aja2s1sok

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```python
[1]: import pandas as pd
     import numpy as np
     from typing import List
     import seaborn as sns
     import matplotlib.pyplot as plt
     # from google.colab import drive
     from sklearn.preprocessing import OneHotEncoder
```

```python
[2]: # drive.mount('/content/gdrive')
```

```python
[3]: # dataset_path = "/content/gdrive/MyDrive/listenings.csv"
```

```python
[4]: dataset_path = "listenings.csv"
```

```python
[5]: dataset = pd.read_csv(dataset_path,on_bad_lines='skip')
     dataset.head()
```

```
[5]:        user_id          date                            track      artist  \
     0  000Silenced  1299680100000                      Price Tag    Jessie J
     1  000Silenced  1299679920000  Price Tag (Acoustic Version)    Jessie J
     2  000Silenced  1299679440000       Be Mine! (Ballad Version)      Robyn
     3  000Silenced  1299679200000                      Acapella       Kelis
     4  000Silenced  1299675660000             I'm Not Invisible   The Tease

                   album
     0        Who You Are
     1          Price Tag
     2           Be Mine!
     3           Acapella
     4   I'm Not Invisible
```

```python
[6]: dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5779568 entries, 0 to 5779567
Data columns (total 5 columns):
 #   Column   Dtype
---  ------   -----
```

1

```
0   user_id   object
1   date      int64
2   track     object
3   artist    object
4   album     object
dtypes: int64(1), object(4)
memory usage: 220.5+ MB
```

[7]:
```python
print("Unique users number: %d"%len(dataset.user_id.unique()))
print("Unique artists number: %d"%len(dataset.artist.unique()))
print("Unique track number: %d"%len(dataset.track.unique()))
```

```
Unique users number: 31373
Unique artists number: 165660
Unique track number: 865916
```

[8]:
```python
na_counts = dataset.isna().sum()
print(na_counts)
```

```
user_id         0
date            0
track          92
artist         13
album      379648
dtype: int64
```

[9]:
```python
dataset['datetime'] = pd.to_datetime(dataset['date'], unit='ms')

# Extract date components
dataset['year'] = dataset['datetime'].dt.year
dataset['month'] = dataset['datetime'].dt.month
dataset['day'] = dataset['datetime'].dt.day
dataset['hour'] = dataset['datetime'].dt.hour
```

[10]:
```python
dataset.head()
```

[10]:
```
      user_id           date                           track      artist  \
0  000Silenced  1299680100000                       Price Tag    Jessie J
1  000Silenced  1299679920000   Price Tag (Acoustic Version)    Jessie J
2  000Silenced  1299679440000      Be Mine! (Ballad Version)       Robyn
3  000Silenced  1299679200000                        Acapella       Kelis
4  000Silenced  1299675660000               I'm Not Invisible   The Tease

          album            datetime  year  month  day  hour
0   Who You Are 2011-03-09 14:15:00  2011      3    9    14
1     Price Tag 2011-03-09 14:12:00  2011      3    9    14
2      Be Mine! 2011-03-09 14:04:00  2011      3    9    14
3      Acapella 2011-03-09 14:00:00  2011      3    9    14
```
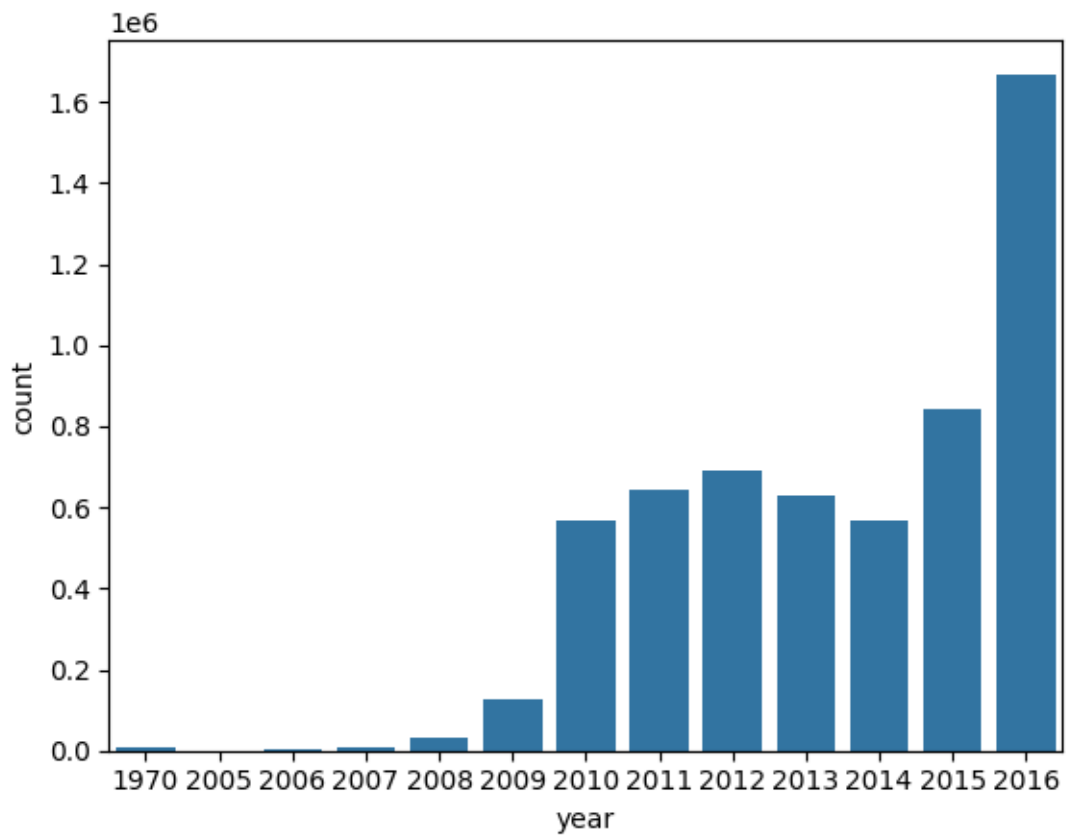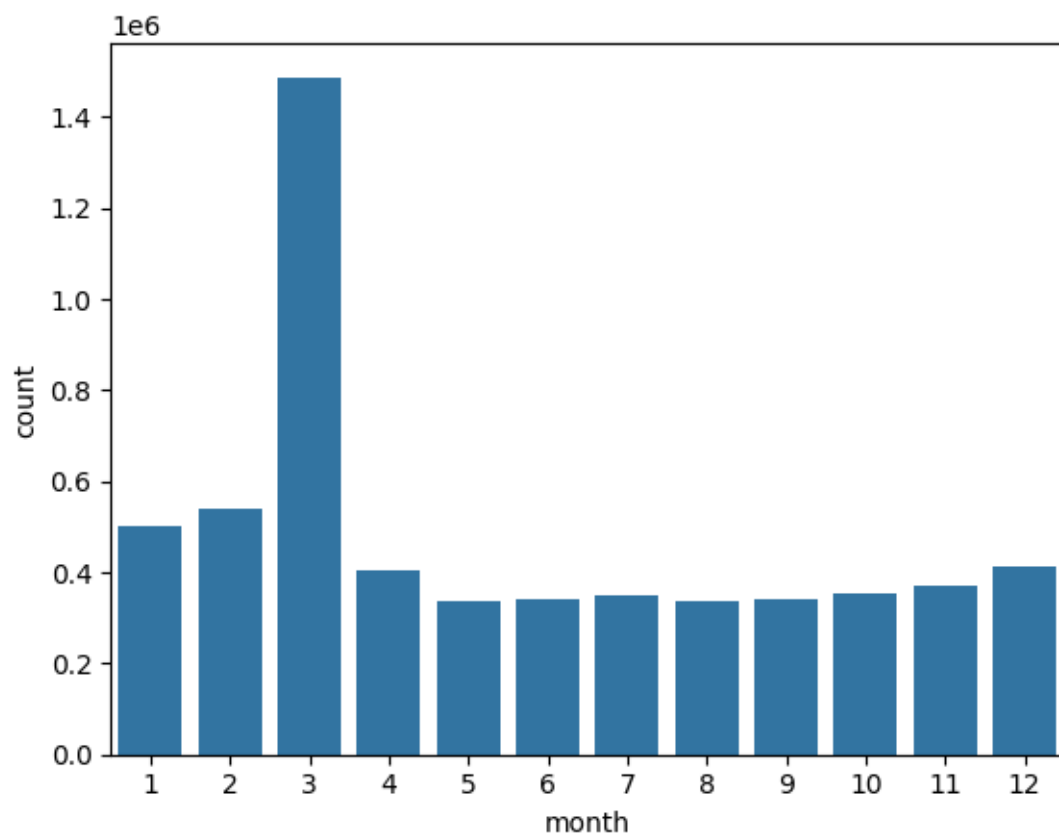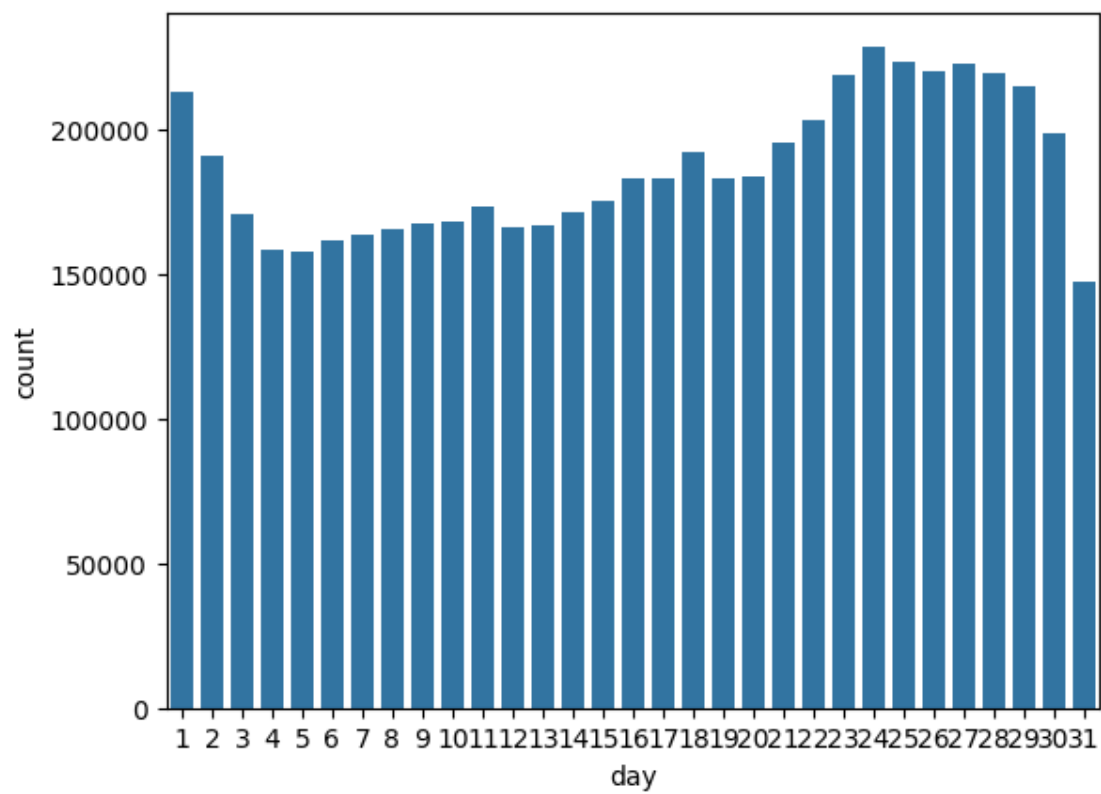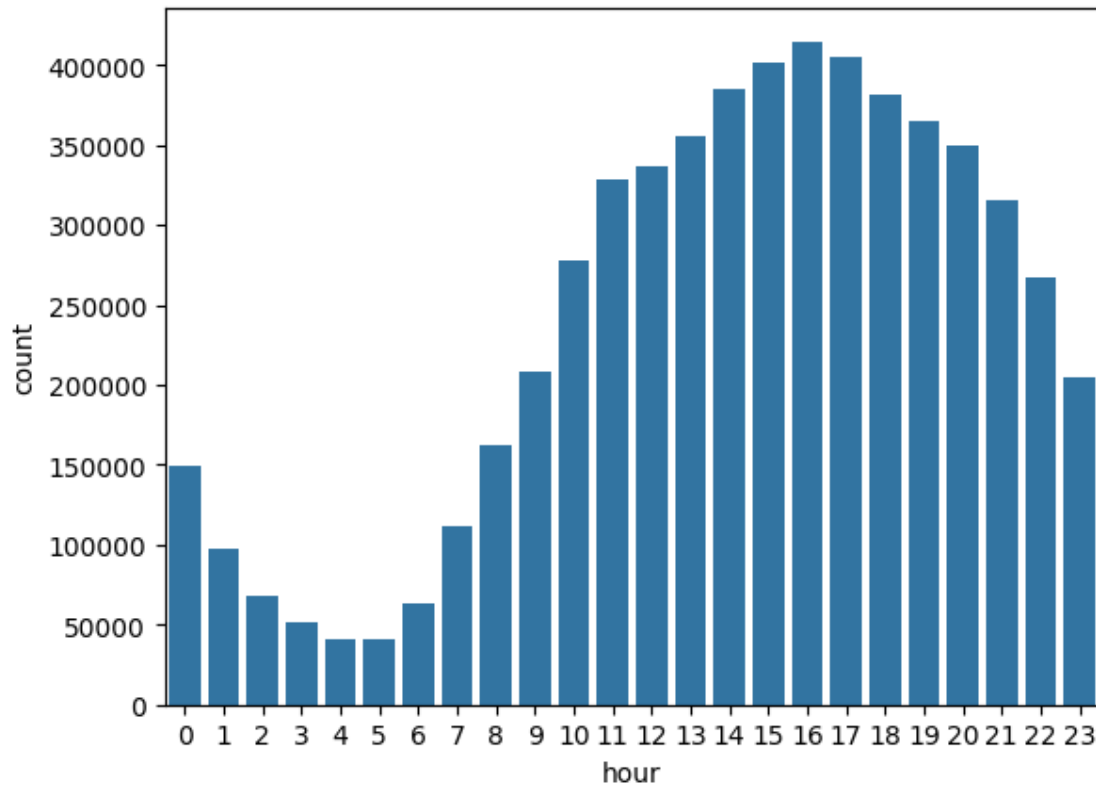
```
4  I'm Not Invisible 2011-03-09 13:01:00   2011        3    9    13
```

[11]:
```python
plt.figure()
ax1 = sns.countplot(x='year',data=dataset)
plt.figure()
ax2 = sns.countplot(x='month',data=dataset)
plt.figure()
ax2 = sns.countplot(x='day',data=dataset)
plt.figure()
ax3 = sns.countplot(x='hour',data=dataset)
```

```
[12]: dataset['track'].value_counts()[:10]
```

```
[12]: track
      Intro       5484
      Home        3255
      Hello       2429
      Work        2175
      Closer      1996
      Runaway     1892
      Sorry       1874
      Hold On     1835
      Stay        1749
      Untitled    1731
      Name: count, dtype: int64
```

```
[13]: dataset['artist'].value_counts()[:10]
```

```
[13]: artist
      David Bowie     26752
      The Beatles     21263
      Kanye West      21242
```

```
    Radiohead        19711
    Rihanna          19403
    Lady Gaga        18016
    Muse             17401
    Arctic Monkeys   16810
    Coldplay         16265
    Taylor Swift     16217
    Name: count, dtype: int64
```

[14]: `dataset['album'].value_counts()[:10]`

[14]:
```
album
Greatest Hits        27779
Sigh No More          6123
xx                    5974
An Awesome Wave       5720
AM                    5390
The Life Of Pablo     5270
Art Angels            4915
21                    4831
Lungs                 4626
To Pimp a Butterfly   4317
Name: count, dtype: int64
```

[15]: `dataset_sample = dataset[(dataset.year==2015) & (dataset.month==3)]`

[16]: `dataset_sample.info()`

```
<class 'pandas.core.frame.DataFrame'>
Index: 54829 entries, 706 to 5770567
Data columns (total 10 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   user_id   54829 non-null  object
 1   date      54829 non-null  int64
 2   track     54827 non-null  object
 3   artist    54829 non-null  object
 4   album     48934 non-null  object
 5   datetime  54829 non-null  datetime64[ns]
 6   year      54829 non-null  int32
 7   month     54829 non-null  int32
 8   day       54829 non-null  int32
 9   hour      54829 non-null  int32
dtypes: datetime64[ns](1), int32(4), int64(1), object(4)
memory usage: 3.8+ MB
```

[17]: `dataset_sample.head()`

```
[17]:        user_id           date                    track              artist   \
     706  00fieldsy  1426974300000                    Roxanne          The Police
     707  00fieldsy  1426974120000              Quiet Whiskey      Wynonie Harris
     708  00fieldsy  1426973640000        Cigarettes & Alcohol               Oasis
     709  00fieldsy  1426972740000  Sway - Remastered 2009  The Rolling Stones
     710  00fieldsy  1426972620000          Too Drunk to Fuck       Nouvelle Vague

                                       album             datetime  year  month  \
     706  The Very Best Of Sting And The Police  2015-03-21 21:45:00  2015      3
     707                    Rhythm & Blues & Booze  2015-03-21 21:42:00  2015      3
     708                         Time Flies 1994-2009  2015-03-21 21:34:00  2015      3
     709        Sticky Fingers (Remastered 2009)  2015-03-21 21:19:00  2015      3
     710          Nouvelle Vague Special Edition  2015-03-21 21:17:00  2015      3

          day  hour
     706   21    21
     707   21    21
     708   21    21
     709   21    21
     710   21    21
```

```python
[18]: print("Unique users number: %d"%len(dataset_sample.user_id.unique()))
      print("Unique artists number: %d"%len(dataset_sample.artist.unique()))
      print("Unique track number: %d"%len(dataset_sample.track.unique()))
```

```
Unique users number: 1302
Unique artists number: 8679
Unique track number: 29489
```

```python
[19]: na_counts = dataset_sample.isna().sum()
      print(na_counts)
```

```
user_id        0
date           0
track          2
artist         0
album       5895
datetime       0
year           0
month          0
day            0
hour           0
dtype: int64
```

```python
[20]: # Assuming you already have your DataFrame, let's call it dataset_sample
      # Dropping missing values
```

```
dataset_sample = dataset_sample.dropna()
```

[21]:
```
na_counts = dataset_sample.isna().sum()
print(na_counts)
```

```
user_id     0
date        0
track       0
artist      0
album       0
datetime    0
year        0
month       0
day         0
hour        0
dtype: int64
```

[22]:
```python
from tqdm import tqdm
```

[23]:
```python
def construct_user_matrix(_dataset:pd.DataFrame) -> pd.DataFrame:
    """
    Construct a n*m dataframe where n means the number of users
    and m means the number of unique tracks.
    Each value means how many times the user listened to the certain track
    """

    dataset = _dataset.copy()

    # sort the orginal dataframe by userid
    dataset_sorted = dataset.sort_values('user_id')
    dataset_sorted.reset_index(inplace=True)

    # one hot encodings for each track
    # set data type to int8 to reduce memory usage
    enc = OneHotEncoder(handle_unknown='ignore',dtype='int8')
    enc_dataset = enc.fit_transform(dataset_sorted[['artist']]).toarray()


    # get the list of occurrences of users
    user_list = list(dataset_sorted.user_id.unique())
    user_occurrence_list = dataset_sorted.user_id.value_counts()

    # user range dictionary with tuple of the start index and end index
    pos=0
    start = 0
    user_range_dic = {}
    index_to_user={}
```

```python
    for user in user_list:
        end = start+user_occurrence_list.loc[user]
        user_range_dic[user] = (start, end,pos)
        index_to_user[pos]=user
        start = end
        pos+=1
        # initialize the array with all zeros
    # set data type to int instead of the default float to reduce memory usage
    user_track_arr = np.zeros((len(user_list), enc_dataset.shape[1]), dtype=int)

    # construct the final dataframe by summing up
    row = 0
    for user, (start, end,pos) in tqdm(user_range_dic.items()):

        # sum the occurrences of each track given the range of rows for the user
        user_track_row = np.sum(enc_dataset[start:end], axis=0)

        # add it to numpy array
        user_track_arr[row,:] = user_track_row

        row += 1

    # column names excluding the 'artist_track_' prefix
    column_names = [i[13:] for i in enc.get_feature_names_out()]

    # convert the numpy array to dataframe
    user_track_dataset = pd.DataFrame(user_track_arr, index=user_list,␣
    ↪columns=column_names)

    return user_track_dataset,user_range_dic,index_to_user
```

```python
[24]: user_track_dataset,user_range_dic,index_to_user=␣
      ↪construct_user_matrix(dataset_sample)
```

```
100%|        | 1142/1142 [00:00<00:00, 6034.05it/s]
```

```python
[25]: #Visualizing the index_to_user dictionary
      index_to_user
```

```python
[25]: {0: '-citric-',
       1: '-haha-',
       2: '00fieldsy',
       3: '01higginsr',
       4: '1losthousemate',
       5: '2manysparkles',
       6: '66z',
       7: '9thAtPine',
```

```
8:  'ABoynamedStu',
9:  'AGIRLCALLEDLISA',
10: 'AJBuggy',
11: 'ALXtop',
12: 'AMB3RR',
13: 'AMomentLikeThis',
14: 'ARRANRP',
15: 'AStormInHeaven',
16: 'AWasteOfPaint',
17: 'Aabey14',
18: 'Aarghlex',
19: 'AaronSpiers',
20: 'Abbstar',
21: 'Acdc2693',
22: 'Acidicx',
23: 'Acquiescence',
24: 'AdamEW',
25: 'AdamJohnLowe',
26: 'Adam_Mitchell20',
27: 'Adam__Thomas',
28: 'Adds102',
29: 'AdeBrown',
30: 'Admiral-jimbob',
31: 'Adzanrana',
32: 'Aestheticist',
33: 'Agento_Orange',
34: 'Ajescent',
35: 'AlBassStar',
36: 'Alan_G',
37: 'AlexEtchells',
38: 'AlexJamesJose',
39: 'AlexM17',
40: 'AlexMaskill',
41: 'AlexOCnr',
42: 'AlexisSkitini',
43: 'AlexxRawr',
44: 'AliBlack',
45: 'AlisonLovelock',
46: 'AlisonSakai',
47: 'All-The-Rage',
48: 'Altercarnated',
49: 'AmandaLeighKidd',
50: 'Amberful',
51: 'Amiii264',
52: 'AmikaS',
53: 'Ammiela',
54: 'AmyEusebi',
```

```
55: 'Andrew8473',
56: 'AndrewM1982',
57: 'AndrewP1964',
58: 'AndrewPorter92',
59: 'Androo_mfzb',
60: 'AndyWills87',
61: 'Andy_Cliff',
62: 'Annavinhto',
63: 'Antideity',
64: 'Anya643',
65: 'Armergeddon',
66: 'As_bridges_Burn',
67: 'AshlenaAres',
68: 'Ashman_87',
69: 'AskingRuby',
70: 'Auron1990',
71: 'AverageB-Side',
72: 'Awww-its-Caz',
73: 'Ayamepanda',
74: 'Azuradam',
75: 'BENecol',
76: 'BON-NICK',
77: 'BUNN3Y3',
78: 'Bad-boy-badger',
79: 'Bambi-strokes',
80: 'Barber85',
81: 'BareFootedGirl',
82: 'BaronHawkey',
83: 'Bass_Militant',
84: 'BeaSTeX',
85: 'BeastmanDan',
86: 'Becki_Louise',
87: 'Becky2289',
88: 'BedTaker',
89: 'Beeeaa',
90: 'Beigeman',
91: 'BenAustin89',
92: 'BenCollett',
93: 'BenIsBen',
94: 'Ben_Clark',
95: 'Benjaminbrum',
96: 'Benji-PHC',
97: 'BenjiSansom',
98: 'Benneh87',
99: 'BethPeppeR',
100: 'BettyMadeley',
101: 'Bex3000',
```

```
102: 'BeyondCognition',
103: 'Biancapol',
104: 'Bibbles3',
105: 'BigDim',
106: 'BigFitz',
107: 'BigLugAudio',
108: 'BillyCupid',
109: 'BimTrayshaw',
110: 'Birdeatsbaby',
111: 'Bjoom',
112: 'BlueReZZ',
113: 'BluecrowX',
114: 'BohemianCoast',
115: 'Boras',
116: 'Bowers19',
117: 'Bowieinspace',
118: 'Boyscout1981',
119: 'BreezyJones',
120: 'Brennan01',
121: 'BroomCottage',
122: 'Browneproject',
123: 'Brunners',
124: 'Brutalsleeper',
125: 'Bubblewrapped',
126: 'Budda084',
127: 'BukasFriend',
128: 'C-A-R-A',
129: 'C0nt1nu1ty',
130: 'CFChef',
131: 'CHebbes',
132: 'C_Moz',
133: 'Cabe6403',
134: 'CalMBP',
135: 'Call_FRANK',
136: 'Callum_Carcass',
137: 'Callum_Hubbard',
138: 'CalumRussell',
139: 'Capitalyouth',
140: 'CaptainMongoose',
141: 'CaptainW',
142: 'Captain_LeChuck',
143: 'CaraKeen',
144: 'CarlHarrison-',
145: 'CarolineD',
146: 'Caroline_tmn',
147: 'CasperCCC',
148: 'CathHenry',
```

```
149: 'CfWW',
150: 'Chairman__LMAO',
151: 'CharLouSau',
152: 'CharisIsTehCool',
153: 'Charlala20',
154: 'CharlieGCC',
155: 'CharlottteRose',
156: 'Charry',
157: 'Chazums',
158: 'ChernobylBob',
159: 'Chess__',
160: 'Chewbeccaaa',
161: 'Chill2006',
162: 'Chippy22',
163: 'ChrisBravoTown',
164: 'ChrisCrus88',
165: 'ChrisDodo',
166: 'ChrissieHines',
167: 'Christobisto',
168: 'CitizenCaned',
169: 'Citizensheep',
170: 'ClearCarbon',
171: 'ClintonMorrison',
172: 'ClocoPop',
173: 'Clunge',
174: 'CoRaRaRa',
175: 'Coates13',
176: 'Coddy123456789',
177: 'Colin1988',
178: 'ConcordPF',
179: 'Connoro',
180: 'Cottie78',
181: 'Couldtryharder',
182: 'Cptcroissant',
183: 'Crazyfistje',
184: 'CrizzleSnaps',
185: 'Cruiserfan',
186: 'CrystalLovesDC',
187: 'CurrySer',
188: 'Cyberpunk_Edd',
189: 'Cycle-maniac',
190: 'DAZ110264',
191: 'DCG_123',
192: 'DELLFM',
193: 'DILLON21',
194: 'DJMattArana',
195: 'DTADS',
```

```
196: 'D_Zero',
197: 'Daisyyduck',
198: 'DaleSargeant',
199: 'Damiomg',
200: 'DanDementia',
201: 'DanHopkinson',
202: 'Dan_Hubble',
203: 'Danatlive',
204: 'Danbojones',
205: 'Dane08',
206: 'Daniel-Gray',
207: 'DanielOwnsJoo',
208: 'DarcyGuiras',
209: 'Dare2shine',
210: 'DarkeningSky',
211: 'Darkhadou',
212: 'Darkvibes',
213: 'Darkwain',
214: 'DavCo',
215: 'DaveGrohl23',
216: 'DaveyEd',
217: 'DavidB6937',
218: 'Davidalbert86',
219: 'Day3000',
220: 'DayMetTheNight',
221: 'Dea_Muta',
222: 'DeadCellz0r',
223: 'DeadFlower6',
224: 'DeadPaparazzi',
225: 'Deadwardson',
226: 'DeanMackinnon',
227: 'DeathByFeedback',
228: 'Deathbyhappy',
229: 'Debaucherry',
230: 'Dehv',
231: 'DemiAllnutt',
232: 'Denoo',
233: 'DetSomEngangVar',
234: 'Devonprog',
235: 'DiamondsandGold',
236: 'Dickie-2k6',
237: 'DigLazarusDig1',
238: 'DigitalFlunkie',
239: 'Dillingerep',
240: 'Dinendal',
241: 'Dingo3001',
242: 'Diranish',
```

```
243: 'Discopants09',
244: 'Djsgotagun',
245: 'Dodge68',
246: 'Doenutty',
247: 'Dolliedaydream',
248: 'DonaldKelly',
249: 'DonnyScum',
250: 'Dovilee',
251: 'Dr_Jon',
252: 'Dr_Terrible',
253: 'Drain_A_way',
254: 'DrifterUK',
255: 'DropDeadPwx',
256: 'Drummer_si',
257: 'Drumtasticnick',
258: 'Dshadow69',
259: 'Dukesy',
260: 'DundeeDude',
261: 'Duracell_Plus',
262: 'DustyPastures',
263: 'EATONNN',
264: 'ELIOTT',
265: 'ERyder',
266: 'Eamonnem',
267: 'Ecomo',
268: 'El-Lloydo',
269: 'ElFierce',
270: 'ElSupermercado',
271: 'Elefant_Stone',
272: 'Elfy1985',
273: 'Elleny',
274: 'ElliotS89',
275: 'ElmoBerry',
276: 'Elzzz93',
277: 'Emilyyandrews',
278: 'Emma3005',
279: 'EmmaDollydagger',
280: 'EmoTigger',
281: 'En_Dogg',
282: 'EnglishStan',
283: 'Enorez',
284: 'Epstra',
285: 'Evil_Fury',
286: 'Eyedee',
287: 'FabienneFormsma',
288: 'FaithbyCourage',
289: 'FalseEyelashes',
```

```
290: 'FalsettoSlumber',
291: 'Fangless',
292: 'FarkMarrall',
293: 'FaustFest',
294: 'FeelGudLost',
295: 'Fernfacee',
296: 'Ferretgames',
297: 'Finiboom',
298: 'FireFury',
299: 'FishesWillLaugh',
300: 'FiskMedGaeller',
301: 'FlammableD',
302: 'FluffyNips',
303: 'FluffySpider',
304: 'ForTheFloods',
305: 'ForgottenRach',
306: 'Frandomization',
307: 'Franyole',
308: 'Franz_fan14',
309: 'Frayja',
310: 'FreedomRoad',
311: 'Freestyle6383',
312: 'Frenchy21320',
313: 'FunkyLarma',
314: 'FunkyRenegade99',
315: 'Furude_Jenny',
316: 'Gar0804',
317: 'GavyDee',
318: 'Gaycard',
319: 'GazM89',
320: 'Gaz_ITFC',
321: 'GemSilca',
322: 'GemmaPearce',
323: 'Gemmwah',
324: 'George_d',
325: 'Georgegrafton',
326: 'Ghoti',
327: 'Gilmarine',
328: 'GinaIsAmazing',
329: 'Gina_Donohoe',
330: 'Glawster2002',
331: 'Glittablitx',
332: 'GoreSteppa',
333: 'Grace_Tickle',
334: 'Greenfly750',
335: 'GregDefinitions',
336: 'GregRyanM',
```

```
337: 'Grimangelus',
338: 'Gronkle',
339: 'Guiltyparty',
340: 'GusMin',
341: 'GuttermouthSIN',
342: 'Guyavern',
343: 'HANI-KINS',
344: 'HAXER1993',
345: 'HISDIZZYNESS',
346: 'Haikukid',
347: 'Hannah8870',
348: 'HannahMurdoch',
349: 'HannahSlater',
350: 'Hanners',
351: 'Hannoja',
352: 'HappyDani',
353: 'HarlequinGresh',
354: 'HarleyLive',
355: 'Harriet_K',
356: 'Harrison101',
357: 'HeadKhandi',
358: 'Hecate83',
359: 'HeddaEdgar',
360: 'Helene_Atsuko',
361: 'Helmoose',
362: 'Henguin',
363: 'HenryBaines',
364: 'Hevhevhev',
365: 'High_Land_Can',
366: 'Hinchcliffe',
367: 'HippyJez',
368: 'HollieH',
369: 'HollyTheWombat',
370: 'ICR',
371: 'IEthghost',
372: 'IGWilliams',
373: 'IM7070',
374: 'IVANSHEET',
375: 'I_HunkyDory_I',
376: 'IcePie',
377: 'Ice_Visions',
378: 'Iceman7427',
379: 'Icequeen20000',
380: 'Inbred',
381: 'Incantrix',
382: 'IndieSkies',
383: 'Inquisitior',
```

```
384: 'Isoniahtar',
385: 'ItsMatteh',
386: 'Ivalicia',
387: 'IzyJude',
388: 'J3110',
389: 'J4m3ZA7X',
390: 'JD_Rusty',
391: 'JFoundation',
392: 'JFreid05',
393: 'JIPrettyAwesome',
394: 'JL5386',
395: 'JackP163',
396: 'Jack_Eyes',
397: 'Jalinde',
398: 'JamesLikesGirls',
399: 'James_D_21',
400: 'James_Gull',
401: 'Jameshodgson100',
402: 'JamesofOxford',
403: 'JammyIII',
404: 'Jamsa',
405: 'Jamusjamus',
406: 'Janfromruglin',
407: 'Jarvillian',
408: 'Jaseonrobinson',
409: 'Jasey_Baby',
410: 'Jay_fezz',
411: 'Jebbie',
412: 'Jed2191',
413: 'Jen_p_x',
414: 'Jengamoose',
415: 'JenniferEllenM',
416: 'Jenniland',
417: 'Jeremy22',
418: 'Jerm_655',
419: 'JessRIOT',
420: 'Jessedinmypants',
421: 'Jetskee',
422: 'Jewfro73',
423: 'Jiiigsaw',
424: 'JilesFTW',
425: 'JimTheBig',
426: 'Jimbob666',
427: 'Jimi-Jam',
428: 'JimiJones',
429: 'JimmySixBellies',
430: 'Jinksano',
```

```
431: '__elly',
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'CitizenCaned': (8012, 8106, 168),
'Citizensheep': (8106, 8108, 169),
'ClearCarbon': (8108, 8137, 170),
'ClintonMorrison': (8137, 8159, 171),
'ClocoPop': (8159, 8211, 172),
'Clunge': (8211, 8219, 173),
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'Colin1988': (8311, 8313, 177),
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'Connoro': (8316, 8330, 179),
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'DustyPastures': (11966, 11968, 262),
'EATONNN': (11968, 11969, 263),
'ELIOTT': (11969, 12007, 264),
'ERyder': (12007, 12012, 265),
'Eamonnem': (12012, 12055, 266),
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'ForTheFloods': (13251, 13425, 304),
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'ICR': (16491, 16503, 370),
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'IM7070': (16515, 16516, 373),
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'ItsMatteh': (17255, 17259, 385),
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```

[27]:
```python
from sklearn.decomposition import PCA
import matplotlib.pyplot as plt
```

[28]:
```python
# Assuming you already have user_track_dataset
pca = PCA(n_components=3)  # Reduce the dimensions to 2 for visualization
user_track_pca = pca.fit_transform(user_track_dataset)
```

[29]:
```python
from mpl_toolkits.mplot3d import Axes3D

fig = plt.figure(figsize=(12, 8))
ax = fig.add_subplot(111, projection='3d')

ax.scatter(user_track_pca[:, 0], user_track_pca[:, 1], user_track_pca[:, 2],
    ↪s=10, alpha=0.5)

ax.set_xlabel("Principal Component 1")
ax.set_ylabel("Principal Component 2")
ax.set_zlabel("Principal Component 3")
ax.set_title("PCA Visualization of User Music Taste (3D)")

plt.show()
```
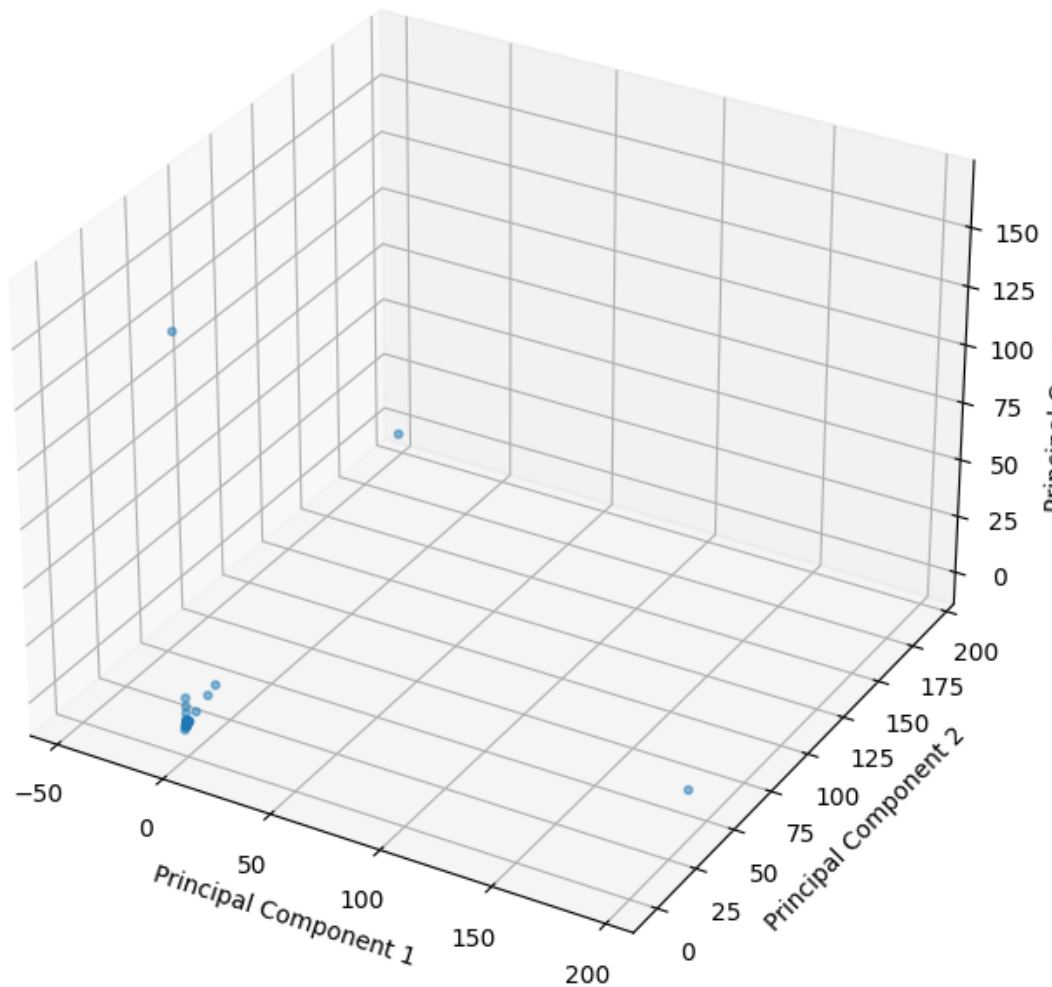
PCA Visualization of User Music Taste (3D)


```
[30]: from sklearn.manifold import TSNE
      from mpl_toolkits.mplot3d import Axes3D   # Import for 3D plotting

      # Assuming you already have user_track_dataset
      user_track_tsne_3d = TSNE(n_components=3, perplexity=30, n_iter=300).
       ↪fit_transform(user_track_dataset)

      fig = plt.figure(figsize=(12, 8))
      ax = fig.add_subplot(111, projection='3d')

      ax.scatter(user_track_tsne_3d[:, 0], user_track_tsne_3d[:, 1],␣
       ↪user_track_tsne_3d[:, 2], s=10, alpha=0.5)
```
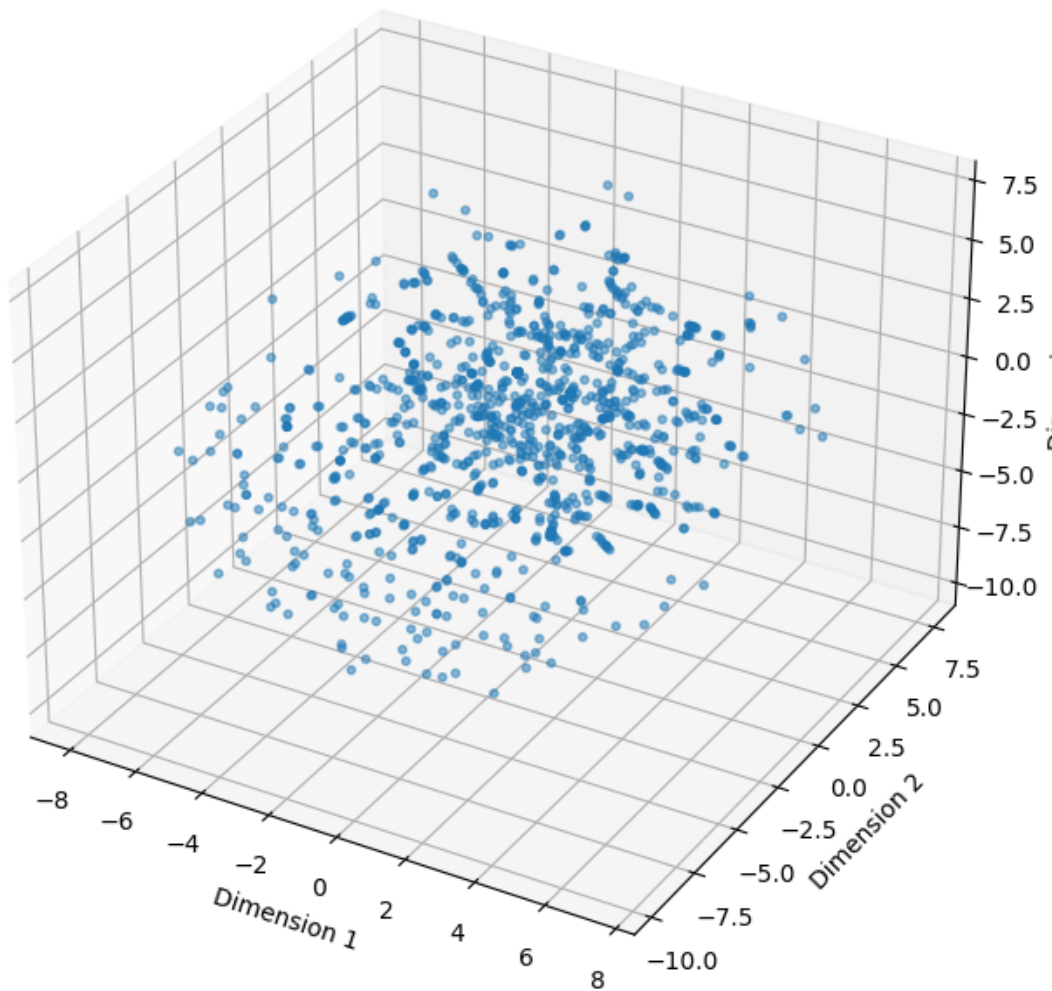
```
ax.set_xlabel("Dimension 1")
ax.set_ylabel("Dimension 2")
ax.set_zlabel("Dimension 3")
ax.set_title("3D t-SNE Visualization of User Music Taste")

plt.show()
```

3D t-SNE Visualization of User Music Taste


```
[31]: from sklearn.cluster import KMeans
      from sklearn.metrics import silhouette_score, davies_bouldin_score

      cluster_range = range(2, 501)  # You can adjust the range as needed
```
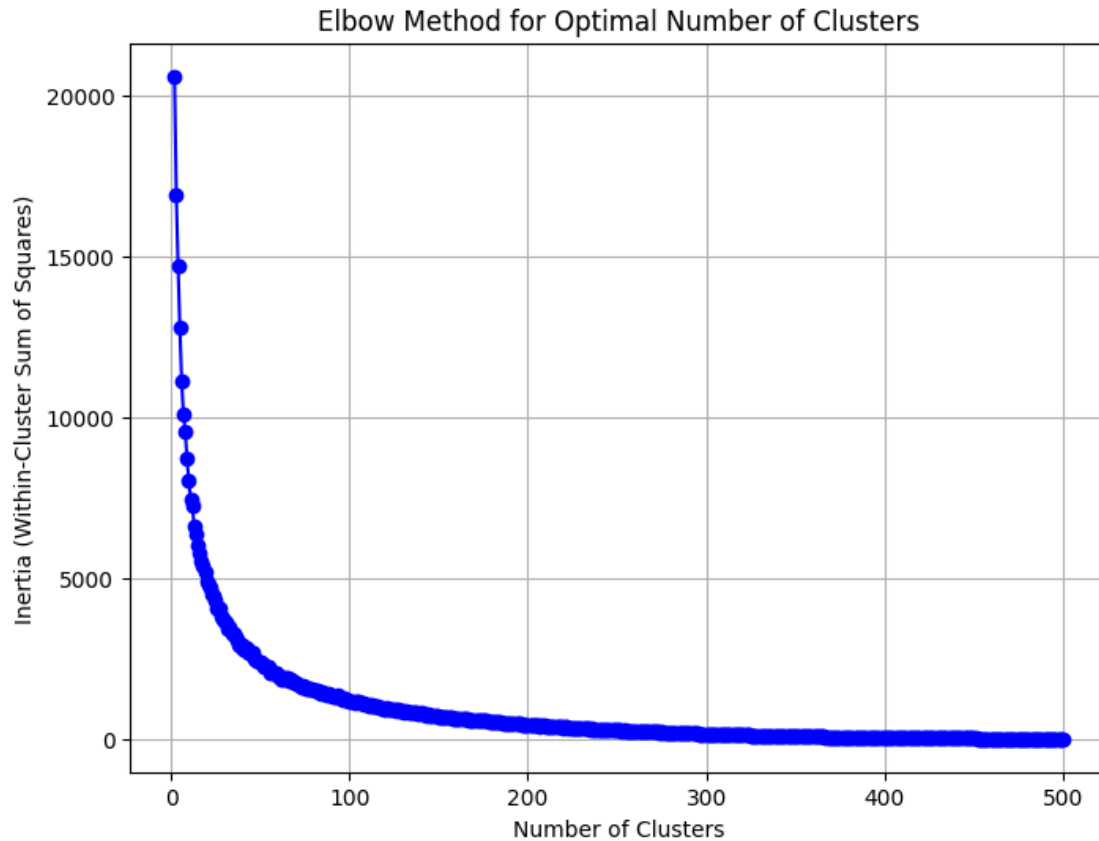
```python
# Initialize a list to store the Inertia values for different cluster numbers
# Initialize lists to store the Silhouette scores and Davies Bouldin scores for
 ↪different cluster numbers
inertia_values = []
silhouette_scores = []
davies_bouldin_scores= []

# Iterate through the cluster numbers and calculate Inertia for each
for i in tqdm(cluster_range,desc='Progress'):
    kmeans = KMeans(n_clusters=i,n_init="auto")
    kmeans.fit(user_track_tsne_3d)
    inertia = kmeans.inertia_
    inertia_values.append(inertia)
    silhouette_scores.append(silhouette_score(user_track_tsne_3d, kmeans.
 ↪labels_))
    davies_bouldin_scores.append(davies_bouldin_score(user_track_tsne_3d,
 ↪kmeans.labels_))

# Plot the Inertia values
plt.figure(figsize=(8, 6))
plt.plot(cluster_range, inertia_values, marker='o', linestyle='-', color='b')
plt.title('Elbow Method for Optimal Number of Clusters')
plt.xlabel('Number of Clusters')
plt.ylabel('Inertia (Within-Cluster Sum of Squares)')
plt.grid(True)
plt.show()
```
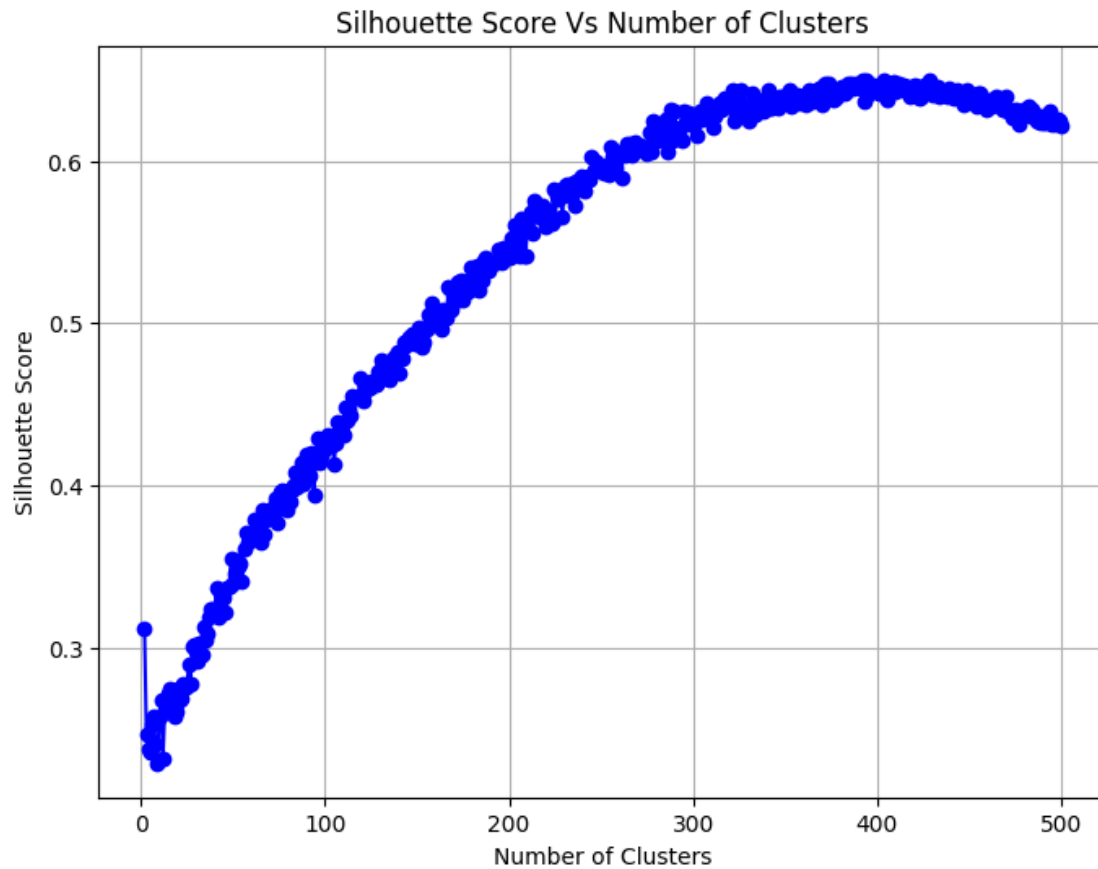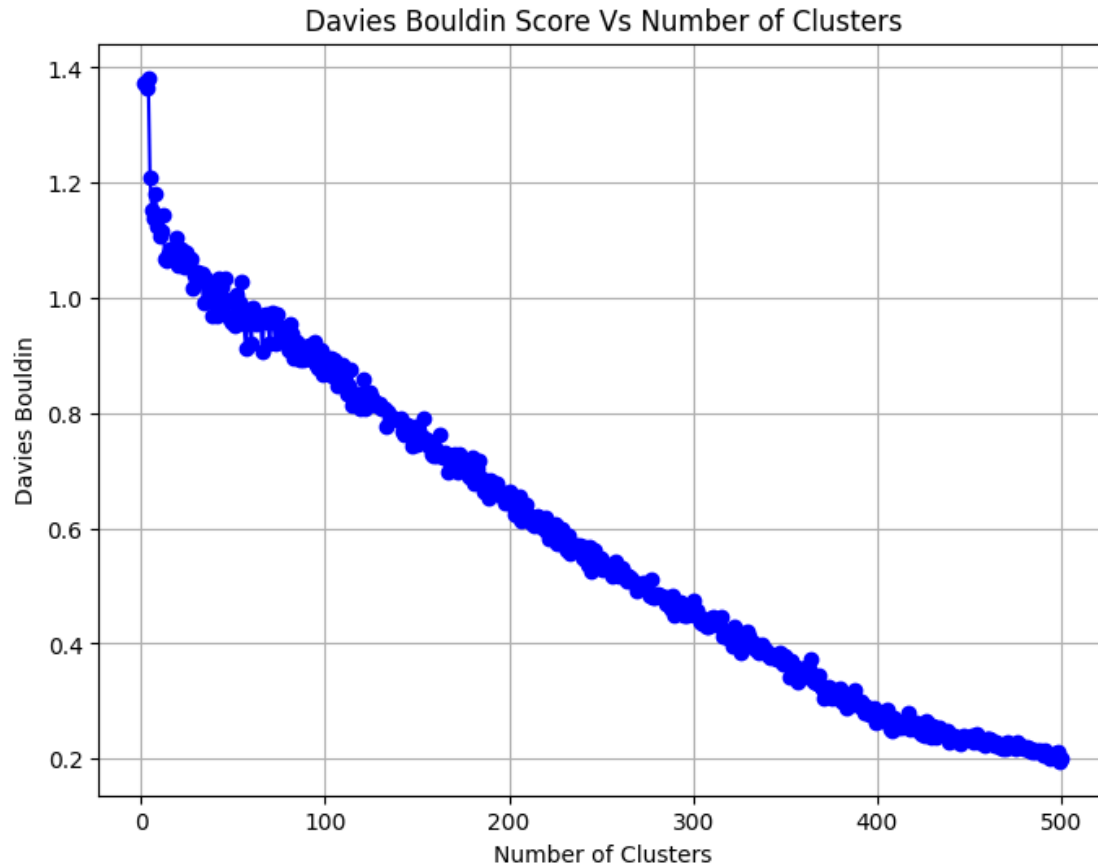
Progress: 100%| | 499/499 [01:55<00:00, 4.32it/s]

Elbow Method for Optimal Number of Clusters


```
[32]:  # Plot the Silhouette Scores
       plt.figure(figsize=(8, 6))
       plt.plot(cluster_range, silhouette_scores, marker='o', linestyle='-', color='b')
       plt.title('Silhouette Score Vs Number of Clusters')
       plt.xlabel('Number of Clusters')
       plt.ylabel('Silhouette Score')
       plt.grid(True)
       plt.show()
```

Silhouette Score Vs Number of Clusters

```
[33]: # Plot the Davies Bouldin Scores
      plt.figure(figsize=(8, 6))
      plt.plot(cluster_range, davies_bouldin_scores, marker='o', linestyle='-',␣
       ↪color='b')
      plt.title('Davies Bouldin Score Vs Number of Clusters')
      plt.xlabel('Number of Clusters')
      plt.ylabel('Davies Bouldin')
      plt.grid(True)
      plt.show()
```

Davies Bouldin Score Vs Number of Clusters

[34]:
```
# Using the elbow curve, the optimal number of clusters = 80

n_clusters = 80

# Initialize and fit the K-Means model
kmeans_3d = KMeans(n_clusters=n_clusters,n_init="auto")
clusters_3d = kmeans_3d.fit_predict(user_track_tsne_3d)  # user_track_tsne_3d␣
 ↪is your 3D t-SNE representation
```

[35]:
```
# Exploring the clusters
print(kmeans_3d.cluster_centers_)
print(clusters_3d)
```

```
[[-0.28569648 -3.5066195  -5.2640557 ]
 [ 1.4424131   0.5933008   0.3903352 ]
 [-3.6411753   0.74347556  1.9374336 ]
 [-3.260189   -8.707686    0.32217383]
 [-0.9885648   3.2314212  -0.18631257]
 [ 1.4246242  -2.2415798   4.9588323 ]
 [-3.408625   -2.9817703  -1.8145437 ]
```

```
[ 3.214769   -3.4842818  -2.0038223 ]
[ 0.23841794  1.2907888  -4.650423  ]
[-0.07247363 -4.6336503   0.9967425 ]
[ 2.743737    5.0576963   1.4461253 ]
[-4.8410125  -5.9143977  -3.695056  ]
[-2.0829606  -0.80758214 -8.316087  ]
[ 2.7604496   2.4053771  -1.567184  ]
[ 1.5204538   1.9254501   5.059799  ]
[-5.4224577   0.22609055 -3.6705322 ]
[-0.33467907 -0.08272082  1.3906097 ]
[ 5.643006   -0.5307004   2.0501127 ]
[ 2.1328337  -6.7857804  -1.2564418 ]
[-2.205607   -6.9455667  -5.4233327 ]
[-2.0356205  -0.07899883 -2.606719  ]
[-6.2771163  -4.826172   -0.6770417 ]
[-2.5466619  -1.8012685   5.522908  ]
[ 0.9940843  -6.4020886  -4.05296   ]
[ 0.0299056   1.8084838  -1.8471644 ]
[-0.04872519 -2.3414867   0.39150965]
[-3.5967486   0.04359645 -1.0279753 ]
[ 0.8620054   4.914824   -1.5162463 ]
[ 1.7027036  -1.03661    -0.5307548 ]
[-2.3751032   3.2533312  -4.102891  ]
[ 0.49961507  2.0418172   0.9049462 ]
[ 3.959569   -2.8936949   3.0417156 ]
[-0.30221748 -0.17487445 -0.38243794]
[-0.58076715  2.6647677   2.168538  ]
[-6.1900344  -1.9136307  -1.8050916 ]
[-3.3247325   2.467812    3.5162086 ]
[-1.8255788  -1.9495863   2.0636253 ]
[-2.5700946  -5.4137077  -0.9392925 ]
[-0.5468301   0.28960997  5.5373216 ]
[ 0.21971537 -4.8691683  -7.3130655 ]
[ 4.2110643  -0.12187779 -2.0382462 ]
[ 2.847944   -0.25268346  5.839949  ]
[-5.195072   -0.5894991   2.3742647 ]
[ 0.0344366   4.44512     4.0895147 ]
[ 0.83264834 -0.97578585  3.00982   ]
[ 1.7399061   4.09906    -4.049441  ]
[-2.6305532   2.7843108  -1.6593399 ]
[ 0.9297827   0.08612084 -2.4143567 ]
[ 4.0866585  -1.3074486   0.31723362]
[-3.4486616   3.3052008   1.106607  ]
[ 2.7189353   2.4093494   1.8541247 ]
[-3.3020558  -0.9236103  -5.5891747 ]
[-1.3742201   5.604354   -0.19296107]
[-0.7054852  -7.734515    2.3739748 ]
[-1.440791   -4.2591767  -2.2845995 ]
```

```
[ 2.2491179  -2.1836119   0.7140486 ]
[-0.78702676 -8.026       -0.87953043]
[ 0.37457514 -2.923907    -2.2003806 ]
[ 0.31789905  0.7461705   -5.9834094 ]
[-1.6315491  -3.7652519    1.9682144 ]
[-2.117594   -1.0758784    0.18894404]
[-0.03626131 -4.256057     3.9915152 ]
[-1.7811797   1.0955782   -0.22269341]
[ 6.358203    3.2372699    0.03883779]
[-5.9784417  -3.0011542   -5.5565133 ]
[-4.44494    -7.718346    -1.6011832 ]
[ 5.2199354   1.5121934    3.6974382 ]
[ 2.3868763   0.41433388   2.7456965 ]
[ 3.103755    2.9631052   -5.8988433 ]
[ 5.0784035  -3.552955    -4.182989  ]
[ 1.0307493  -2.5067482   -7.9768815 ]
[ 4.469369    1.2601866    0.44824094]
[-4.1032953  -6.3129754    2.2597604 ]
[-1.7324966   1.0618128    3.8869348 ]
[ 2.0786223  -1.2473872   -5.302444  ]
[ 1.8070624  -1.1735647   -2.9558225 ]
[ 4.52972    -3.9195569    0.59652483]
[-1.0665423  -1.5697069   -4.127203  ]
[-3.7950056  -4.404099    -7.1965027 ]
[-5.0581956   2.5190914   -1.337904  ]]
[55 47 42 … 54 14 15]
```

[36]:
```python
data = user_track_tsne_3d
clusters = clusters_3d
# 1. Inertia (Within-Cluster Sum of Squares)
kmeans = KMeans(n_clusters=80,n_init="auto")  # Replace with the number of␣
 ↪clusters used
kmeans.fit(data)
inertia = kmeans.inertia_
print(f'Inertia: {inertia}')

# 2. Silhouette Score
silhouette_avg = silhouette_score(data, clusters)
print(f'Silhouette Score: {silhouette_avg}')

# 3. Davies-Bouldin Index
davies_bouldin = davies_bouldin_score(data, clusters)
print(f'Davies-Bouldin Index: {davies_bouldin}')
```

```
Inertia: 1521.648193359375
Silhouette Score: 0.3965287208557129
Davies-Bouldin Index: 0.9226827439757574
```

```
[37]: import matplotlib.pyplot as plt
      from mpl_toolkits.mplot3d import Axes3D

      fig = plt.figure(figsize=(12, 8))
      ax = fig.add_subplot(111, projection='3d')

      # Assuming you have 3D t-SNE representation
      ax.scatter(user_track_tsne_3d[:, 0], user_track_tsne_3d[:, 1],
       →user_track_tsne_3d[:, 2], c=clusters_3d, cmap='viridis')

      ax.set_xlabel("Dimension 1")
      ax.set_ylabel("Dimension 2")
      ax.set_zlabel("Dimension 3")
      ax.set_title("3D Clustering Result")

      plt.show()
```
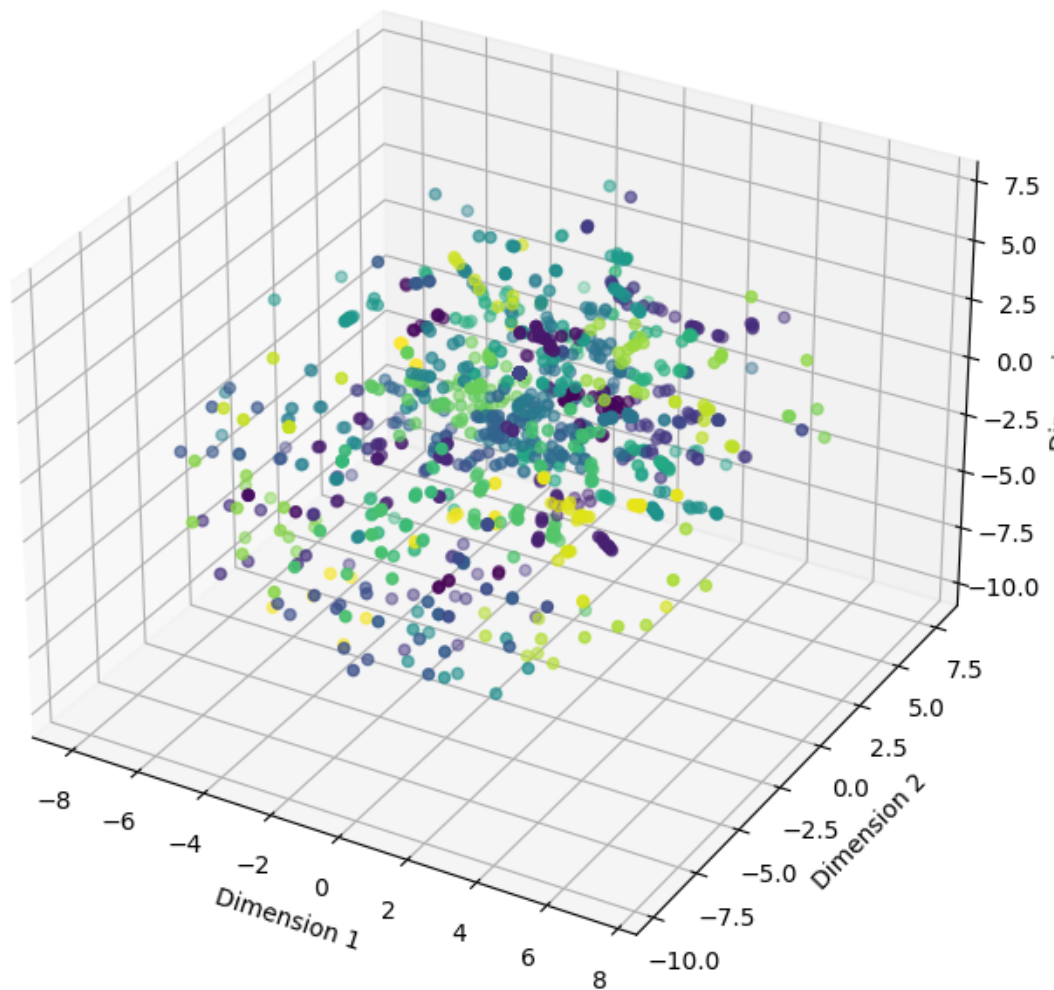
3D Clustering Result


```
[87]: def recommender(pos,user_track_tsne_3d,index_to_user):
        from sklearn.neighbors import NearestNeighbors
        neighbour = NearestNeighbors(n_neighbors=40, metric="manhattan")
        neighbour.fit(user_track_tsne_3d)
        a,b=neighbour.kneighbors(user_track_tsne_3d[pos].reshape(1,-1))
        b=np.delete(b[0],0) # Excluding the user from his set of nearest neighbours
        friends=[]
        print("Top 5 Friends based on Similar Music Tastes")
        for p in b:
            friends.append(index_to_user[p])
            if(len(friends)==5):
                break
```

```python
    print(friends)

    community=[]
    people=[]
    community_index=clusters_3d[pos]
    print("People in your Music Community ")
    for i in range(len(clusters_3d)):
      if(community_index==clusters_3d[i]):
        community.append(i)
    for i in community:
      people.append(index_to_user[i])
    print(people)
    recommend=set()
    print("Top 3 Recommendations ")
    for row in b:
      max=0
      for column in user_track_dataset:
        l=user_track_dataset.iloc[row][column]
        listen_count=np.sum(l)
        if(listen_count>=max):
          max=listen_count
          favourite=column
      recommend.add(favourite)
      recommend.discard('')
      if(len(recommend)==3):
        break
    print(recommend)

    return {"top_friends":friends,"community":people,"recommend":list(recommend)}
```

```python
[88]: while(True):
    # funcoder
    id=input("Enter your user id  ")
    try:
      start,end,pos=user_range_dic[id]
      results2= recommender(pos,user_track_tsne_3d,index_to_user)
    except:
      print("Please enter a valid ID ")
    choice=input("Do you wish to continue (y/n) ")
    if(choice=='n'):
      break
```

```
Top 5 Friends based on Similar Music Tastes
['Discopants09', 'cardiffthomas', 'agzdaredz', 'crypussycry', 'jakebuck_']
People in your Music Community
['DaveyEd', 'Discopants09', 'DonaldKelly', 'ElmoBerry', 'ForgottenRach',
'Harrison101', 'IndieSkies', 'Jaseonrobinson', 'agzdaredz', 'bfalava',
```

```
'buriedbirds', 'cardiffthomas', 'chesterbbb', 'crypussycry', 'darefordistance',
'dodgyfox', 'ewan_p', 'funcoder', 'gouniche']
Top 3 Recommendations
{'atrol', 'ay', 're'}
```

[40]: `! pip install gradio`

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: gradio in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (4.7.1)
Requirement already satisfied: fastapi in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.104.1)
Requirement already satisfied: pillow<11.0,>=8.0 in /usr/lib/python3/dist-
packages (from gradio) (9.0.1)
Requirement already satisfied: gradio-client==0.7.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.7.0)
Requirement already satisfied: python-multipart in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.0.6)
Requirement already satisfied: pandas<3.0,>=1.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (2.0.3)
Requirement already satisfied: packaging in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (23.1)
Requirement already satisfied: typer[all]<1.0,>=0.9 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.9.0)
Requirement already satisfied: matplotlib~=3.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (3.7.2)
Requirement already satisfied: typing-extensions~=4.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (4.8.0)
Requirement already satisfied: requests~=2.0 in /usr/lib/python3/dist-packages
(from gradio) (2.25.1)
Requirement already satisfied: tomlkit==0.12.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.12.0)
Requirement already satisfied: aiofiles<24.0,>=22.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (23.2.1)
Requirement already satisfied: jinja2<4.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (3.1.2)
Requirement already satisfied: pyyaml<7.0,>=5.0 in /usr/lib/python3/dist-
packages (from gradio) (5.4.1)
Requirement already satisfied: orjson~=3.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (3.9.10)
Requirement already satisfied: pydub in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.25.1)
Requirement already satisfied: httpx in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.25.1)
Requirement already satisfied: pydantic>=2.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (2.4.2)
Requirement already satisfied: semantic-version~=2.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (2.10.0)
```

```
Requirement already satisfied: huggingface-hub>=0.14.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.15.1)
Requirement already satisfied: altair<6.0,>=4.2.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (5.1.2)
Requirement already satisfied: markupsafe~=2.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (2.1.3)
Requirement already satisfied: importlib-resources<7.0,>=1.3 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (6.0.1)
Requirement already satisfied: numpy~=1.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (1.23.5)
Requirement already satisfied: uvicorn>=0.14.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.24.0.post1)
Requirement already satisfied: ffmpy in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio) (0.3.1)
Requirement already satisfied: fsspec in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio-client==0.7.0->gradio)
(2023.6.0)
Requirement already satisfied: websockets<12.0,>=10.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from gradio-client==0.7.0->gradio)
(11.0.3)
Requirement already satisfied: toolz in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from altair<6.0,>=4.2.0->gradio)
(0.12.0)
Requirement already satisfied: jsonschema>=3.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from altair<6.0,>=4.2.0->gradio)
(4.19.1)
Requirement already satisfied: tqdm>=4.42.1 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from huggingface-
hub>=0.14.0->gradio) (4.65.0)
Requirement already satisfied: filelock in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from huggingface-
hub>=0.14.0->gradio) (3.12.0)
Requirement already satisfied: pyparsing<3.1,>=2.3.1 in /usr/lib/python3/dist-
packages (from matplotlib~=3.0->gradio) (2.4.7)
Requirement already satisfied: kiwisolver>=1.0.1 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from matplotlib~=3.0->gradio)
(1.4.4)
Requirement already satisfied: contourpy>=1.0.1 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from matplotlib~=3.0->gradio)
(1.1.0)
Requirement already satisfied: fonttools>=4.22.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from matplotlib~=3.0->gradio)
(4.41.1)
Requirement already satisfied: cycler>=0.10 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from matplotlib~=3.0->gradio)
(0.11.0)
Requirement already satisfied: python-dateutil>=2.7 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from matplotlib~=3.0->gradio)
```

(2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/lib/python3/dist-packages
(from pandas<3.0,>=1.0->gradio) (2022.1)
Requirement already satisfied: tzdata>=2022.1 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from pandas<3.0,>=1.0->gradio)
(2023.3)
Requirement already satisfied: pydantic-core==2.10.1 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from pydantic>=2.0->gradio) (2.10.1)
Requirement already satisfied: annotated-types>=0.4.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from pydantic>=2.0->gradio) (0.6.0)
Requirement already satisfied: click<9.0.0,>=7.1.1 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from typer[all]<1.0,>=0.9->gradio)
(8.1.7)
Requirement already satisfied: colorama<0.5.0,>=0.4.3 in /usr/lib/python3/dist-
packages (from typer[all]<1.0,>=0.9->gradio) (0.4.4)
Requirement already satisfied: rich<14.0.0,>=10.11.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from typer[all]<1.0,>=0.9->gradio)
(13.6.0)
Requirement already satisfied: shellingham<2.0.0,>=1.3.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from typer[all]<1.0,>=0.9->gradio)
(1.5.4)
Requirement already satisfied: h11>=0.8 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from uvicorn>=0.14.0->gradio)
(0.14.0)
Requirement already satisfied: starlette<0.28.0,>=0.27.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from fastapi->gradio) (0.27.0)
Requirement already satisfied: anyio<4.0.0,>=3.7.1 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from fastapi->gradio) (3.7.1)
Requirement already satisfied: httpcore in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from httpx->gradio) (1.0.2)
Requirement already satisfied: idna in /usr/lib/python3/dist-packages (from
httpx->gradio) (3.3)
Requirement already satisfied: certifi in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from httpx->gradio) (2023.7.22)
Requirement already satisfied: sniffio in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from httpx->gradio) (1.3.0)
Requirement already satisfied: exceptiongroup in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from
anyio<4.0.0,>=3.7.1->fastapi->gradio) (1.1.3)
Requirement already satisfied: jsonschema-specifications>=2023.03.6 in
/home/hanish-ubuntu/.local/lib/python3.10/site-packages (from
jsonschema>=3.0->altair<6.0,>=4.2.0->gradio) (2023.7.1)
Requirement already satisfied: referencing>=0.28.4 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from
jsonschema>=3.0->altair<6.0,>=4.2.0->gradio) (0.30.2)
Requirement already satisfied: attrs>=22.2.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from
jsonschema>=3.0->altair<6.0,>=4.2.0->gradio) (23.1.0)

```
Requirement already satisfied: rpds-py>=0.7.1 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from
jsonschema>=3.0->altair<6.0,>=4.2.0->gradio) (0.10.3)
Requirement already satisfied: six>=1.5 in /usr/lib/python3/dist-packages (from
python-dateutil>=2.7->matplotlib~=3.0->gradio) (1.16.0)
Requirement already satisfied: markdown-it-py>=2.2.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from
rich<14.0.0,>=10.11.0->typer[all]<1.0,>=0.9->gradio) (3.0.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from
rich<14.0.0,>=10.11.0->typer[all]<1.0,>=0.9->gradio) (2.16.1)
Requirement already satisfied: mdurl~=0.1 in /home/hanish-
ubuntu/.local/lib/python3.10/site-packages (from markdown-it-
py>=2.2.0->rich<14.0.0,>=10.11.0->typer[all]<1.0,>=0.9->gradio) (0.1.2)
```

[90]:
```python
import gradio as gr
```

[92]:
```python
def fn(id):
    try:
        start, end, pos = user_range_dic[id]
        result = recommender(pos, user_track_tsne_3d, index_to_user)

        top_friends = ', '.join(result["top_friends"])
        top_comm = ', '.join(result["community"])
        top_recomm = ', '.join(result["recommend"])

        return top_friends, top_comm, top_recomm
    except KeyError:
        return "Invalid ID. Please enter a valid user ID.", ""

with gr.Blocks() as demo:
    gr.Markdown("Symphony Mates")
    with gr.Tab("Music recommendation system"):
        with gr.Row():
            text_input = gr.Textbox(label="User ID")
            text_output1 = gr.Textbox(label = "Top 5 Friends")
            text_output2 = gr.Textbox(label = "Music Community")
            text_output3 = gr.Textbox(label = "Top 3 Recommendations")

        button = gr.Button("Submit")




    button.click(fn, inputs = text_input, outputs = [text_output1,␣
  ↪text_output2, text_output3])
```

```
demo.launch()
```

Running on local URL: http://127.0.0.1:7887

To create a public link, set `share=True` in `launch()`.

<IPython.core.display.HTML object>

[92]:

Top 5 Friends based on Similar Music Tastes
['Discopants09', 'cardiffthomas', 'agzdaredz', 'crypussycry', 'jakebuck_']
People in your Music Community
['DaveyEd', 'Discopants09', 'DonaldKelly', 'ElmoBerry', 'ForgottenRach',
'Harrison101', 'IndieSkies', 'Jaseonrobinson', 'agzdaredz', 'bfalava',
'buriedbirds', 'cardiffthomas', 'chesterbbb', 'crypussycry', 'darefordistance',
'dodgyfox', 'ewan_p', 'funcoder', 'gouniche']
Top 3 Recommendations
{'atrol', 'ay', 're'}

Traceback (most recent call last):
  File "/home/hanish-ubuntu/.local/lib/python3.10/site-
packages/gradio/queueing.py", line 456, in call_prediction
    output = await route_utils.call_process_api(
  File "/home/hanish-ubuntu/.local/lib/python3.10/site-
packages/gradio/route_utils.py", line 232, in call_process_api
    output = await app.get_blocks().process_api(
  File "/home/hanish-ubuntu/.local/lib/python3.10/site-
packages/gradio/blocks.py", line 1531, in process_api
    data = self.postprocess_data(fn_index, result["prediction"], state)
  File "/home/hanish-ubuntu/.local/lib/python3.10/site-
packages/gradio/blocks.py", line 1362, in postprocess_data
    self.validate_outputs(fn_index, predictions) # type: ignore
  File "/home/hanish-ubuntu/.local/lib/python3.10/site-
packages/gradio/blocks.py", line 1336, in validate_outputs
    raise ValueError(
ValueError: An event handler (fn) didn't receive enough output values (needed:
3, received: 2).
Wanted outputs:
    [textbox, textbox, textbox]
Received outputs:
    ["Invalid ID. Please enter a valid user ID.", ""]
Traceback (most recent call last):
  File "/home/hanish-ubuntu/.local/lib/python3.10/site-
packages/gradio/queueing.py", line 456, in call_prediction
    output = await route_utils.call_process_api(
  File "/home/hanish-ubuntu/.local/lib/python3.10/site-
packages/gradio/route_utils.py", line 232, in call_process_api
    output = await app.get_blocks().process_api(
```

```
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    [textbox, textbox, textbox]
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    ["Invalid ID. Please enter a valid user ID.", ""]


The above exception was the direct cause of the following exception:

Traceback (most recent call last):
  File "/home/hanish-ubuntu/.local/lib/python3.10/site-
packages/gradio/queueing.py", line 501, in process_events
    response = await self.call_prediction(awake_events, batch)
  File "/home/hanish-ubuntu/.local/lib/python3.10/site-
packages/gradio/queueing.py", line 465, in call_prediction
    raise Exception(str(error) if show_error else None) from error
Exception: None
```