []
 []
 ['italian opera', 'italian romanticism', 'late romantic era']
 []
 ['barnmusik', 'swedish jazz', 'vintage swedish pop']
 ['dark wave', 'deathrock', 'gothic rock', 'industrial', 'industrial rock']
 []
 ['classic bollywood', 'desi pop', 'filmi', 'modern bollywood', 'sufi']
 ['baroque violin']
 ['bluegrass', 'folk', 'progressive bluegrass']
 ['alternative metal', 'melodic metalcore', 'metalcore', 'nu metal']
 ['album rock', 'blues rock', 'classic rock', 'country rock', 'double drumming',
 'electric blues', 'folk rock', 'hard rock', 'jam band', 'mellow gold',

'psychedelic rock', 'rock', 'roots rock', 'soft rock', 'southern rock']
 ['neon pop punk', 'post-teen pop']
 []
 []
 ['dub', 'lovers rock', 'reggae', 'rock steady', 'roots reggae', 'ska']
 ['dance pop', 'electropop', 'girl group', 'indie pop', 'indie pop optimism', 'pop', 'pop dance',
 'post-teen pop']
 ['classic russian rock', 'russian post-punk']
 []
 []
 ['art pop']
 ['alternative r&b', 'indie r&b', 'indie soul', 'neo soul', 'nyc pop']
 ['sound']
 []
 ['desi pop', 'filmi', 'modern bollywood', 'sufi']
 ['american romanticism', 'post-romantic era']
 ['modern blues']
 []
 ['dance pop', 'europop']
 []
 ['cumbia andina mexicana', 'cumbia sonidera']
 []
 []
 []
 ['gangster rap', 'hyphy', 'west coast rap', 'west coast trap']
 ['show tunes']
 []
 []
 []
 []
 ['baroque singing', 'choral', 'classical countertenor', 'classical performance',
 'opera']
 ['avant-garde jazz', 'bebop', 'contemporary jazz', 'contemporary post-bop',
 'cool jazz', 'free improvisation', 'free jazz', 'hard bop', 'jazz', 'jazz funk',
 'jazz piano', 'soul jazz']
 ['atl hip hop', 'dirty south rap', 'southern hip hop']
 ['easy listening', 'operatic pop', 'pop violin']
 []
 ['latin pop', 'pop flamenco', 'rumba', 'spanish pop']
 []
 []
 []
 ['latin', 'latin hip hop', 'latin pop', 'reggaeton', 'trap latino', 'tropical']
 []
 ['hollywood', 'movie tunes', 'show tunes']
 ['scottish singer-songwriter']
 ['funk', 'new jack swing', 'post-disco', 'quiet storm', 'urban contemporary']
 ['australian indie folk', 'indie folk', 'stomp and holler']

[]
 ['funk', 'motown', 'neo soul', 'new jack swing', 'quiet storm', 'r&b', 'smooth
 jazz', 'soul', 'urban contemporary']
 ['disco']
 []
 []
 ['adult standards', 'canadian country', 'canadian pop', 'folk', 'folk rock',
 'mellow gold', 'soft rock']
 []
 ['classic russian pop', 'russian folk']
 []
 ['europop', 'folk', 'mellow gold', 'new wave pop', 'pop rock', 'soft rock']
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 punk', 'indie rock', 'lo-fi', 'lo-fi emo', 'post-hardcore', 'triangle indie']
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 'rock-and-roll']
 ['deep uplifting trance', 'progressive house', 'progressive trance',
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 ['vintage italian soundtrack']

```

['swedish pop']
['comic', 'kingston on indie']
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['jazz accordion']
['easy listening']
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['easy listening', 'exotica', 'jazz vibraphone', 'lounge']
['christmas instrumental']
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```

```

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'post-romantic era': 1,
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'cumbia sonidera': 1,
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'cool jazz': 1,
'free improvisation': 1,
'free jazz': 1,
'hard bop': 1,
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'impressionism': 1,
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'exotica': 1,
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'art rock': 1,
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'fourth world': 1,
'freak folk': 1,
'minimalism': 1,
'alternative pop rock': 1,
'pop emo': 1,
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'arkansas country': 1,
'contemporary country': 1,
'country': 1,
'country pop': 1,
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'death metal': 1,
'gothenburg metal': 1,
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'swedish metal': 1,
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'dub': 2,
'reggae': 2,
'roots reggae': 2,
'atl hip hop': 2,
'cello': 2,
'west coast rap': 2,
'pop punk': 2,
'oi': 2,

'punk': 2,
'ska': 2,
'bubblegum dance': 2,
'ambient': 2,
'chamber psych': 2,
'deep indian pop': 2,
'duranguense': 2,
'regional mexican': 2,
'classic bollywood': 2,
'vocal jazz': 2,
'smooth jazz': 2,
'country rap': 2,
'redneck': 2,
'tropical': 2,
'classical soprano': 2,
'blues rock': 2,
'classic rock': 2,
'country rock': 2,
'electric blues': 2,
'psychedelic rock': 2,
'library music': 2,
'classic canadian rock': 2,
'new wave pop': 2,
'canadian pop': 2,
'classical piano': 2,
'alternative r&b': 2,
'indie r&b': 2,
'indie soul': 2,
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'french classical piano': 2,
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'modern bollywood': 2,
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'neon pop punk': 2,
'girl group': 2,
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'classical': 2,
'trap': 3,
'pop dance': 3,
'rap': 3,
'pop rap': 3,
'broadway': 3,
'r&b': 3,

```

'hollywood': 3,
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'new jack swing': 3,
'quiet storm': 3,
'classical performance': 3,
'folk': 3,
'mellow gold': 3,
'soft rock': 3,
'easy listening': 3,
'southern hip hop': 4,
'hip hop': 4,
'europop': 4,
'urban contemporary': 4,
'folk rock': 4,
'dirty south rap': 5,
'gangster rap': 5,
'pop': 5,
'post-teen pop': 5,
'show tunes': 5,
'filmi': 5,
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'dance pop': 7}

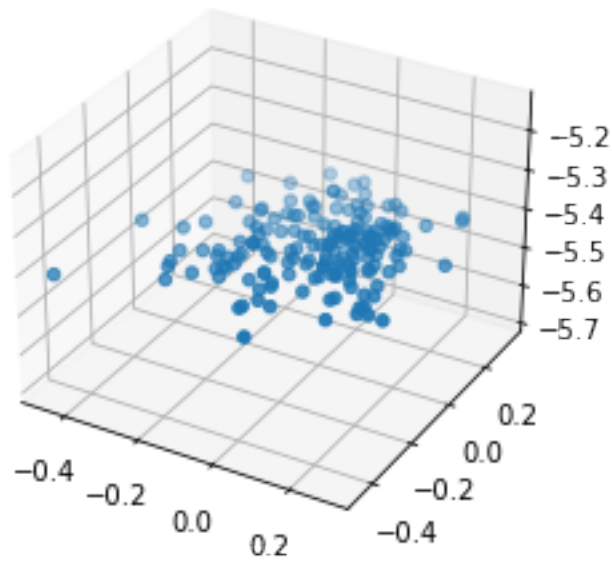
```

9 DBScan Clustering

```

[287]: from sklearn.cluster import DBSCAN
# define the model
model = DBSCAN(eps=0.30, min_samples=10)
# fit model and predict clusters
yhat2 = model.fit_predict(Z[:,0:3])
# retrieve unique clusters
clusters = unique(yhat2)
# create scatter plot for samples from each cluster
for cluster in clusters:
    # get row indexes for samples with this cluster
    row_ix = where(yhat2 == cluster)
    # create scatter of these samples
    ax = plt.axes(projection='3d')
    ax.scatter3D(Z[:,0:3][row_ix, 0], Z[:,0:3][row_ix, 1], Z[:,0:3][row_ix, 2])
# show the plot
pyplot.show()

```



10 Genre Analysis Function for DBScan

```
[288]: my_dict = dict()
my_dict['x'] = 1
'y' in my_dict

strlist = '[1,2]'
ast.literal_eval(strlist)

genre_dict = dict()
q = where(yhat2 == 4)
for i in q:
    for j in df['genres'][i]:
        res_list = ast.literal_eval(j)
        print(res_list)
        for genre in res_list:
            if genre in genre_dict:
                genre_dict[genre] += 1
            else:
                genre_dict[genre] = 1

dict(sorted(genre_dict.items(), key=lambda item: item[1]))
```

```
[]
['boy band', 'dance pop', 'europop', 'pop']
['alternative rock', 'dance-punk', 'double drumming', 'indie rock', 'modern
```

rock', 'post-hardcore']
 []
 ['bachata', 'latin', 'tropical']
 []
 ['new wave pop', 'pop rock']
 ['detroit trap', 'rap', 'southern hip hop', 'trap']
 ['hardcore', 'hardcore punk', 'melodic hardcore', 'punk', 'skate punk',
 'straight edge', 'thrash core']
 ['grunge', 'riot grrrl']
 ['asian american hip hop', 'pop']
 ['lo-fi beats']
 ['boy band', 'dance pop']
 []
 ['baltimore hip hop', 'drill', 'underground hip hop', 'vapor trap']
 ['hip hop', 'rap', 'southern hip hop', 'trap', 'vapor trap']
 []
 []
 []
 ['trap soul']
 []
 ['modern rock']
 ['la indie', 'modern alternative rock', 'modern rock', 'pop rock', 'rock',
 'stomp pop']
 ['gruperas inmortales', 'nu-cumbia', 'regional mexican']
 ['focus']
 ['motown', 'soul']
 ['contemporary country', 'country', 'country road', 'modern country rock',
 'texas country']
 []
 []
 ['dance rock', 'double drumming', 'new romantic', 'new wave', 'new wave pop',
 'post-punk', 'punk', 'ska']
 ['alternative country', 'roots americana', 'roots rock', 'texas country']
 ['american contemporary classical']
 ['latin jazz']
 ['classical mezzo-soprano', 'classical performance', 'opera']
 ['celtic', 'new age', 'string folk']
 ['barockinterpreten', 'baroque ensemble', 'choral', 'classical performance',
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 ['jazz trio']
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 ['album rock', 'art rock', 'classic rock', 'classic uk pop', 'country rock',
 'folk', 'folk rock', 'mellow gold', 'progressive rock', 'soft rock', 'symphonic
 rock']
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 francaise']
 ['electro house']

['blues', 'blues rock', 'classic rock', 'electric blues', 'memphis soul', 'soul blues', 'traditional blues']
 ['classic italian pop', 'swing italiano', 'vintage italian pop']
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 ['pop']
 ['alternative country', 'country rock', 'folk', 'heartland rock', 'new americana', 'pub rock', 'roots rock']
 ['bachata', 'bachata dominicana', 'latin', 'merengue', 'tropical']
 ['smooth jazz']
 ['berlin minimal techno']
 ['funky tech house', 'tech house']
 ['cosmic american', 'experimental', 'folk rock', 'outsider', 'psychedelic rock']
 []
 ['disco', 'funk', 'minneapolis sound', 'new jack swing', 'post-disco', 'quiet storm', 'soul', 'urban contemporary']
 []
 ['dance pop', 'electropop', 'pop dance', 'romanian pop']
 ['axe', 'pagode']
 ['chill r&b']
 []
 ['canadian hip hop', 'pop']
 []
 ['alternative metal', 'alternative rock', 'grunge', 'hard rock', 'nu metal', 'rock']
 ['lo-fi beats']
 ['indie rock', 'modern alternative rock', 'modern blues rock', 'neo-psychedelic', 'space rock', 'stoner rock']
 ['dance rock', 'europop', 'new romantic', 'new wave', 'new wave pop', 'synthpop']
 []
 ['latin', 'latin arena pop', 'latin pop', 'spanish pop', 'spanish pop rock']
 ['hollywood', 'pop']
 ['french opera', 'french romanticism', 'late romantic era']
 ['hip hop', 'underground hip hop']
 ['big beat', 'drill and bass', 'electronica', 'intelligent dance music', 'jazztronica', 'ninja', 'nu jazz', 'trip hop']
 ['acoustic pop', 'indie folk', 'lilith', 'neo mellow', 'new americana', 'pop rock', 'stomp and holler']
 ['baroque ensemble', 'classical performance']
 ['chamber orchestra', 'string orchestra']
 ['fado']
 ['grupera', 'latin', 'mexican pop', 'regional mexican']
 ['background music', 'background piano', 'calming instrumental', 'focus', 'neo-classical']
 ['sitar', 'world fusion']
 []
 []

['blues rock', 'country rock', 'deep new americana', 'funk', 'jam band',
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 orleans blues', 'roots rock']
 ['easy listening']
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 []
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