# Music Clustering

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Overview

1. Free Music Archive(FMA) is a dataset for Music Analysis including 13129 music track level features from Spotify.
2. The challenge with most of the music recommender systems is that the songs recommended to the users are based on peer user's choices, from keywords of music such as genre, year or musician to predict similar songs.
3. Often times user might be looking for similar songs based on song characteristics such as how acoustic and loud song is.
4. The objective of this project is to use the dataset to segment songs into different clusters based on high level audio features using different clustering techniques like K-means, Hierarchical clustering and Gaussian mixture models.
5. This music tracks segmentation is helpful to recommend a set of songs that best fits user interests. We can use this clustering algorithm to create a new recommendation engine to the music services like Spotify, Pandora etc which takes in a playlist, classify it to right group and returns similar songs in the cluster.
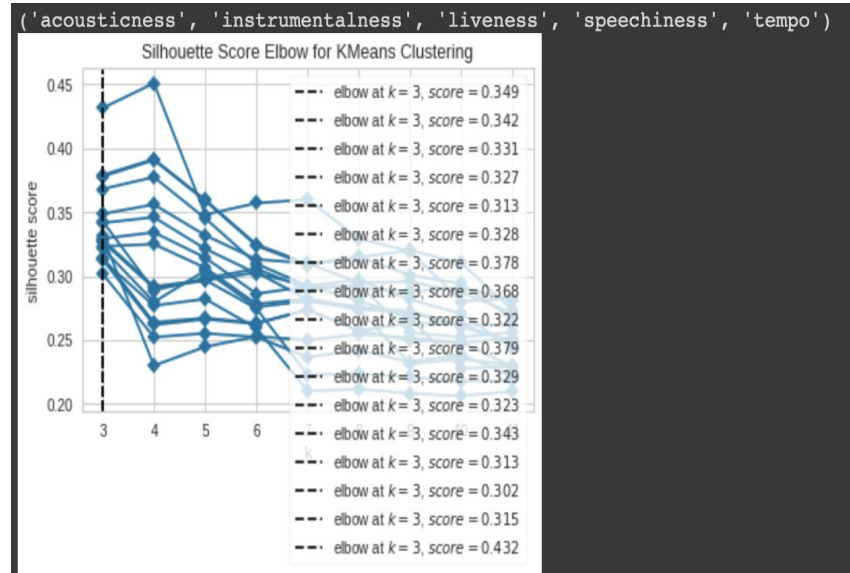
Baseline Model

- Using all features to fit a K-means clustering model.
- From the K-means score i.e., 0.27, the performance is not that good considering all the features in the dataset.
- The maximum score obtained trying other clustering techniques like Hierarchical, Gaussian Mixture models is less than K-means.
- This tells that the music tracks are not grouped pretty well using all features.
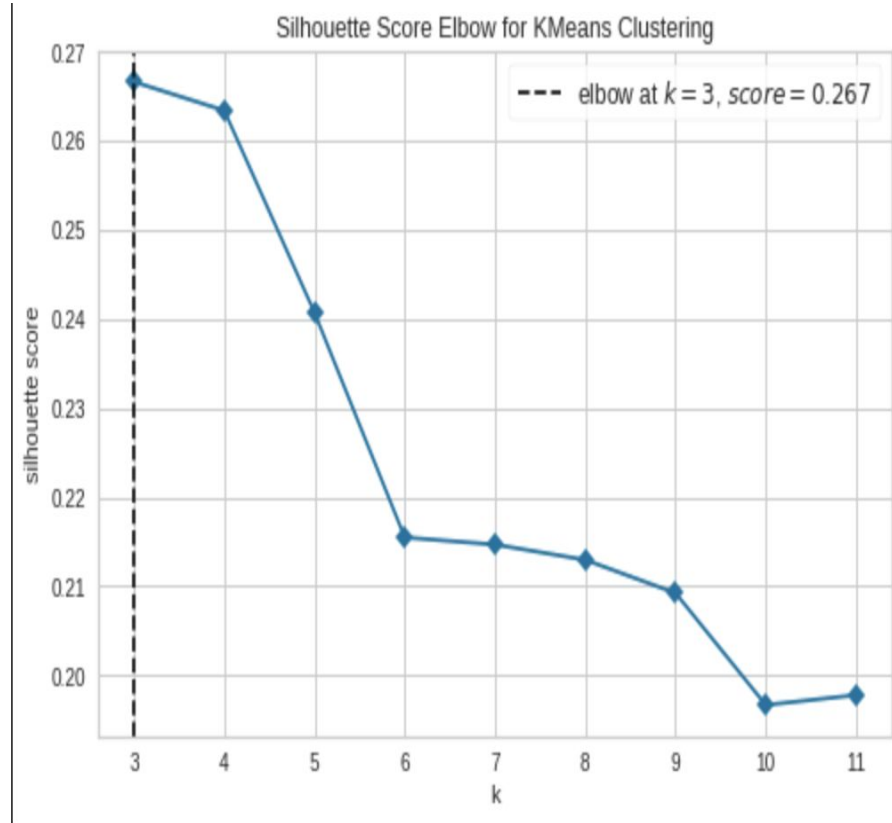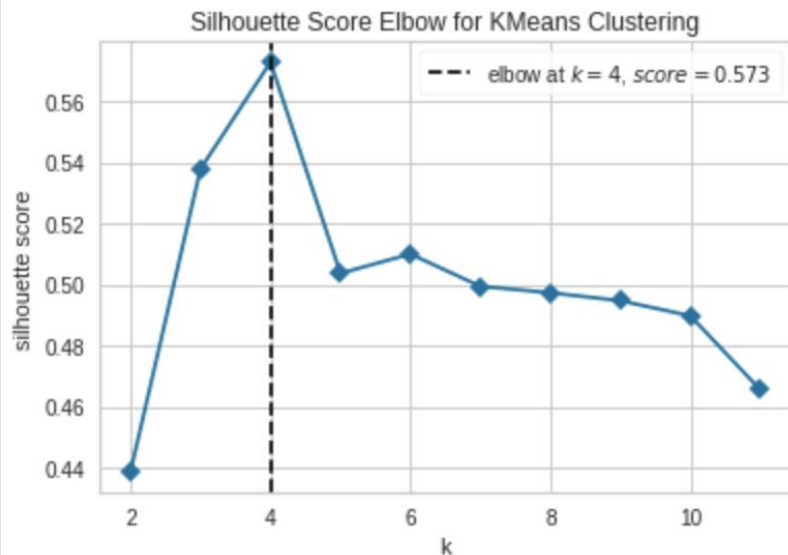
Approach-1

1. Created a set of all possible combinations of the features using 5 song features at a time.
2. For each combination, silhouette_score which defines how well the data is clustered, elbow value which tells the ideal number of clusters are calculated.
3. As shown in the plot, the combination ('acousticness', 'instrumentalness', 'liveness', 'speechiness', 'tempo') had a comparatively good score of 0.432 suggesting 3 clusters.
4. This model performance is improvement to baseline model by 1.59x in terms of well clustering the data.

('acousticness', 'instrumentalness', 'liveness', 'speechiness', 'tempo')

Silhouette Score Elbow for KMeans Clustering

- elbow at k = 3, score = 0.349
- elbow at k = 3, score = 0.342
- elbow at k = 3, score = 0.331
- elbow at k = 3, score = 0.327
- elbow at k = 3, score = 0.313
- elbow at k = 3, score = 0.328
- elbow at k = 3, score = 0.378
- elbow at k = 3, score = 0.368
- elbow at k = 3, score = 0.322
- elbow at k = 3, score = 0.379
- elbow at k = 3, score = 0.329
- elbow at k = 3, score = 0.323
- elbow at k = 3, score = 0.343
- elbow at k = 3, score = 0.313
- elbow at k = 3, score = 0.302
- elbow at k = 3, score = 0.315
- elbow at k = 3, score = 0.432

Approach-2

1. This time, created a set of all possible combinations of the features using 3 song features at a time.
2. Again for each combination, silhouette_score and elbow value are calculated.
3. As shown in the plot, the combination ['acousticness', 'instrumentalness', 'speechiness']
4. had a score of 0.57 suggesting 4 clusters.
5. This model performance is improved compared to baseline by 2x.

Silhouette Score Elbow for KMeans Clustering

Clustering based on Approach-2

1. Based on the Approach-2, the combination ['acousticness', 'instrumentalness', 'speechiness'] yielded comparatively great results suggesting 4 clusters and had a score of 0.57 using K-means.
2. Hierarchical and Gaussian models were also trained using the same number of clusters, their cluster score is around 0.44 which is lower than K-means score which is 0.57.
3. The right side plot uses k-means model to represent how the music tracks are grouped based on the predicted clusters.

Distribution of music tracks by cluster

Clustering by KMeans (k=4)
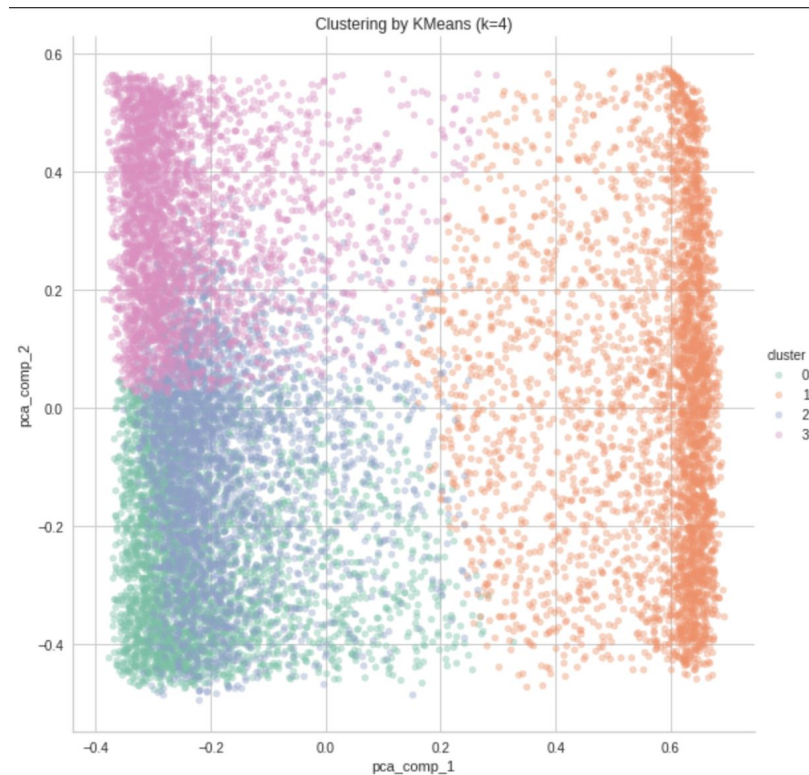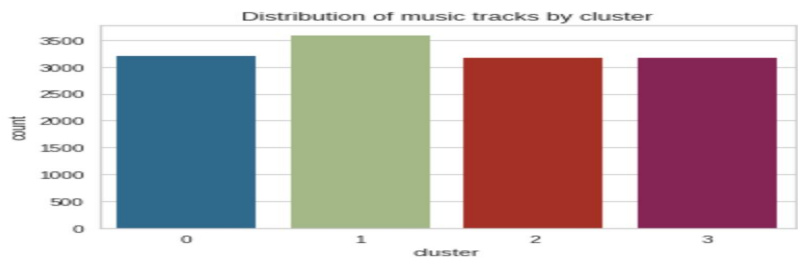
Results

Models	Cluster Score	Clusters
Baseline using K-means	0.267	3
Approach-1 using K-means	0.43	3
Approach-2 using K-means	0.57	4
Approach-2 using Hierarchical Clustering, Gaussian Mixture Models	0.44	4

Conclusion

- Classified the music tracks using different clustering techniques such as K-means, Hierarchical, Gaussian models.
- Out of the different techniques used, K-means achieved best clustering with score of 0.57 where music tracks are segmented to 4 clusters.
- As next steps, this model's performance can be improved considering other lower level features of the data as well. After that, integrating it to recommendation engines for music services like Spotify can help improve the prediction of recommending more suitable songs to its users.