In [1]:
```python
import numpy as np
import pandas as pd
import psycopg2
import sqlalchemy
from sqlalchemy.ext.automap import automap_base
from sqlalchemy.orm import Session
from sqlalchemy import create_engine, func, inspect, desc
from config import username, password
```

In [2]:
```python
# create engine
engine = create_engine(f'postgresql+psycopg2://{username}:{password}@aws-gt-da
taviz-finalpg-001.cloqvwuqbywl.us-east-1.rds.amazonaws.com:5432/spotify_db')
```

In [3]:
```python
# reflect an existing database into a new model
Base = automap_base()

# reflect the tables
Base.prepare(engine, reflect=True)
```

In [4]:
```python
# We can view all of the classes that automap found
Base.classes.keys()
```

Out[4]: ['artistgenre', 'artists', 'genres', 'tracks', 'years']

In [5]:
```python
# Save references to each table
Artistgenre = Base.classes.artistgenre
Artists = Base.classes.artists
Genres = Base.classes.genres
Tracks = Base.classes.tracks
Years = Base.classes.years
```

```
In [6]:  # look at columns in tables
         inspector = inspect(engine)
         columns = inspector.get_columns('tracks')
         for column in columns:
             print(column["name"], column["type"])
```

```
acousticness DOUBLE PRECISION
artists TEXT
danceability DOUBLE PRECISION
duration_ms BIGINT
energy DOUBLE PRECISION
explicit BIGINT
id TEXT
instrumentalness DOUBLE PRECISION
key BIGINT
liveness DOUBLE PRECISION
loudness DOUBLE PRECISION
mode BIGINT
name TEXT
popularity BIGINT
release_date TEXT
speechiness DOUBLE PRECISION
tempo DOUBLE PRECISION
valence DOUBLE PRECISION
year BIGINT
```

```
In [7]:  # Create our session (link) from Python to the DB
         session = Session(engine)
```

```
In [8]:  tracks_q = session.query(Tracks.id, Tracks.name, Tracks.artists, Tracks.acoust
         icness, Tracks.danceability,
                                  Tracks.energy, Tracks.instrumentalness, Tracks.valence
         , Tracks.popularity, Tracks.year, Tracks.tempo).\
                                  filter(Tracks.popularity > 20).all()

         # store results in dataframe
         tracks_kDF = pd.DataFrame(tracks_q, columns=['id', 'name', 'artists', 'acousti
         cness',
                                                      'danceability' ,'energy' ,'instru
         mentalness' ,'valence',
                                                      'popularity', 'year','tempo'])
```

```
In [9]:  tracks_kDF['tempo'].max()
```

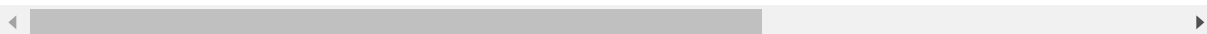```
Out[9]: 243.507
```

```
In [10]:  tracks_kDF['popularity'] = tracks_kDF['popularity']/1000
          tracks_kDF['year'] = tracks_kDF['year']/2021/10
          tracks_kDF['tempo'] = tracks_kDF['tempo']/500
```

In [11]: `tracks_kDF`

Out[11]:

	id	name	artists	acousticness	danceability	energy	in
0	2wAfHM7Whz67VFbdanhZlk	Nobody Knows You When You're Down and Out	['Bessie Smith']	0.99600	0.614	0.0423	
1	3eMrYc092k7SIJfWJ7oasR	Weather Bird	['Louis Armstrong', 'Earl Hines']	0.98400	0.831	0.2620	
2	2AZgaYZSwUosJD71J2N2Zo	'Tain't Nobody's Bizness If I Do	['Bessie Smith']	0.99600	0.537	0.0443	
3	0V1iYWPXCBTaB6dhbiprGF	Send Me to the 'Lectric Chair	['Bessie Smith']	0.98600	0.771	0.0905	
4	6qRvnXftofjYJm1Mg98UWL	Need a Little Sugar in My Bowl	['Bessie Smith']	0.99200	0.693	0.0270	
...	...	...	...	...	...	...	
98463	3NUmUIyzNLBp8bCFMH8Mif	Waiting On A War	['Foo Fighters']	0.00984	0.530	0.7590	
98464	0fJ1caLzidzTllL3pPX1eU	Precious' Tale	['Jazmine Sullivan']	0.71500	0.734	0.3460	
98465	3HSUqAErTyFQWLfLdnFVnB	Connexion	['ZAYN']	0.49800	0.597	0.3680	
98466	660rulYF3eLCuW6rQpiMdL	Little Boy	['Ashnikko']	0.10500	0.781	0.4870	
98467	1gcyHQpBQ1lfXGdhZmWrHP	champagne problems	['Taylor Swift']	0.92000	0.462	0.2400	

98468 rows × 11 columns

In [12]: `session.close()`

In [13]:
```python
from sklearn.cluster import KMeans

X = tracks_kDF.select_dtypes(np.number)
number_cols = list(X.columns)
tracks_fitted = KMeans(n_clusters=1100, init='k-means++', verbose=4).fit(X)
```

```
Initialization complete
Iteration 0, inertia 1292.4520283148897
Iteration 1, inertia 1168.4343659456101
Iteration 2, inertia 1137.9006025664266
Iteration 3, inertia 1122.1456812581307
Iteration 4, inertia 1112.2868881746358
Iteration 5, inertia 1105.5206874154098
Iteration 6, inertia 1100.7276013822543
Iteration 7, inertia 1097.1404226515062
Iteration 8, inertia 1094.223400351694
Iteration 9, inertia 1091.7862047009085
Iteration 10, inertia 1089.630451467552
Iteration 11, inertia 1087.919457208212
Iteration 12, inertia 1086.4462013300574
Iteration 13, inertia 1085.1899846855538
Iteration 14, inertia 1084.1694096610083
Iteration 15, inertia 1083.2175574753362
Iteration 16, inertia 1082.3766057090018
Iteration 17, inertia 1081.6331038429362
Iteration 18, inertia 1080.9985252301535
Iteration 19, inertia 1080.4580367464835
Iteration 20, inertia 1079.982385778549
Iteration 21, inertia 1079.5832256259814
Iteration 22, inertia 1079.18093785841
Iteration 23, inertia 1078.7784202434957
Iteration 24, inertia 1078.4414543347182
Iteration 25, inertia 1078.1295522008093
Iteration 26, inertia 1077.854652357834
Iteration 27, inertia 1077.5835461032827
Iteration 28, inertia 1077.3512010611748
Iteration 29, inertia 1077.129563230006
Iteration 30, inertia 1076.9358814253167
Iteration 31, inertia 1076.7679060487887
Iteration 32, inertia 1076.6148028798384
Iteration 33, inertia 1076.442477765538
Iteration 34, inertia 1076.3008485912403
Iteration 35, inertia 1076.1687700516552
Iteration 36, inertia 1076.035198916007
Iteration 37, inertia 1075.926468515084
Iteration 38, inertia 1075.8421423769855
Iteration 39, inertia 1075.7696631709885
Iteration 40, inertia 1075.7068422997022
Iteration 41, inertia 1075.6334993219998
Iteration 42, inertia 1075.5704002746068
Iteration 43, inertia 1075.5172416885187
Iteration 44, inertia 1075.4708490977357
Iteration 45, inertia 1075.4272154472408
Iteration 46, inertia 1075.3803249045607
Iteration 47, inertia 1075.3361428499384
Iteration 48, inertia 1075.3010766382658
Iteration 49, inertia 1075.2663559208615
Iteration 50, inertia 1075.232468970847
Iteration 51, inertia 1075.2039411091123
Iteration 52, inertia 1075.172536421301
Initation 53, inertia 1075.134656963617
Iteration 54, inertia 1075.1017988195042
Iteration 55, inertia 1075.0764237529563
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Iteration 56, inertia 1075.05687026496
Iteration 57, inertia 1075.0360545234262
Iteration 58, inertia 1075.020910440566
Iteration 59, inertia 1075.0047870385263
Iteration 60, inertia 1074.988944036129
Iteration 61, inertia 1074.9766151463864
Iteration 62, inertia 1074.9693152793682
Iteration 63, inertia 1074.961665441566
Iteration 64, inertia 1074.9536258583241
Iteration 65, inertia 1074.9476143397987
Iteration 66, inertia 1074.9425063550643
Iteration 67, inertia 1074.9388606199177
Iteration 68, inertia 1074.9362988507667
Iteration 69, inertia 1074.934217347353
Iteration 70, inertia 1074.932645474216
Converged at iteration 70: center shift 2.696232550895005e-06 within toleranc
e 4.3387452392311315e-06
Initialization complete
Iteration 0, inertia 1290.3094074195324
Iteration 1, inertia 1164.4956988584772
Iteration 2, inertia 1135.8355039229345
Iteration 3, inertia 1120.9709233697633
Iteration 4, inertia 1112.1500677565725
Iteration 5, inertia 1105.9155488195408
Iteration 6, inertia 1101.2067121712353
Iteration 7, inertia 1097.313597638507
Iteration 8, inertia 1094.15423445766
Iteration 9, inertia 1091.7591782316335
Iteration 10, inertia 1089.9963212484001
Iteration 11, inertia 1088.5990783944198
Iteration 12, inertia 1087.3753157441063
Iteration 13, inertia 1086.37825417035
Iteration 14, inertia 1085.5506650688117
Iteration 15, inertia 1084.776098145206
Iteration 16, inertia 1084.104058072409
Iteration 17, inertia 1083.5054910613985
Iteration 18, inertia 1082.9948175492027
Iteration 19, inertia 1082.5912125441453
Iteration 20, inertia 1082.2233480312468
Iteration 21, inertia 1081.9054225402
Iteration 22, inertia 1081.6358617361657
Iteration 23, inertia 1081.4083379404542
Iteration 24, inertia 1081.2124829866382
Iteration 25, inertia 1081.0541694344472
Iteration 26, inertia 1080.9046361500693
Iteration 27, inertia 1080.7450672124708
Iteration 28, inertia 1080.5827627373628
Iteration 29, inertia 1080.4196845437862
Iteration 30, inertia 1080.2655165730748
Iteration 31, inertia 1080.111300259688
Iteration 32, inertia 1079.960912385869
Iteration 33, inertia 1079.8367866200374
Iteration 34, inertia 1079.7256569354572
Iteration 35, inertia 1079.600157252466
Iteration 36, inertia 1079.47458266077
Iteration 37, inertia 1079.3458957565872
Iteration 38, inertia 1079.2133685264869
```

```
Iteration 39, inertia 1079.085040618398
Iteration 40, inertia 1078.9748474054334
Iteration 41, inertia 1078.8581972367965
Iteration 42, inertia 1078.7348597158946
Iteration 43, inertia 1078.6165546266795
Iteration 44, inertia 1078.5252197422708
Iteration 45, inertia 1078.4387573457484
Iteration 46, inertia 1078.351344166174
Iteration 47, inertia 1078.2726150151143
Iteration 48, inertia 1078.1994983069121
Iteration 49, inertia 1078.1293452234104
Iteration 50, inertia 1078.0636645869656
Iteration 51, inertia 1078.0002235146906
Iteration 52, inertia 1077.9436966613152
Iteration 53, inertia 1077.8931135145017
Iteration 54, inertia 1077.8463542573609
Iteration 55, inertia 1077.8009675819555
Iteration 56, inertia 1077.7569819127095
Iteration 57, inertia 1077.7168952437962
Iteration 58, inertia 1077.6834721727566
Iteration 59, inertia 1077.6550630999318
Iteration 60, inertia 1077.6236299949967
Iteration 61, inertia 1077.5906305312426
Iteration 62, inertia 1077.5640761572838
Iteration 63, inertia 1077.5430295245774
Iteration 64, inertia 1077.5257242873615
Iteration 65, inertia 1077.5117656238074
Iteration 66, inertia 1077.4984511853334
Iteration 67, inertia 1077.4840033425774
Iteration 68, inertia 1077.4744159772108
Iteration 69, inertia 1077.4671131589855
Iteration 70, inertia 1077.4585483247847
Iteration 71, inertia 1077.449027598321
Iteration 72, inertia 1077.4368175848317
Iteration 73, inertia 1077.428049243633
Iteration 74, inertia 1077.4166936906297
Iteration 75, inertia 1077.4005825606625
Iteration 76, inertia 1077.3845424124536
Iteration 77, inertia 1077.3788843656057
Iteration 78, inertia 1077.372424303892
Iteration 79, inertia 1077.3649399445526
Iteration 80, inertia 1077.3609657134239
Iteration 81, inertia 1077.3562147016862
Iteration 82, inertia 1077.3509017894373
Iteration 83, inertia 1077.3481500715336
Iteration 84, inertia 1077.3459970204642
Iteration 85, inertia 1077.3450875699268
Converged at iteration 85: center shift 3.104764765712932e-06 within toleranc
e 4.3387452392311315e-06
Initialization complete
Iteration 0, inertia 1285.0078946484648
Iteration 1, inertia 1163.5515327112066
Iteration 2, inertia 1134.7424622922792
Iteration 3, inertia 1120.0560187216372
Iteration 4, inertia 1111.0025614584563
Iteration 5, inertia 1104.8553869622572
Iteration 6, inertia 1100.4464638627114
```

```
Iteration 7, inertia 1097.0371358359023
Iteration 8, inertia 1094.077877990436
Iteration 9, inertia 1091.6180251414537
Iteration 10, inertia 1089.7614079964972
Iteration 11, inertia 1088.3086624147165
Iteration 12, inertia 1087.053917168843
Iteration 13, inertia 1085.8991577290067
Iteration 14, inertia 1084.9536628024173
Iteration 15, inertia 1084.2136653421094
Iteration 16, inertia 1083.611821040491
Iteration 17, inertia 1083.0963478915187
Iteration 18, inertia 1082.5797548525657
Iteration 19, inertia 1082.0889386129363
Iteration 20, inertia 1081.6643382488037
Iteration 21, inertia 1081.274532881881
Iteration 22, inertia 1080.8862435084634
Iteration 23, inertia 1080.5429369521685
Iteration 24, inertia 1080.2266895778544
Iteration 25, inertia 1079.9308952817964
Iteration 26, inertia 1079.6815428191596
Iteration 27, inertia 1079.4505751246968
Iteration 28, inertia 1079.2365034457725
Iteration 29, inertia 1079.0406511353028
Iteration 30, inertia 1078.8543940928005
Iteration 31, inertia 1078.6805941957034
Iteration 32, inertia 1078.4959636387189
Iteration 33, inertia 1078.3306267352293
Iteration 34, inertia 1078.160757073912
Iteration 35, inertia 1077.9919080312386
Iteration 36, inertia 1077.8433104511614
Iteration 37, inertia 1077.7316119362401
Iteration 38, inertia 1077.6378459909627
Iteration 39, inertia 1077.5600519996906
Iteration 40, inertia 1077.4837135109422
Iteration 41, inertia 1077.415130730609
Iteration 42, inertia 1077.3463543026578
Iteration 43, inertia 1077.2696931937112
Iteration 44, inertia 1077.2045106272437
Iteration 45, inertia 1077.1288780153027
Iteration 46, inertia 1077.060384762112
Iteration 47, inertia 1076.9929979681765
Iteration 48, inertia 1076.9217615285797
Iteration 49, inertia 1076.8635864167986
Iteration 50, inertia 1076.8107428535768
Iteration 51, inertia 1076.7763927799533
Iteration 52, inertia 1076.7441215604467
Iteration 53, inertia 1076.7086418174576
Iteration 54, inertia 1076.6788855478917
Iteration 55, inertia 1076.654134209705
Iteration 56, inertia 1076.632109362067
Iteration 57, inertia 1076.6064385612033
Iteration 58, inertia 1076.5803157727244
Iteration 59, inertia 1076.553067675001
Iteration 60, inertia 1076.5216170293368
Iteration 61, inertia 1076.488396339446
Iteration 62, inertia 1076.465492271726
Iteration 63, inertia 1076.4429388348894
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Iteration 64, inertia 1076.421982379335
Iteration 65, inertia 1076.406398088546
Iteration 66, inertia 1076.3913336230187
Iteration 67, inertia 1076.3788950458752
Iteration 68, inertia 1076.3702042006944
Iteration 69, inertia 1076.362309286135
Iteration 70, inertia 1076.3562975972293
Iteration 71, inertia 1076.3491311553016
Iteration 72, inertia 1076.342504947972
Iteration 73, inertia 1076.3358224557933
Iteration 74, inertia 1076.331089639133
Iteration 75, inertia 1076.325105071015
Iteration 76, inertia 1076.3215378262967
Iteration 77, inertia 1076.3174754723168
Iteration 78, inertia 1076.3162058755288
Converged at iteration 78: center shift 2.3900729702581437e-06 within toleran
ce 4.3387452392311315e-06
Initialization complete
Iteration 0, inertia 1289.8251943305754
Iteration 1, inertia 1166.1836499509561
Iteration 2, inertia 1136.8859277187312
Iteration 3, inertia 1121.958383296313
Iteration 4, inertia 1112.4845370170399
Iteration 5, inertia 1106.1388548465973
Iteration 6, inertia 1101.5533229068556
Iteration 7, inertia 1097.9752510801447
Iteration 8, inertia 1095.0778717835788
Iteration 9, inertia 1092.5632783246738
Iteration 10, inertia 1090.3860838886787
Iteration 11, inertia 1088.615682747489
Iteration 12, inertia 1087.1951165499347
Iteration 13, inertia 1085.9571777229348
Iteration 14, inertia 1084.8800337088949
Iteration 15, inertia 1083.9444191194211
Iteration 16, inertia 1083.1256087539975
Iteration 17, inertia 1082.3518937629203
Iteration 18, inertia 1081.7555876514984
Iteration 19, inertia 1081.2154975304106
Iteration 20, inertia 1080.7409416804526
Iteration 21, inertia 1080.293075534324
Iteration 22, inertia 1079.8978803606558
Iteration 23, inertia 1079.528528995761
Iteration 24, inertia 1079.210197817593
Iteration 25, inertia 1078.9047224650976
Iteration 26, inertia 1078.6239271191016
Iteration 27, inertia 1078.357513660119
Iteration 28, inertia 1078.1159899765214
Iteration 29, inertia 1077.8938146559292
Iteration 30, inertia 1077.6934810219363
Iteration 31, inertia 1077.5089088823897
Iteration 32, inertia 1077.3317849384314
Iteration 33, inertia 1077.1687796423585
Iteration 34, inertia 1077.0086581067264
Iteration 35, inertia 1076.8478568719895
Iteration 36, inertia 1076.7084347422074
Iteration 37, inertia 1076.5814710006491
Iteration 38, inertia 1076.4703935737234
```

```
Iteration 39, inertia 1076.3817142275793
Iteration 40, inertia 1076.30144641071
Iteration 41, inertia 1076.2288436044964
Iteration 42, inertia 1076.1534634329173
Iteration 43, inertia 1076.0701562011875
Iteration 44, inertia 1075.993910192652
Iteration 45, inertia 1075.930269824922
Iteration 46, inertia 1075.8669675294877
Iteration 47, inertia 1075.808783284942
Iteration 48, inertia 1075.7556995227026
Iteration 49, inertia 1075.7003563716974
Iteration 50, inertia 1075.6471050396592
Iteration 51, inertia 1075.5863442567972
Iteration 52, inertia 1075.5241068513176
Iteration 53, inertia 1075.45026071056
Iteration 54, inertia 1075.3892442491872
Iteration 55, inertia 1075.346450665898
Iteration 56, inertia 1075.3192835757513
Iteration 57, inertia 1075.3018543999535
Iteration 58, inertia 1075.2852106561904
Iteration 59, inertia 1075.2686012797806
Iteration 60, inertia 1075.2520930849566
Iteration 61, inertia 1075.2374499248153
Iteration 62, inertia 1075.2214868819456
Iteration 63, inertia 1075.203173040279
Iteration 64, inertia 1075.1839537775468
Iteration 65, inertia 1075.1725515499822
Iteration 66, inertia 1075.1641011270376
Iteration 67, inertia 1075.1572661470937
Iteration 68, inertia 1075.1517837712563
Iteration 69, inertia 1075.1434677817701
Iteration 70, inertia 1075.1286867767717
Iteration 71, inertia 1075.1178293569562
Iteration 72, inertia 1075.1078015109251
Iteration 73, inertia 1075.0922932361218
Iteration 74, inertia 1075.0792550057463
Iteration 75, inertia 1075.068755748633
Iteration 76, inertia 1075.061563828989
Iteration 77, inertia 1075.0553188787928
Iteration 78, inertia 1075.0495700543588
Iteration 79, inertia 1075.0430397090415
Iteration 80, inertia 1075.037173478231
Iteration 81, inertia 1075.0326059879521
Iteration 82, inertia 1075.029162651977
Iteration 83, inertia 1075.0262933972515
Converged at iteration 83: center shift 3.6695647339641584e-06 within toleran
ce 4.3387452392311315e-06
Initialization complete
Iteration 0, inertia 1284.6582384559013
Iteration 1, inertia 1163.9527553501532
Iteration 2, inertia 1136.116135211715
Iteration 3, inertia 1122.9380850027364
Iteration 4, inertia 1114.4248828408445
Iteration 5, inertia 1108.3376675103307
Iteration 6, inertia 1103.8361120357508
Iteration 7, inertia 1100.3450535321324
Iteration 8, inertia 1097.486588827959
```

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Iteration 9, inertia 1094.9317167433428
Iteration 10, inertia 1092.8289587445067
Iteration 11, inertia 1091.0275691189595
Iteration 12, inertia 1089.426493380449
Iteration 13, inertia 1087.9708372034513
Iteration 14, inertia 1086.748165202545
Iteration 15, inertia 1085.7582608352618
Iteration 16, inertia 1084.8437927730567
Iteration 17, inertia 1083.9635784992795
Iteration 18, inertia 1083.2237345712317
Iteration 19, inertia 1082.6543624128115
Iteration 20, inertia 1082.2075451037683
Iteration 21, inertia 1081.8115905343273
Iteration 22, inertia 1081.4464021753388
Iteration 23, inertia 1081.0836335773336
Iteration 24, inertia 1080.7680897078462
Iteration 25, inertia 1080.4351161440457
Iteration 26, inertia 1080.147456696137
Iteration 27, inertia 1079.8821399903682
Iteration 28, inertia 1079.6361059782946
Iteration 29, inertia 1079.393599391401
Iteration 30, inertia 1079.1665785696655
Iteration 31, inertia 1078.9582533466048
Iteration 32, inertia 1078.7501854233678
Iteration 33, inertia 1078.5605585841317
Iteration 34, inertia 1078.3890967353504
Iteration 35, inertia 1078.2226090904849
Iteration 36, inertia 1078.1109097460574
Iteration 37, inertia 1078.0143602175274
Iteration 38, inertia 1077.9180081736838
Iteration 39, inertia 1077.828369577395
Iteration 40, inertia 1077.7587121549657
Iteration 41, inertia 1077.6939413369196
Iteration 42, inertia 1077.6402332609575
Iteration 43, inertia 1077.5899768418838
Iteration 44, inertia 1077.5433162628256
Iteration 45, inertia 1077.4911446315707
Iteration 46, inertia 1077.4380926152053
Iteration 47, inertia 1077.3919489295554
Iteration 48, inertia 1077.358194377849
Iteration 49, inertia 1077.336791239526
Iteration 50, inertia 1077.3158315716144
Iteration 51, inertia 1077.294389915865
Iteration 52, inertia 1077.2739901200173
Iteration 53, inertia 1077.2366377341652
Iteration 54, inertia 1077.202367965777
Iteration 55, inertia 1077.181447747114
Iteration 56, inertia 1077.1644462728302
Iteration 57, inertia 1077.1447765282535
Iteration 58, inertia 1077.131994688247
Iteration 59, inertia 1077.120824149971
Iteration 60, inertia 1077.1112616541711
Iteration 61, inertia 1077.0986786625244
Iteration 62, inertia 1077.0859307356309
Iteration 63, inertia 1077.0730850872592
Iteration 64, inertia 1077.0574916710284
Iteration 65, inertia 1077.0444100108698
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```
Iteration 66, inertia 1077.0284987143632
Iteration 67, inertia 1077.013349464753
Iteration 68, inertia 1077.0012703254524
Iteration 69, inertia 1076.9903907648284
Iteration 70, inertia 1076.9742882172043
Iteration 71, inertia 1076.9588466650566
Iteration 72, inertia 1076.950599436423
Iteration 73, inertia 1076.9454488290796
Iteration 74, inertia 1076.9399963335331
Iteration 75, inertia 1076.934099119569
Iteration 76, inertia 1076.9301151391192
Iteration 77, inertia 1076.9265852734995
Iteration 78, inertia 1076.9219998129622
Iteration 79, inertia 1076.918960376893
Iteration 80, inertia 1076.9169900028992
Iteration 81, inertia 1076.9154571566805
Iteration 82, inertia 1076.914571936642
Converged at iteration 82: center shift 1.941328503808402e-06 within toleranc
e 4.3387452392311315e-06
Initialization complete
Iteration 0, inertia 1285.5721032108124
Iteration 1, inertia 1165.448322986092
Iteration 2, inertia 1136.8463262379241
Iteration 3, inertia 1122.5798358546565
Iteration 4, inertia 1113.2103998829539
Iteration 5, inertia 1106.7727076107212
Iteration 6, inertia 1102.014164822518
Iteration 7, inertia 1098.4758244256202
Iteration 8, inertia 1095.8549890922882
Iteration 9, inertia 1093.7643637734695
Iteration 10, inertia 1091.9288732217417
Iteration 11, inertia 1090.5621906688857
Iteration 12, inertia 1089.482715280871
Iteration 13, inertia 1088.4672543602887
Iteration 14, inertia 1087.581988427899
Iteration 15, inertia 1086.7148366282556
Iteration 16, inertia 1085.9994927336081
Iteration 17, inertia 1085.2882213445416
Iteration 18, inertia 1084.6935048722298
Iteration 19, inertia 1084.164125358181
Iteration 20, inertia 1083.6609056129325
Iteration 21, inertia 1083.2015439676788
Iteration 22, inertia 1082.8061536574837
Iteration 23, inertia 1082.4355009662552
Iteration 24, inertia 1082.1333031428326
Iteration 25, inertia 1081.8429401337823
Iteration 26, inertia 1081.549635342484
Iteration 27, inertia 1081.27575162897
Iteration 28, inertia 1081.0701014862532
Iteration 29, inertia 1080.8822249672182
Iteration 30, inertia 1080.6959248059325
Iteration 31, inertia 1080.5018796251454
Iteration 32, inertia 1080.3238951934045
Iteration 33, inertia 1080.1235863519182
Iteration 34, inertia 1079.9331620157943
Iteration 35, inertia 1079.7586164716608
Iteration 36, inertia 1079.5918653101355
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Iteration 37, inertia 1079.43956502586
Iteration 38, inertia 1079.3191865215333
Iteration 39, inertia 1079.213389411752
Iteration 40, inertia 1079.1419974441067
Iteration 41, inertia 1079.082839183085
Iteration 42, inertia 1079.026832350869
Iteration 43, inertia 1078.9616966431283
Iteration 44, inertia 1078.9081721103394
Iteration 45, inertia 1078.8607779280053
Iteration 46, inertia 1078.8215879402483
Iteration 47, inertia 1078.794294409029
Iteration 48, inertia 1078.7698242200518
Iteration 49, inertia 1078.7454659529285
Iteration 50, inertia 1078.7191401076989
Iteration 51, inertia 1078.6985526464507
Iteration 52, inertia 1078.6813609691985
Iteration 53, inertia 1078.667338850823
Iteration 54, inertia 1078.6550268428587
Iteration 55, inertia 1078.6402169647984
Iteration 56, inertia 1078.6218405857007
Iteration 57, inertia 1078.5981149069896
Iteration 58, inertia 1078.571241702468
Iteration 59, inertia 1078.547098854248
Iteration 60, inertia 1078.524965658904
Iteration 61, inertia 1078.5068213144027
Iteration 62, inertia 1078.48513443201
Iteration 63, inertia 1078.4638403811825
Iteration 64, inertia 1078.44382436986
Iteration 65, inertia 1078.4235330260865
Iteration 66, inertia 1078.4044964515356
Iteration 67, inertia 1078.3904699043485
Iteration 68, inertia 1078.382442029276
Iteration 69, inertia 1078.3726833851729
Iteration 70, inertia 1078.3630660579847
Iteration 71, inertia 1078.3519502886327
Iteration 72, inertia 1078.3431743423655
Iteration 73, inertia 1078.3345424475565
Iteration 74, inertia 1078.3290676265774
Iteration 75, inertia 1078.32491015268
Iteration 76, inertia 1078.3210837867505
Iteration 77, inertia 1078.3192569724492
Converged at iteration 77: center shift 3.8256866427075e-06 within tolerance
4.3387452392311315e-06
Initialization complete
Iteration 0, inertia 1287.5710199798284
Iteration 1, inertia 1165.982734840829
Iteration 2, inertia 1136.2805745490086
Iteration 3, inertia 1121.3564843307674
Iteration 4, inertia 1112.0011149179506
Iteration 5, inertia 1105.770033809085
Iteration 6, inertia 1101.0944832381729
Iteration 7, inertia 1097.3790365257873
Iteration 8, inertia 1094.4183116245865
Iteration 9, inertia 1092.0824416612022
Iteration 10, inertia 1090.2009950304398
Iteration 11, inertia 1088.6963804265044
Iteration 12, inertia 1087.4740287431387
```

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Iteration 13, inertia 1086.3844918788975
Iteration 14, inertia 1085.449118529422
Iteration 15, inertia 1084.6600629758386
Iteration 16, inertia 1083.951083764534
Iteration 17, inertia 1083.330079530853
Iteration 18, inertia 1082.7365831265295
Iteration 19, inertia 1082.173893620798
Iteration 20, inertia 1081.7236967626104
Iteration 21, inertia 1081.2890657230607
Iteration 22, inertia 1080.8921510004566
Iteration 23, inertia 1080.5234587272648
Iteration 24, inertia 1080.2198449567331
Iteration 25, inertia 1079.950820803799
Iteration 26, inertia 1079.7186528480077
Iteration 27, inertia 1079.4890695798042
Iteration 28, inertia 1079.2731228776624
Iteration 29, inertia 1079.0494719857413
Iteration 30, inertia 1078.854798275291
Iteration 31, inertia 1078.6562175507975
Iteration 32, inertia 1078.468823008259
Iteration 33, inertia 1078.270028148535
Iteration 34, inertia 1078.0804128098957
Iteration 35, inertia 1077.9114847083608
Iteration 36, inertia 1077.7573898327964
Iteration 37, inertia 1077.6322199266306
Iteration 38, inertia 1077.4956041393782
Iteration 39, inertia 1077.3798684429935
Iteration 40, inertia 1077.2973924082173
Iteration 41, inertia 1077.2334402419135
Iteration 42, inertia 1077.1615145911755
Iteration 43, inertia 1077.093473861549
Iteration 44, inertia 1077.025523242455
Iteration 45, inertia 1076.9596239334858
Iteration 46, inertia 1076.9059593182399
Iteration 47, inertia 1076.849584180582
Iteration 48, inertia 1076.8025298540736
Iteration 49, inertia 1076.76041366429
Iteration 50, inertia 1076.7108816973641
Iteration 51, inertia 1076.67079571645
Iteration 52, inertia 1076.6403061410754
Iteration 53, inertia 1076.6117979716375
Iteration 54, inertia 1076.5720879994142
Iteration 55, inertia 1076.535253974015
Iteration 56, inertia 1076.5078332574244
Iteration 57, inertia 1076.4804025766923
Iteration 58, inertia 1076.4589889859355
Iteration 59, inertia 1076.4356066465352
Iteration 60, inertia 1076.4149529206436
Iteration 61, inertia 1076.3848709991883
Iteration 62, inertia 1076.3619701649939
Iteration 63, inertia 1076.34520060045
Iteration 64, inertia 1076.3353115999696
Iteration 65, inertia 1076.3241640081533
Iteration 66, inertia 1076.3133798041601
Iteration 67, inertia 1076.305315837439
Iteration 68, inertia 1076.2959678073903
Iteration 69, inertia 1076.2877372622831
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Iteration 70, inertia 1076.2823064895388
Iteration 71, inertia 1076.2797746757687
Iteration 72, inertia 1076.2749887210264
Iteration 73, inertia 1076.267990055135
Iteration 74, inertia 1076.2623923781396
Iteration 75, inertia 1076.2585242820792
Iteration 76, inertia 1076.2546877871466
Iteration 77, inertia 1076.252229061906
Iteration 78, inertia 1076.250053429952
Iteration 79, inertia 1076.2484220004592
Iteration 80, inertia 1076.246605273559
Iteration 81, inertia 1076.2440271255327
Iteration 82, inertia 1076.2390855384645
Iteration 83, inertia 1076.2335492589543
Iteration 84, inertia 1076.2303634996313
Iteration 85, inertia 1076.2262323557734
Iteration 86, inertia 1076.2220254404738
Iteration 87, inertia 1076.2204948068127
Iteration 88, inertia 1076.2194988341964
Converged at iteration 88: center shift 4.298854135873539e-06 within toleranc
e 4.3387452392311315e-06
Initialization complete
Iteration 0, inertia 1288.5455901515782
Iteration 1, inertia 1166.433761187296
Iteration 2, inertia 1136.8960212059328
Iteration 3, inertia 1122.312980045642
Iteration 4, inertia 1113.194766830829
Iteration 5, inertia 1106.6080413253726
Iteration 6, inertia 1101.6905099936807
Iteration 7, inertia 1098.0696029808814
Iteration 8, inertia 1095.1649976296305
Iteration 9, inertia 1092.8170507504747
Iteration 10, inertia 1090.7878863323967
Iteration 11, inertia 1089.0120554990833
Iteration 12, inertia 1087.3973313158303
Iteration 13, inertia 1085.9602821581545
Iteration 14, inertia 1084.805442157217
Iteration 15, inertia 1083.8151269836574
Iteration 16, inertia 1082.9790906812805
Iteration 17, inertia 1082.1766547983123
Iteration 18, inertia 1081.4909181846265
Iteration 19, inertia 1080.8767785316159
Iteration 20, inertia 1080.3666757045155
Iteration 21, inertia 1079.9331422480225
Iteration 22, inertia 1079.585363443164
Iteration 23, inertia 1079.2717933185165
Iteration 24, inertia 1078.987358751596
Iteration 25, inertia 1078.7219118609985
Iteration 26, inertia 1078.4745423349539
Iteration 27, inertia 1078.2456511997575
Iteration 28, inertia 1078.0355221734064
Iteration 29, inertia 1077.848584399324
Iteration 30, inertia 1077.6780707785663
Iteration 31, inertia 1077.5232212429505
Iteration 32, inertia 1077.3776403785366
Iteration 33, inertia 1077.2420759071153
Iteration 34, inertia 1077.1286880285788
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Iteration 35, inertia 1077.0260249562104
Iteration 36, inertia 1076.9130872105452
Iteration 37, inertia 1076.8255127370956
Iteration 38, inertia 1076.736041210121
Iteration 39, inertia 1076.6728094637176
Iteration 40, inertia 1076.6150951951752
Iteration 41, inertia 1076.5709409001668
Iteration 42, inertia 1076.5359004051654
Iteration 43, inertia 1076.5069020771352
Iteration 44, inertia 1076.4837529010813
Iteration 45, inertia 1076.4660447730391
Iteration 46, inertia 1076.4463585702101
Iteration 47, inertia 1076.4284303765032
Iteration 48, inertia 1076.4063886666395
Iteration 49, inertia 1076.3884933162237
Iteration 50, inertia 1076.3771677163304
Iteration 51, inertia 1076.366485009314
Iteration 52, inertia 1076.35681034355
Iteration 53, inertia 1076.34912563803
Iteration 54, inertia 1076.3417990634723
Iteration 55, inertia 1076.3328830831201
Iteration 56, inertia 1076.321704572525
Iteration 57, inertia 1076.3155205171024
Iteration 58, inertia 1076.3101717467466
Iteration 59, inertia 1076.3075316609816
Iteration 60, inertia 1076.3039303650235
Iteration 61, inertia 1076.3015371339532
Iteration 62, inertia 1076.2989571153946
Iteration 63, inertia 1076.2965843681427
Iteration 64, inertia 1076.293143004265
Iteration 65, inertia 1076.2907228997776
Iteration 66, inertia 1076.2886067287393
Iteration 67, inertia 1076.2860825374576
Iteration 68, inertia 1076.2838754631564
Iteration 69, inertia 1076.2799560755932
Iteration 70, inertia 1076.2768175752292
Iteration 71, inertia 1076.2729294992912
Iteration 72, inertia 1076.2644865654217
Iteration 73, inertia 1076.2561079625873
Iteration 74, inertia 1076.249805605104
Iteration 75, inertia 1076.2479515753196
Iteration 76, inertia 1076.2465092466932
Converged at iteration 76: center shift 3.6971447099342532e-06 within toleran
ce 4.3387452392311315e-06
Initialization complete
Iteration 0, inertia 1284.791993796321
Iteration 1, inertia 1161.6093963149362
Iteration 2, inertia 1133.2096002624612
Iteration 3, inertia 1119.092917401312
Iteration 4, inertia 1110.0789833815363
Iteration 5, inertia 1104.012168689808
Iteration 6, inertia 1099.5226312543323
Iteration 7, inertia 1095.9860664538778
Iteration 8, inertia 1093.3348141271892
Iteration 9, inertia 1091.212453774433
Iteration 10, inertia 1089.4523312228416
Iteration 11, inertia 1088.0651680115334
```

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Iteration 12, inertia 1086.9244106623878
Iteration 13, inertia 1085.9260976198743
Iteration 14, inertia 1085.0882294182109
Iteration 15, inertia 1084.3803878755034
Iteration 16, inertia 1083.8264152217541
Iteration 17, inertia 1083.3670981686796
Iteration 18, inertia 1082.872975730687
Iteration 19, inertia 1082.3742153219453
Iteration 20, inertia 1081.9322626061569
Iteration 21, inertia 1081.4464599294636
Iteration 22, inertia 1081.0172833078484
Iteration 23, inertia 1080.6551476405796
Iteration 24, inertia 1080.3648714659248
Iteration 25, inertia 1080.0455629928647
Iteration 26, inertia 1079.777649456003
Iteration 27, inertia 1079.571134434165
Iteration 28, inertia 1079.3807702967702
Iteration 29, inertia 1079.2000581447107
Iteration 30, inertia 1079.0452295358969
Iteration 31, inertia 1078.9037069431527
Iteration 32, inertia 1078.774003475906
Iteration 33, inertia 1078.639851991478
Iteration 34, inertia 1078.5132373471263
Iteration 35, inertia 1078.407100013918
Iteration 36, inertia 1078.2894984741456
Iteration 37, inertia 1078.186541085619
Iteration 38, inertia 1078.0955787960863
Iteration 39, inertia 1077.9998799128782
Iteration 40, inertia 1077.8982772995148
Iteration 41, inertia 1077.7951349156463
Iteration 42, inertia 1077.7080125866494
Iteration 43, inertia 1077.635874770575
Iteration 44, inertia 1077.569337334351
Iteration 45, inertia 1077.5107751631149
Iteration 46, inertia 1077.464828577026
Iteration 47, inertia 1077.4180858122606
Iteration 48, inertia 1077.3782602003207
Iteration 49, inertia 1077.3345606870507
Iteration 50, inertia 1077.2759690974824
Iteration 51, inertia 1077.2128435276488
Iteration 52, inertia 1077.1560564027616
Iteration 53, inertia 1077.1217767187445
Iteration 54, inertia 1077.088883455816
Iteration 55, inertia 1077.043663239273
Iteration 56, inertia 1077.0005655150842
Iteration 57, inertia 1076.964415940147
Iteration 58, inertia 1076.9270617452905
Iteration 59, inertia 1076.9001401530286
Iteration 60, inertia 1076.882885813364
Iteration 61, inertia 1076.8684016297161
Iteration 62, inertia 1076.8530516521823
Iteration 63, inertia 1076.8412202197837
Iteration 64, inertia 1076.829941614154
Iteration 65, inertia 1076.81945670384
Iteration 66, inertia 1076.8082573822583
Iteration 67, inertia 1076.7874636848346
Iteration 68, inertia 1076.7632802685666
```

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Iteration 69, inertia 1076.7450668592903
Iteration 70, inertia 1076.730628583001
Iteration 71, inertia 1076.7125673509415
Iteration 72, inertia 1076.688565770705
Iteration 73, inertia 1076.6734085652706
Iteration 74, inertia 1076.6598231461508
Iteration 75, inertia 1076.6489177261235
Iteration 76, inertia 1076.641195698485
Iteration 77, inertia 1076.636700894569
Iteration 78, inertia 1076.6310542490257
Iteration 79, inertia 1076.629273592022
Iteration 80, inertia 1076.625391225414
Iteration 81, inertia 1076.62214836472
Converged at iteration 81: center shift 7.582806246904879e-30 within toleranc
e 4.3387452392311315e-06
Initialization complete
Iteration 0, inertia 1289.6980024653224
Iteration 1, inertia 1169.4893504991812
Iteration 2, inertia 1140.0111171543488
Iteration 3, inertia 1124.5449108520586
Iteration 4, inertia 1114.755558766295
Iteration 5, inertia 1107.9125787601754
Iteration 6, inertia 1103.0349462580882
Iteration 7, inertia 1099.3691510238561
Iteration 8, inertia 1096.4791598454774
Iteration 9, inertia 1094.2454752515293
Iteration 10, inertia 1092.4864657233838
Iteration 11, inertia 1090.8822372577658
Iteration 12, inertia 1089.3213992510596
Iteration 13, inertia 1087.9467526578992
Iteration 14, inertia 1086.8239569947684
Iteration 15, inertia 1085.81904597139
Iteration 16, inertia 1084.935855882728
Iteration 17, inertia 1084.1331481621005
Iteration 18, inertia 1083.399703675756
Iteration 19, inertia 1082.7204078337818
Iteration 20, inertia 1082.1457488112271
Iteration 21, inertia 1081.6564585834237
Iteration 22, inertia 1081.1362980121
Iteration 23, inertia 1080.6863926847047
Iteration 24, inertia 1080.2687775411432
Iteration 25, inertia 1079.9183876486982
Iteration 26, inertia 1079.603246750344
Iteration 27, inertia 1079.3315055135247
Iteration 28, inertia 1079.1222978381772
Iteration 29, inertia 1078.9324971402916
Iteration 30, inertia 1078.7359878189047
Iteration 31, inertia 1078.5535137867294
Iteration 32, inertia 1078.375024091423
Iteration 33, inertia 1078.2191900902935
Iteration 34, inertia 1078.076202075131
Iteration 35, inertia 1077.9358233814403
Iteration 36, inertia 1077.8091790738147
Iteration 37, inertia 1077.686915803115
Iteration 38, inertia 1077.578750057034
Iteration 39, inertia 1077.467062884861
Iteration 40, inertia 1077.3824637857704
```

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Iteration 41, inertia 1077.297335790124
Iteration 42, inertia 1077.2214998732466
Iteration 43, inertia 1077.1567671201751
Iteration 44, inertia 1077.093820932941
Iteration 45, inertia 1077.0306408754493
Iteration 46, inertia 1076.978562363664
Iteration 47, inertia 1076.9413491846612
Iteration 48, inertia 1076.912182489492
Iteration 49, inertia 1076.884672327255
Iteration 50, inertia 1076.8473875963632
Iteration 51, inertia 1076.8280287988757
Iteration 52, inertia 1076.8044128875824
Iteration 53, inertia 1076.7877307601827
Iteration 54, inertia 1076.7716236543974
Iteration 55, inertia 1076.7605281692904
Iteration 56, inertia 1076.7515978233532
Iteration 57, inertia 1076.7415841390448
Iteration 58, inertia 1076.731433729233
Iteration 59, inertia 1076.716157703391
Iteration 60, inertia 1076.7011531827902
Iteration 61, inertia 1076.6881753526961
Iteration 62, inertia 1076.6711424539121
Iteration 63, inertia 1076.6582460619452
Iteration 64, inertia 1076.6434441208537
Iteration 65, inertia 1076.630820423918
Iteration 66, inertia 1076.609048828937
Iteration 67, inertia 1076.5902019063433
Iteration 68, inertia 1076.5765103881547
Iteration 69, inertia 1076.56104885045
Iteration 70, inertia 1076.550889600124
Iteration 71, inertia 1076.5372040730047
Iteration 72, inertia 1076.5182637544583
Iteration 73, inertia 1076.5060987022373
Iteration 74, inertia 1076.4942846977426
Iteration 75, inertia 1076.4856210673827
Iteration 76, inertia 1076.4767312712947
Iteration 77, inertia 1076.4683644175643
Iteration 78, inertia 1076.4637119649583
Iteration 79, inertia 1076.460621506419
Iteration 80, inertia 1076.4591396976066
Iteration 81, inertia 1076.4581292997173
Iteration 82, inertia 1076.455924728233
Iteration 83, inertia 1076.4510227367728
Iteration 84, inertia 1076.4468080773615
Iteration 85, inertia 1076.4436252827177
Iteration 86, inertia 1076.437854843753
Iteration 87, inertia 1076.4341691613665
Iteration 88, inertia 1076.431527682731
Iteration 89, inertia 1076.427569050107
Iteration 90, inertia 1076.424098651128
Iteration 91, inertia 1076.4207423255084
Iteration 92, inertia 1076.4154795128593
Iteration 93, inertia 1076.4139151157522
Converged at iteration 93: center shift 3.3312551989010246e-06 within toleran
ce 4.3387452392311315e-06
```
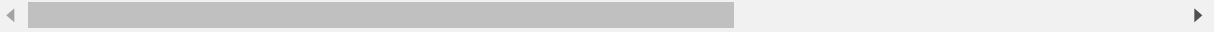
In [14]:
```
song_cluster_labels = tracks_fitted.predict(X)
```

In [15]:
```
tracks_kDF['cluster_label'] = song_cluster_labels
```

In [16]:
```
tracks_kDF.loc[tracks_kDF['name']== "Tell Me I'm A Wreck"]
```

Out[16]:

	id	name	artists	acousticness	danceability	energy	instrument
22607	203zTFd1zbfG0fiOG9OREv	Tell Me I'm A Wreck	['Every Avenue']	0.00188	0.578	0.76	

In [17]:
```
tracks_kDF['search']= tracks_kDF["artists"].str.find('Secondhand')

# All Time Low, Taylor Swift, Fleetwood Mac, Luke Bryan, Dan + Shay
```

In [18]:
```
tracks_kDF.loc[tracks_kDF['search'] != -1].sort_values(by = 'popularity', ascending=False)
```

Out[18]:

	id	name	artists	acousticness	danceability	energy	in
72108	5V7mTIcXVU9k2JNu0mE6vy	Fall for You (Acoustic)	['Secondhand Serenade']	0.65	0.433	0.307	
11195	7lWF2mVr1KKbVnaT2nSlPo	Fall For You	['Secondhand Serenade']	0.19	0.387	0.442	

In [19]:
```
tracks_kDF.loc[tracks_kDF['search'] != -1]["cluster_label"].unique()
```

Out[19]:
```
array([929, 331])
```

In [20]:
```python
tracks_kDF.loc[tracks_kDF['cluster_label']== 421].sort_values(by = 'popularit
y', ascending=False)
```

Out[20]:

	id	name	artists	acousticness	danceability
4664	1tDWVeCR9oWGX8d5J9rswk	Eclipse	['Pink Floyd']	0.059100	0.359
8718	0oxYB9GoOIDrdzniNdKC44	When the Sun Hits	['Slowdive']	0.001010	0.330
81436	143CswMcu3YPIaYYsb1KZu	An Angry Thunderstorm	['White Noise Meditation', 'Rain for Deep Slee...	0.000200	0.145
21079	14xj58ZexBaEaHARb11Cqs	Lucky	['Radiohead']	0.053000	0.213
32605	5M67k54BVUDADZPryaqV1y	Aqueous Transmission	['Incubus']	0.005010	0.415
52883	0Xq7FPQaLJglHSB605YUMy	Sweet Dreams (Are Made Of This)	['Marilyn Manson']	0.004400	0.218
41735	2yKrGPtlwsiwv5tGTDgpNd	Galapogos - Remastered 2012	['The Smashing Pumpkins']	0.016000	0.362
31805	5Ca9qZBftB2kGmuUOoJoea	Useful Idiot	['TOOL']	0.000012	0.282
71191	619bPJZXSzqYi5vysR51Sa	First Breath After Coma	['Explosions In The Sky']	0.018500	0.328
19889	1nT1WwzjraW3Iu8Pa8wXEi	Rhinoceros - Remastered 2011	['The Smashing Pumpkins']	0.000388	0.310
50362	5kOxj05I5jTqzWNjcJPdsT	Leaving Wallbrook/On The Road	['Hans Zimmer']	0.006620	0.332
51321	2W70vgf87uyNB2XRpRDEES	Alison	['Slowdive']	0.010600	0.260
19425	76rfUs6iZBa3OCf8tCBn27	Plainsong - 2010 Remaster	['The Cure']	0.004510	0.36
28367	6Ox9HWLHipsG6RH2a3eB8h	New Dawn Fades - 2019 Digital Master	['Joy Division']	0.002040	0.362
51598	7mNyAFramOVsGZxdRyz4KQ	Porcelina Of The Vast Oceans - Remastered 2012	['The Smashing Pumpkins']	0.000764	0.268
40489	2wBJCrwLcKL0Sqa1OQVhD7	Hawkmoon 269	['U2']	0.001730	0.282
40971	1Y67fOHM7hb04jj6FLBWDQ	Snail - Remastered 2011	['The Smashing Pumpkins']	0.000690	0.240
30371	7MkWXuDcqo09FmVut8Ugkl	Plainsong - 2010 Remaster	['The Cure']	0.004510	0.36
69510	2pajYwitfIBfNUZwag6NEt	Bloody Kisses (A Death in the Family)	['Type O Negative']	0.079900	0.326
95866	78wsICkkDnDxftSjBWLPjl	Reed to Hillsborough	['Duster']	0.001130	0.355
49380	3Lf7TZurgJF7PexdrE5TOf	Donimo	['Cocteau Twins']	0.036100	0.358
70446	5t08jqyzXhKlBcs78edvsp	Boughs of Holly - Instrumental	['Trans-Siberian Orchestra']	0.022600	0.310
68503	4ImbE4F46Lhu7lG1Unurvp	The Sprawl (Album Version)	['Sonic Youth']	0.000456	0.240

	id	name	artists	acousticness	danceability
95899	4Jw9S4kXGemW1Gewq2KYPv	"Reflection - From ""Mulan""/Instrumental Vers...	['Vanessa-Mae']	0.074800	0.219
76623	3OLD4pHbtPtGmlU3YdLjaW	Defenders of the Faith	['Judas Priest']	0.062800	0.270
38875	139vGPQ7UFWjP0ou6Vf68z	Animal Magnetism	['Scorpions']	0.000112	0.274
38481	3uOpN1IdMSnzLOoRNcw60p	Mihalis	['David Gilmour']	0.056300	0.359
12634	6nunttbju0sb6U7ao7fedI	Marooned Jam - 1994 Recording	['Pink Floyd']	0.004590	0.348
12559	0oQlbs16wtdkKYoSfVAQUt	Yet Another Movie - Remix 2019	['Pink Floyd']	0.051300	0.298
76415	51zLiDo0u9xsbVXvUxBf7n	When Mama Was Moth	['Cocteau Twins']	0.000112	0.170
48214	4b36EWdCMBk2hCm9QQ9F5G	Short And Sweet	['David Gilmour']	0.076500	0.417
65745	44mzt1ihrrKCoiCagN6R0G	A Sprinkling Of Clouds - Remastered 2018	['Gong']	0.041000	0.239
65715	6piC8NdaOgfjcQ9jM1Od3S	Earthrise	['Camel']	0.003200	0.150
83545	4SnA0nbgsQ8jljhkCIO18r	Evening Wind	['Scorpions']	0.027400	0.243
84571	3h27YD93ShGmMwuDTAsnEw	No Fair	['Wipers']	0.000034	0.250
75416	53yjU4vJquCLPRJ5fG2Joq	La Villa Strangiato	['Rush']	0.000560	0.350
66076	6t1qG0YWhTx2LySGioK2od	Los Endos	['Genesis']	0.003850	0.175
65639	26YBB0K2GkM2r4GSdnbhsn	Winter/deep Freeze/winter Retreat/cheater	['Judas Priest']	0.061100	0.279

In [21]: `tracks_kDF.describe()`

Out[21]:

	acousticness	danceability	energy	instrumentalness	valence	popularity
count	98468.000000	98468.000000	98468.000000	98468.000000	98468.000000	98468.000000
mean	0.372530	0.548568	0.555895	0.114267	0.544981	0.042022
std	0.334264	0.173603	0.253578	0.262269	0.261449	0.014184
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.021000
25%	0.049800	0.431000	0.365000	0.000000	0.336000	0.031000
50%	0.281000	0.557000	0.568000	0.000090	0.555000	0.040000
75%	0.679000	0.674000	0.763000	0.018500	0.766000	0.052000
max	0.996000	0.988000	1.000000	1.000000	1.000000	0.100000

In [ ]: `k_clusters1 =[1000, 1100, 1200,1300,1400,1500,1600,1700,1800,1900]`
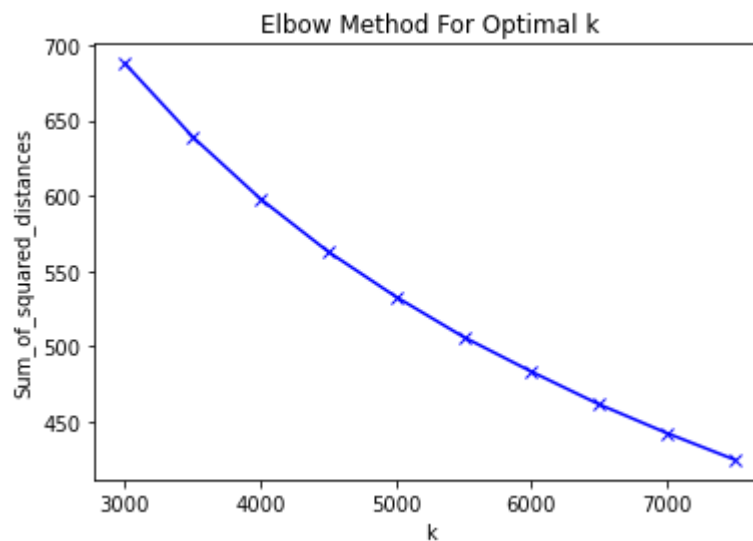
In [ ]:

In [26]:
```python
Sum_of_squared_distances = []
K = range(3000,8000, 500)
for k in K:
    km = KMeans(n_clusters=k)
    km = km.fit(X)
    Sum_of_squared_distances.append(km.inertia_)
    print(k)
```

```
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
```

In [27]:
```python
import matplotlib.pyplot as plt

plt.plot(K, Sum_of_squared_distances, 'bx-')
plt.xlabel('k')
plt.ylabel('Sum_of_squared_distances')
plt.title('Elbow Method For Optimal k')
plt.show()
```


In [29]:
```python
plt.savefig("ElbowMethodK_3k_8k.png")
```

```
<Figure size 432x288 with 0 Axes>
```

```
In [31]: for i in range(1,10):
             print(f'{K[i]} Clusters - {Sum_of_squared_distances[i]} inertia')
```

```
3500 Clusters - 639.0535345989566 inertia
4000 Clusters - 597.9034675561498 inertia
4500 Clusters - 562.8069384215119 inertia
5000 Clusters - 532.8522859262009 inertia
5500 Clusters - 506.10313790688264 inertia
6000 Clusters - 483.1234252189957 inertia
6500 Clusters - 461.3656331500063 inertia
7000 Clusters - 442.28284330967136 inertia
7500 Clusters - 424.62437412810795 inertia
```

```
In [33]: # 1100 Clusters - 1074.1422641480335 inertia
         # 1200 Clusters - 1035.5987273645721 inertia
         # 1300 Clusters - 1001.0174852416969 inertia
         # 1400 Clusters - 968.5874485251337 inertia
         # 1500 Clusters - 941.0744826073156 inertia
         # 1600 Clusters - 914.3621517818383 inertia
         # 1700 Clusters - 889.747172392275 inertia
         # 1800 Clusters - 868.8630953758765 inertia
         # 1900 Clusters - 848.5170540348556 inertia
         # 3500 Clusters - 639.0535345989566 inertia
         # 4000 Clusters - 597.9034675561498 inertia
         # 4500 Clusters - 562.8069384215119 inertia
         # 5000 Clusters - 532.8522859262009 inertia
         # 5500 Clusters - 506.10313790688264 inertia
         # 6000 Clusters - 483.1234252189957 inertia
         # 6500 Clusters - 461.3656331500063 inertia
         # 7000 Clusters - 442.28284330967136 inertia
         # 7500 Clusters - 424.62437412810795 inertia
```

```
  File "<ipython-input-33-01667d81b863>", line 10
    3500 Clusters - 639.0535345989566 inertia
       ^
SyntaxError: invalid syntax
```

```
In [ ]:
```

```
In [ ]:
```

```
In [ ]: # Visualizing the Clusters with PCA
        import plotly.express as px
        from sklearn.decomposition import PCA


        song_embedding = PCA(n_components=2).fit_transform(X)
        projection = pd.DataFrame(columns=['x', 'y'], data=song_embedding)
        projection['title'] = tracks_kDF['name']
        projection['cluster'] = tracks_kDF['cluster_label']

        fig = px.scatter(projection, x='x', y='y', color='cluster', hover_data=['x',
        'y', 'title'])
        fig.show()
```

In [ ]: