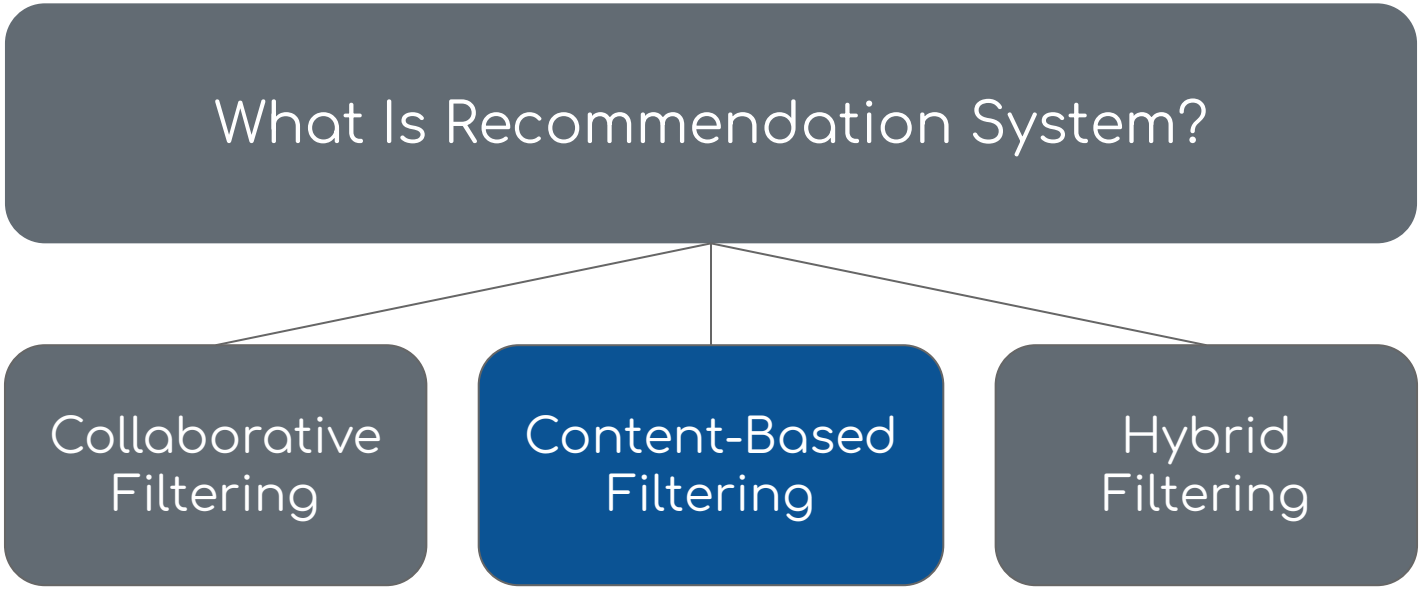
Music Recommendation System using Clustering

Aicha Slaitane
Chaelin Lee

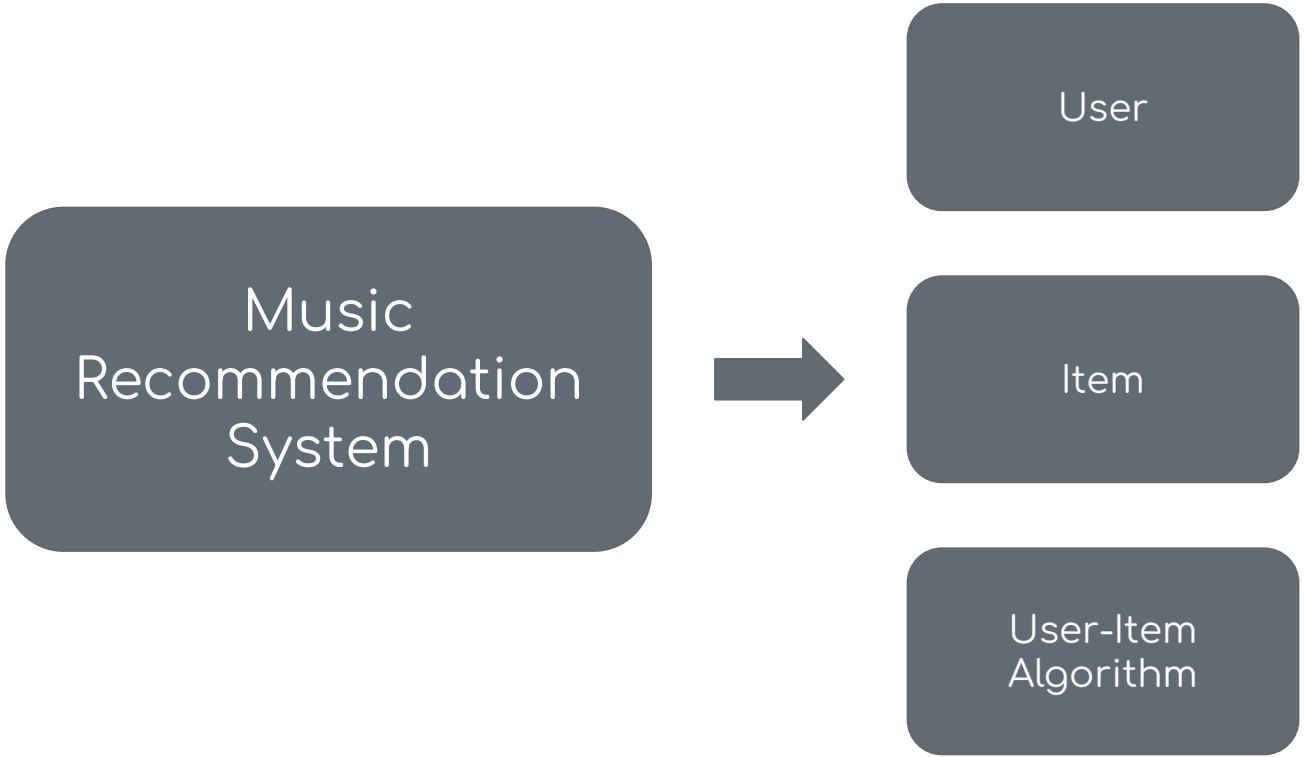
Outline

- Background
- Data Exploration
- Models:
  - Clustering without k as a parameter
  - Clustering with k as a parameter
- Recommendation System
- Conclusion / Future Work

Background

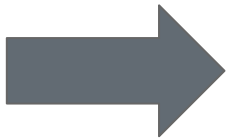

What Is Recommendation System?
Collaborative Filtering
Content-Based Filtering
Hybrid Filtering

Background


Music Recommendation System
User
Item
User-Item Algorithm

Problem

Personalization at Scale
Multi-model content: heavily rely on audio features or collaborative filtering



Aims to find the best solution for the recommendation system model using clustering techniques in terms of content-based filtering

Data

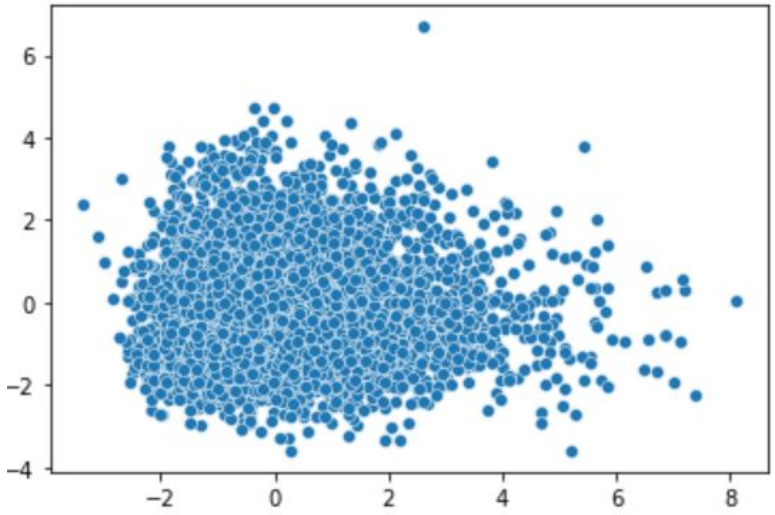
track_id	name	artist	spotify_pr	spotify_id	tags	genre	year	duration_	danceabili	energy	key	loudness	mode	speechine	acousticne	instrumen	liveness
TRIOREW1	Mr. Bright:	The Killers	https://p.s	09ZQ5TmU	rock, alternative, indi		2004	222200	0.355	0.918	1	-4.36	1	0.0746	0.00119	0	0.0971
TRRIVDJ12	Wonderwa	Oasis	https://p.s	06UfBBDIS	rock, alternative, indi		2006	258613	0.409	0.892	2	-4.373	1	0.0336	0.000807	0	0.207
TROUVHL:	Come as Y	Nirvana	https://p.s	0keNu0t0t	rock, alter	RnB	1991	218920	0.508	0.826	4	-5.783	0	0.04	0.000175	0.000459	0.0878
TRUEIND1	Take Me O	Franz Ferd	https://p.s	0ancVQ9w	rock, alternative, indi		2004	237026	0.279	0.664	9	-8.851	1	0.0371	0.000389	0.000655	0.133
TRLNZBD1	Creep	Radiohead	https://p.s	01QoK9DA	rock, alter	RnB	2008	238640	0.515	0.43	7	-9.935	1	0.0369	0.0102	0.000141	0.129
TRUMISQ:	Somebody	The Killers	https://p.s	0FNmIQ7u	rock, alternative, indi		2005	198480	0.508	0.979	10	-4.289	0	0.0847	8.71E-05	0.000643	0.0641
TRVCCWR	Viva la Vid	Coldplay	https://p.s	08A1lZeyL	rock, alternative, indi		2013	235384	0.588	0.806	8	-7.903	1	0.105	0.153	0	0.0634
TRXOGZT1	Karma Pol	Radiohead	https://p.s	01puceOq	rock, alternative, indi		1996	264066	0.36	0.505	7	-9.129	1	0.026	0.0626	9.22E-05	0.172
TRMZXEW	The Scient	Coldplay	https://p.s	0GSSsT9sz	rock, alter	Rock	2007	311014	0.566	0.429	5	-7.826	1	0.0242	0.715	1.44E-05	0.12

- Utilized a subset of the Million Song Dataset, the official dataset provided by Spotify.
- Using dataset with 6000 data points
- Includes the audio features, such as the duration of song, duration, danceability, energy, key, loudness, speechiness, acoustiness, mode.

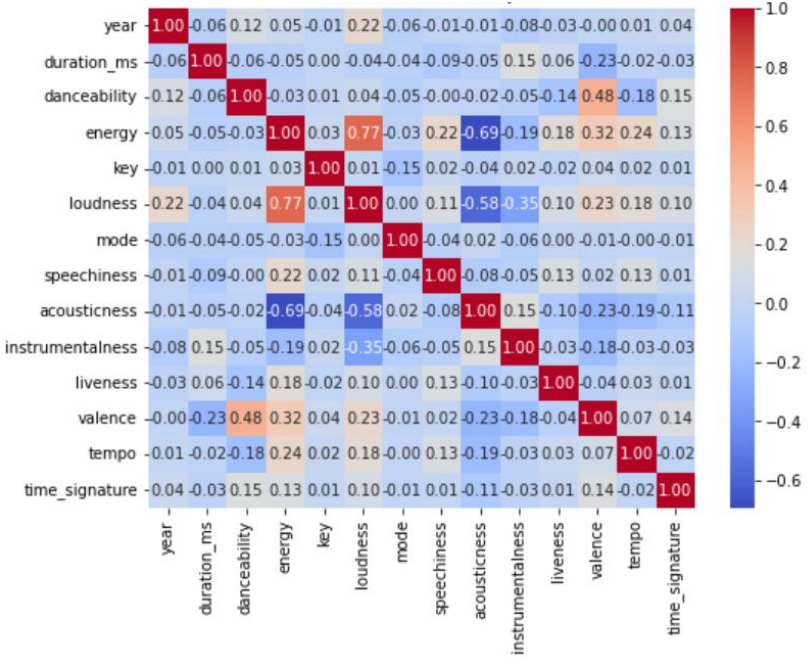
http://millionsongdataset.com/

Exploratory Data Analysis

Visualization of the dataset in 2D
Dimensionality Reduction using PCA



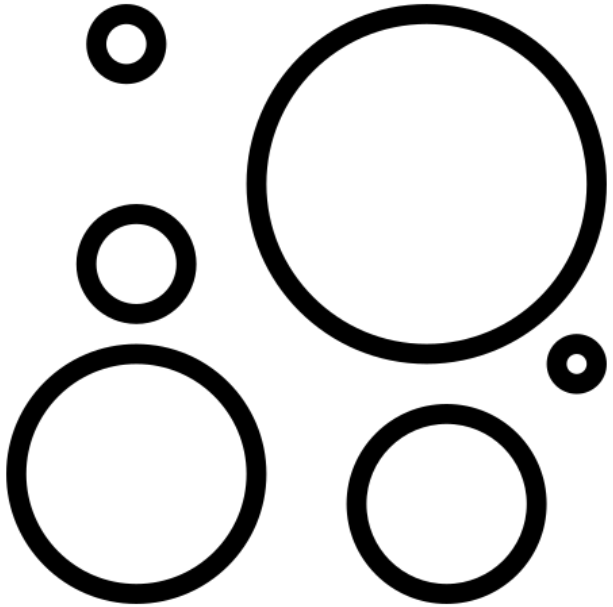
Correlation heatmap



- Duration: the duration of the song in milliseconds
- Danceability: a metric for determining how "danceable" a song is. A value of 0.0 is least danceable and 1.0 is most danceable.
- ~~Energy: a subjective assessment of activity and intensity of the song. Its range if [0,1]. Typically, energetic tracks feel fast,~~ loud, and noisy.
- Key: a specific set of pitches or notes that form the basis of a musical composition.
- Loudness: the decibel level of a song.
- Mode: minor or Major mode. It has a significant impact on the mood and tonality of a song.
- Speechiness: the presence of words.
- Acousticness: a confidence measure from 0.0 to 1.0 of whether the track is acoustic.
- Instrumentality: whether or not a song has no vocals (pure instrumental).
- Liveness: refers to the presence of an audience in a song, such as at a performance.
- Valence: a measure from 0.0 to 1.0 describing the musical positiveness conveyed by a track.
- Tempo: beats per minute (BPM).
- Time signature: a musical notation that appears at the beginning of a piece of sheet music to indicate the rhythmic structure of the music.

Features

Clustering without k as a parameter

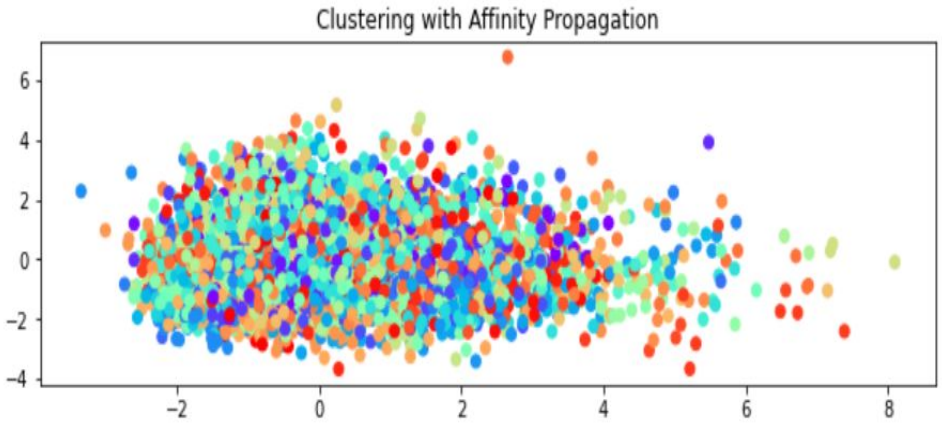


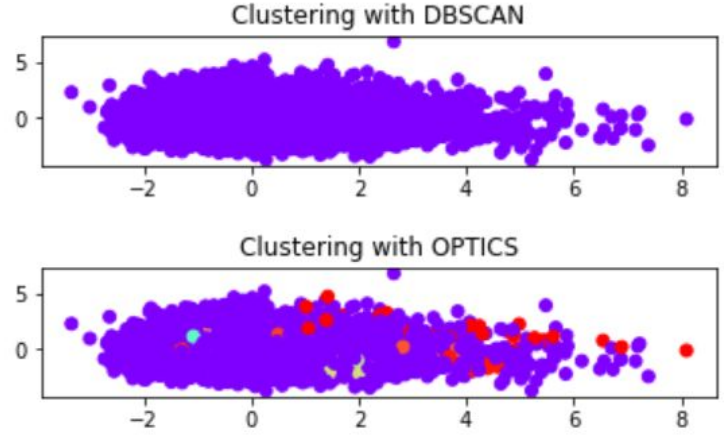
Models

Affinity Propagation

DBSCAN

OPTICS



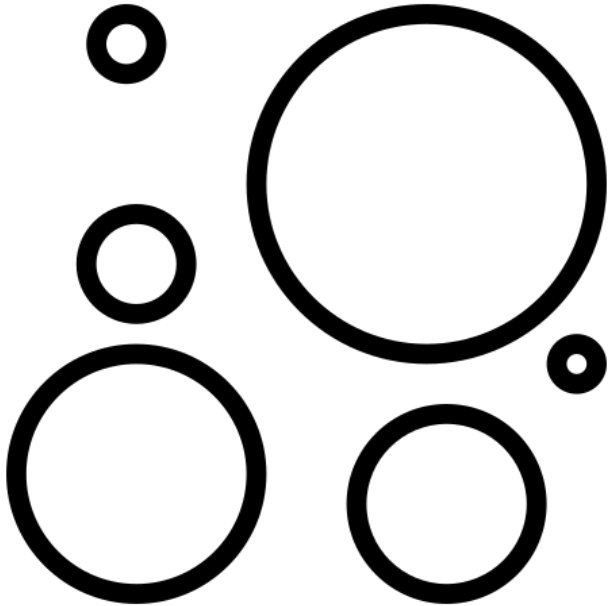


Hyperparameter Tuning...

Problems:

- Model fails to converge
- Number of clusters = number of samples
- Number of clusters = 1

Clustering with k as a parameter



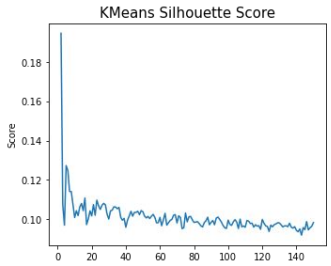
Models

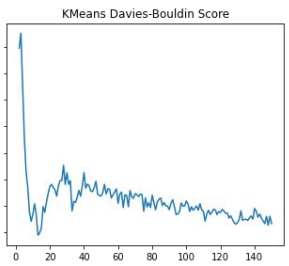
K-means

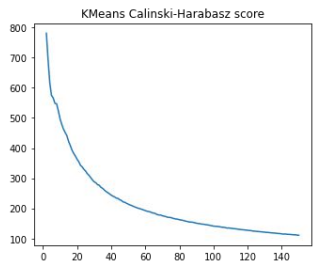
Birch

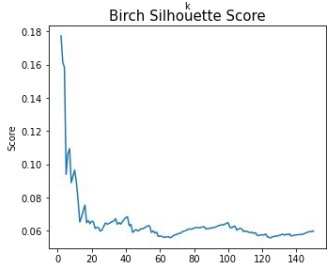
Gaussian Mixture

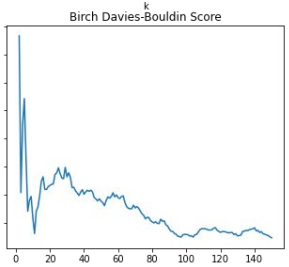
Agglomerative

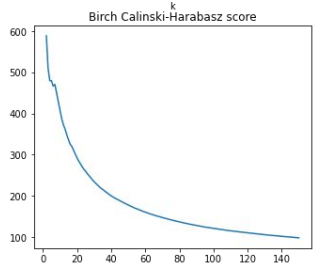


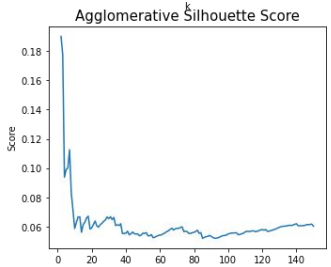


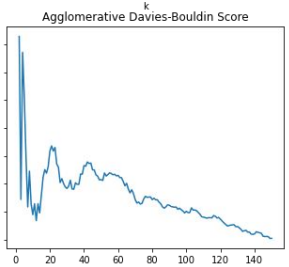


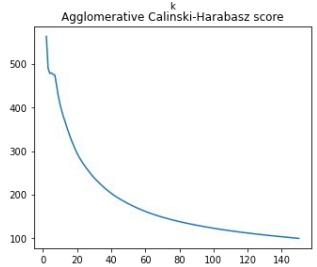


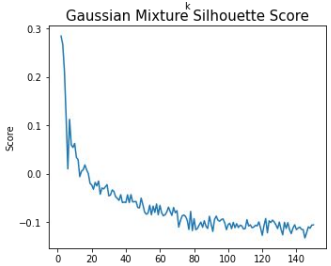


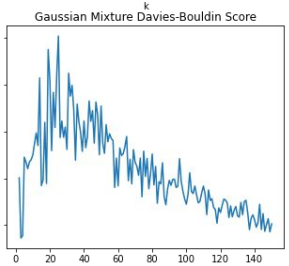


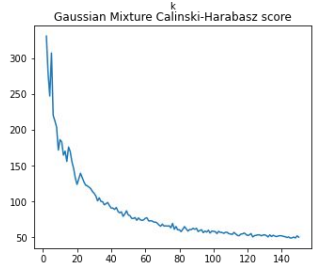












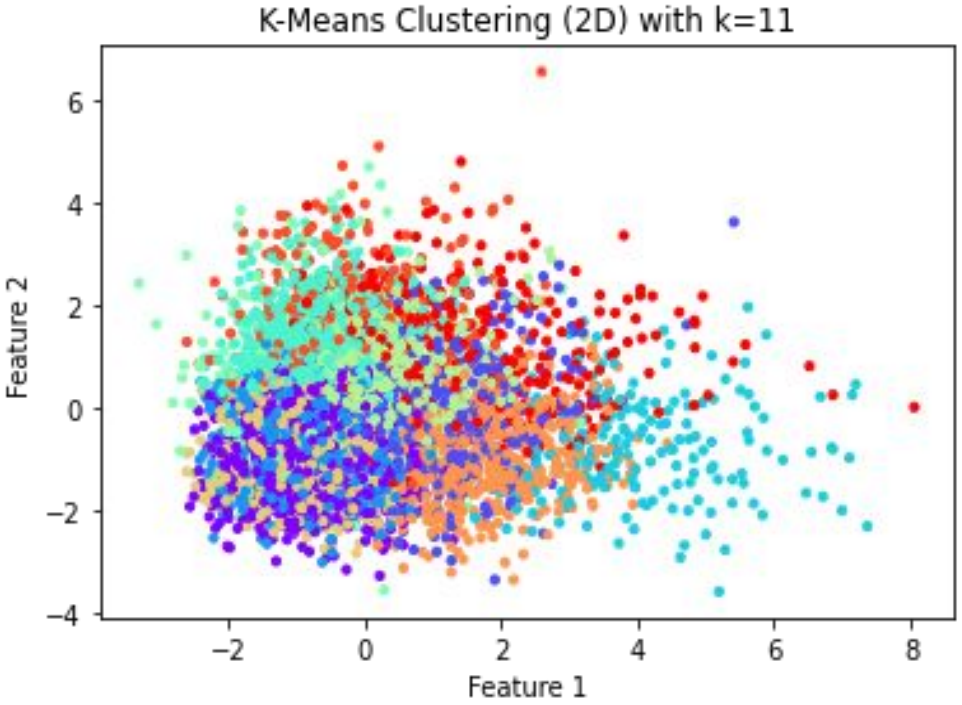
Lowest Davies Score

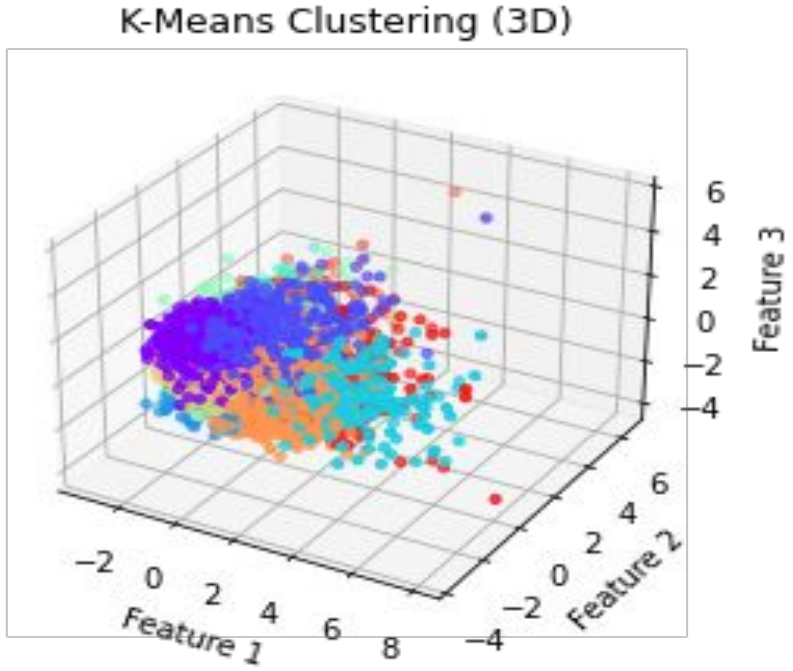
- k-mean : 1.6896
- Birch: 2.0712
- Agglomerative: 1.8674
- Gaussian Mixture: 2.3872

Optimal k number

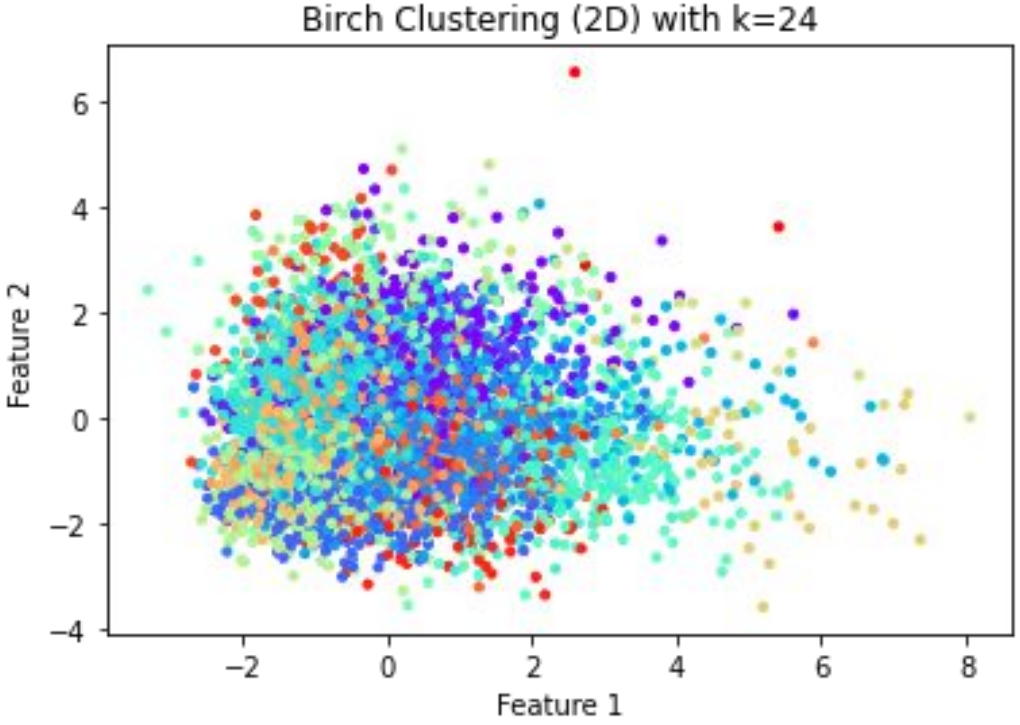
- k-mean : 11
- Birch: 24
- Agglomerative: 10
- Gaussian Mixture: 2

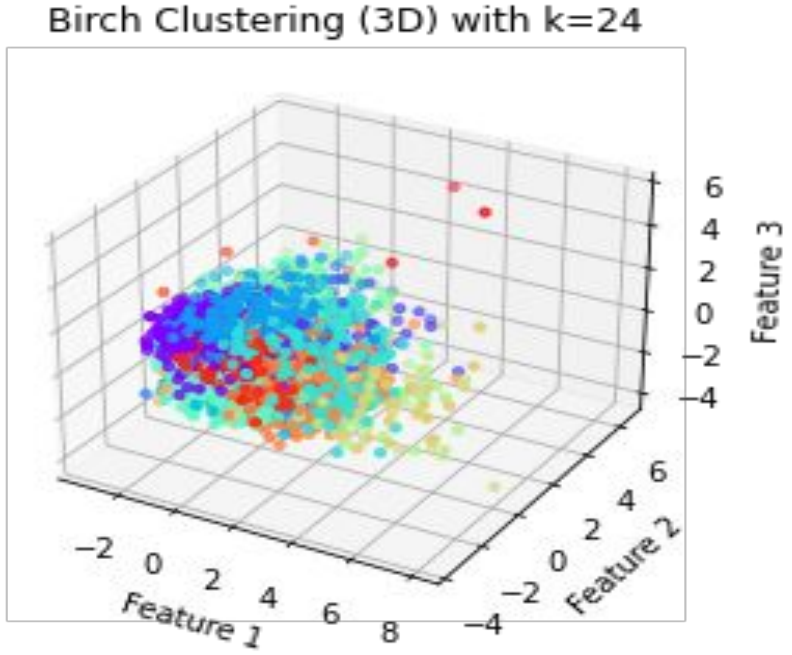
K-means Clustering (k=11)



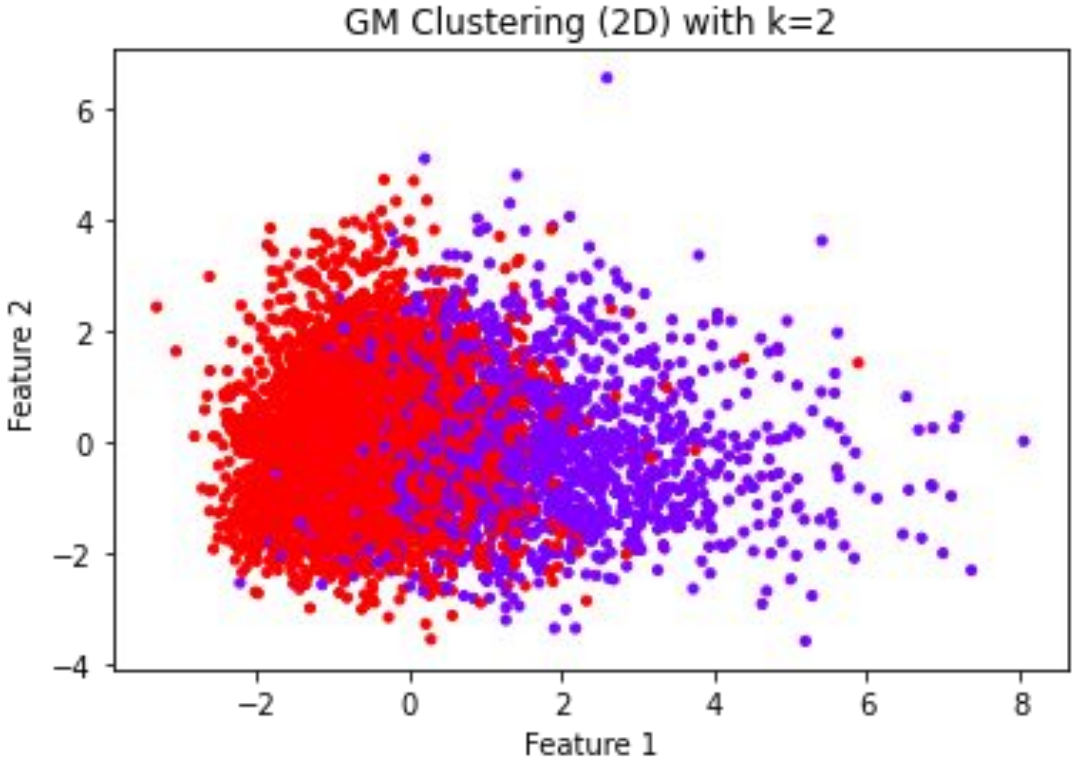


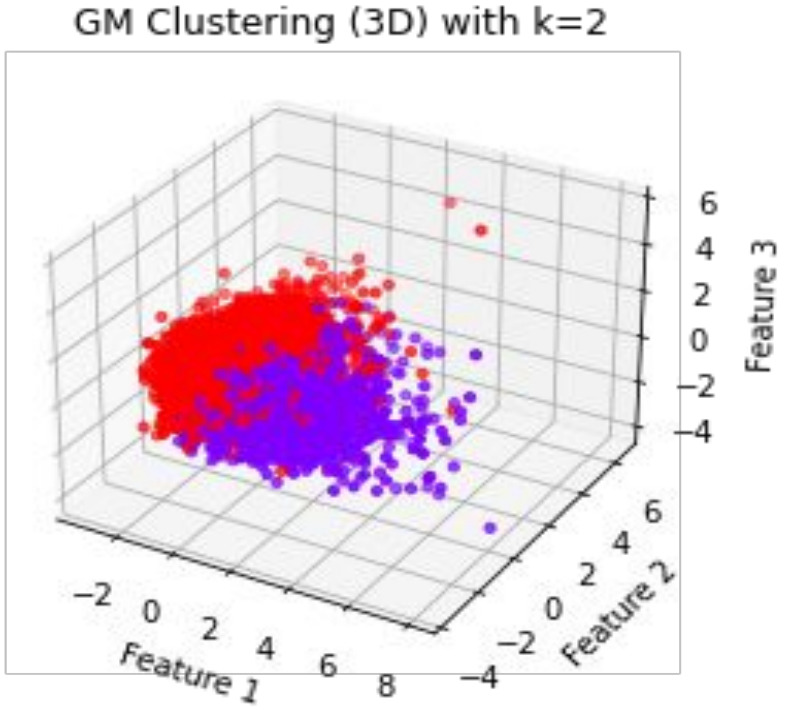
Birch Clustering (k=24)



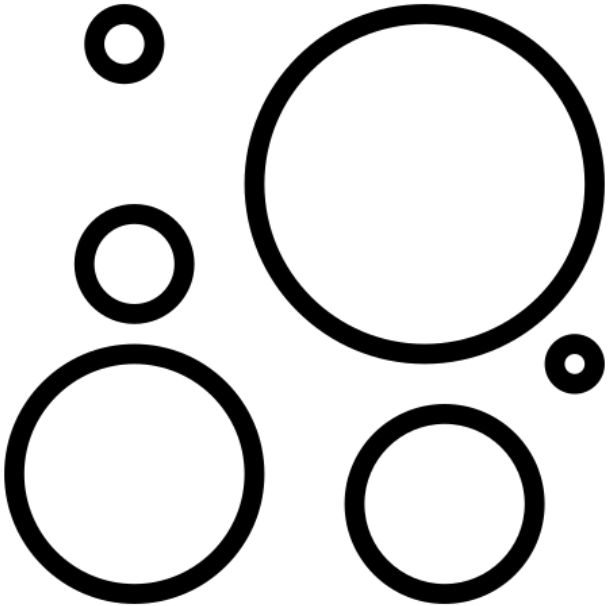


Gaussian Mixture (k=2)



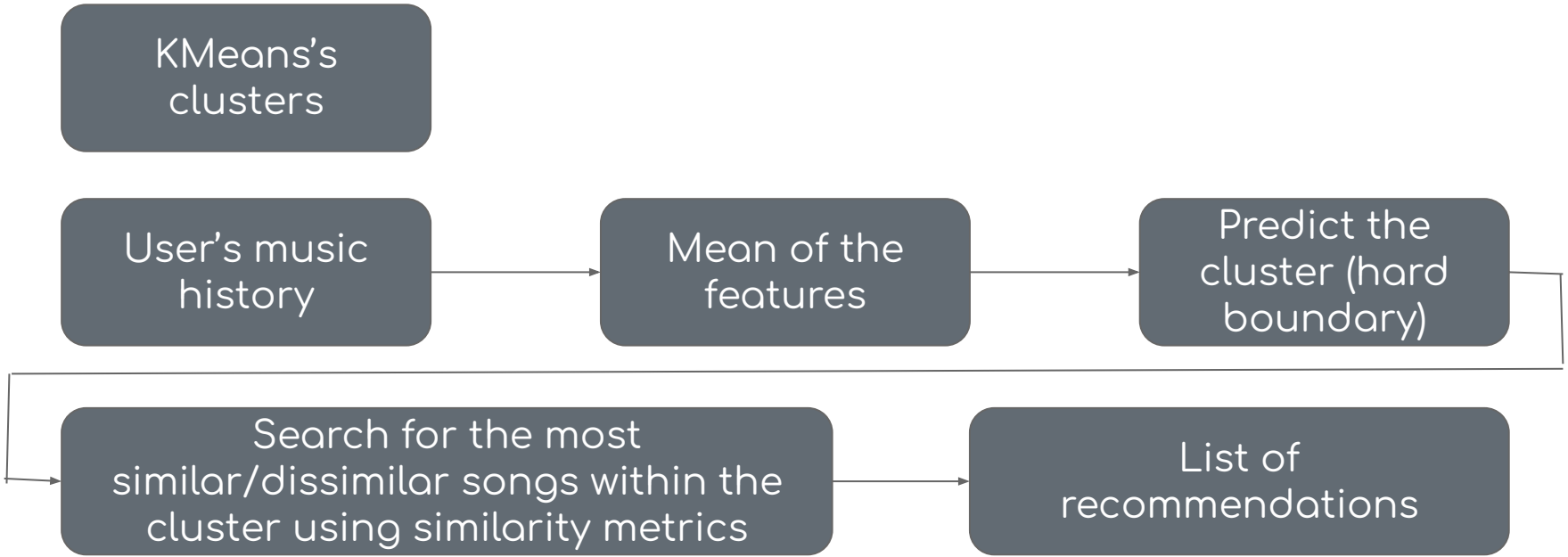


Music Recommendation System



How can we use KMeans to recommend a song for a user based on it music listening history?

Music Recommendation System:



Conclusion

- Clustering algorithms without k as a parameter fail to create clusters.
- KMeans is the best clustering algorithm for our music recommendation system.
- The system can recommend both similar and dissimilar songs within a hard boundary cluster.

Future Work:

- Overcome the problems of the clustering algorithms without k as a parameter.

Thank you

Any Questions ?

Work Distribution

Chaelin

- Research in clustering with k numbers
  - Birch
  - K-means
  - Agglomerative
  - Gaussian Mixture

Aicha