
A Model-based Approach to Music Genre Assignment

— A case study using technical
attributes of music from Spotify —

Preet Khowaja, John Owusu Duah, Cameron Ratliff, Clarissa Ache

What is pop
music?

What is Latin
music?

What is
Bollywood
music?

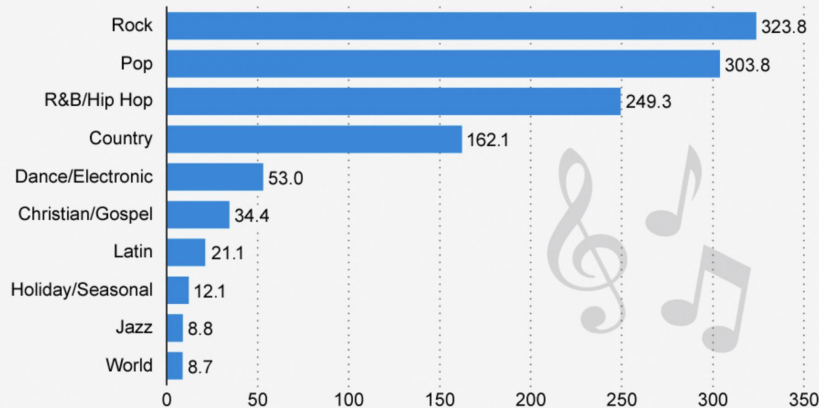


What problem are we trying to solve?



Top 10 U.S. Digital Music Genres in 2012

Digital music sales in the U.S. by genre (million tracks)

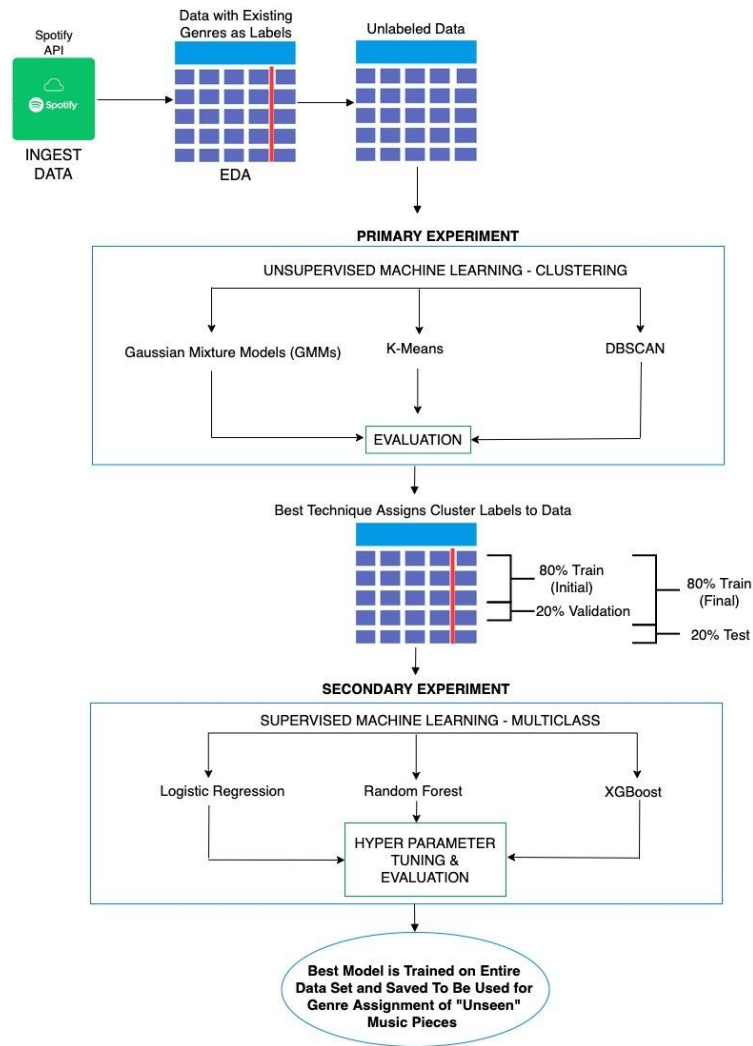


statista
The Statistics Portal

Source: Nielsen

<https://www.statista.com/chart/1783/album-sales-in-the-us-by-genre/>

Process Flow



Spotify Data

- **12 features:** Direct measurements + Confidence Scores

Tempo	Loudness	Key	Mode	Speechiness	Liveness	Instrumental	Danceability	Energy	Acousticness	Valence	Duration
-------	----------	-----	------	-------------	----------	--------------	--------------	--------	--------------	---------	----------

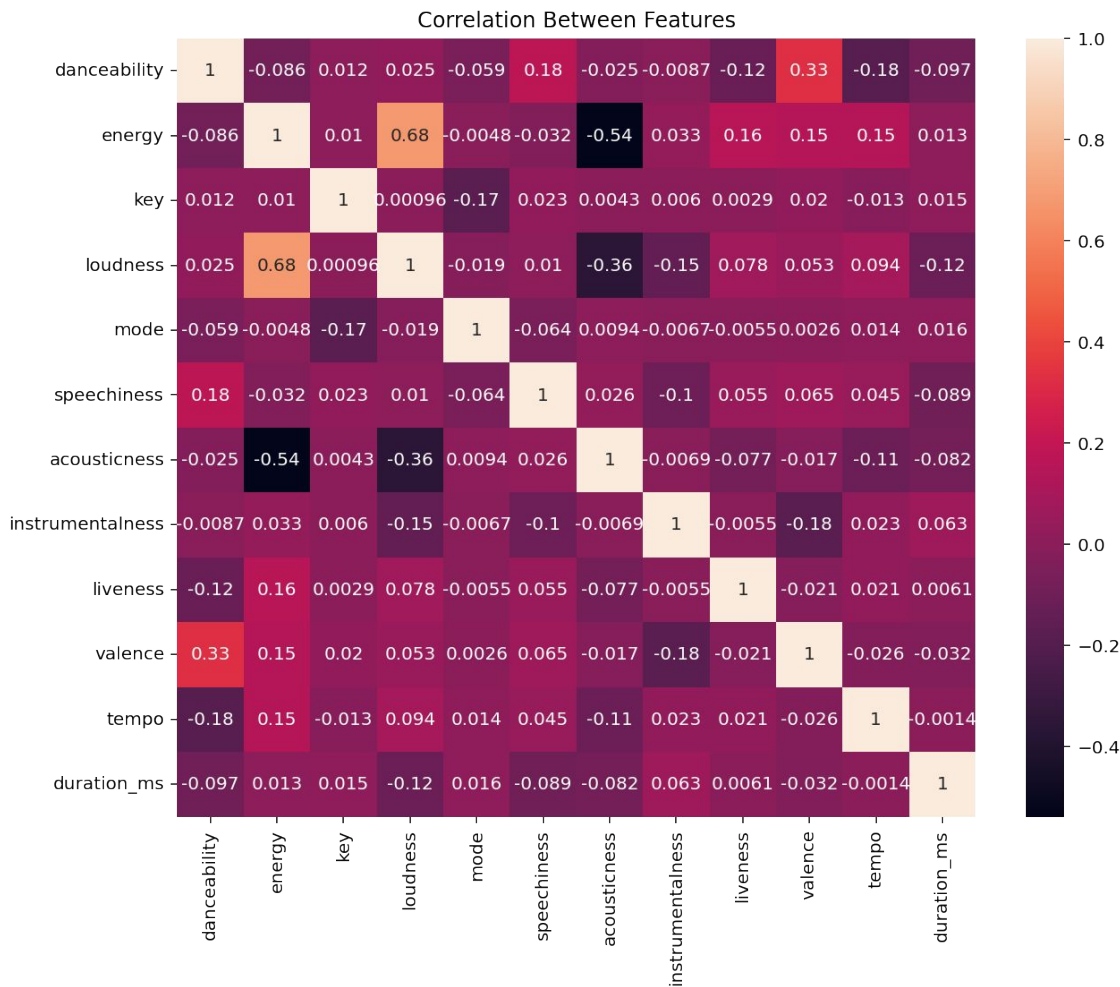
- Obtained from Spotify API by querying the top ~5000 songs from the top 6 most popular genres in 2015: **EDM, POP, ROCK, RAP, LATIN, and R&B**

Example table:

track_name	track_artist	danceability	energy	key	loudness	mode	speechiness	acousticness	instrumentalness	liveness	valence	tempo	duration_ms
Lavish	WYLD	0.662	0.582	7	-7.937	1	0.1130	0.40400	0.000014	0.1920	0.599	99.904	204600
Work	Rihanna	0.725	0.534	11	-6.238	1	0.0946	0.07520	0.000000	0.0919	0.558	91.974	219320
Sleep Rider	K.D.S	0.819	0.825	3	-6.657	0	0.0654	0.14400	0.673000	0.0951	0.539	114.992	286500
Black Leather	Guns N' Roses	0.466	0.991	8	-3.272	1	0.1420	0.00551	0.174000	0.3540	0.205	137.595	248493

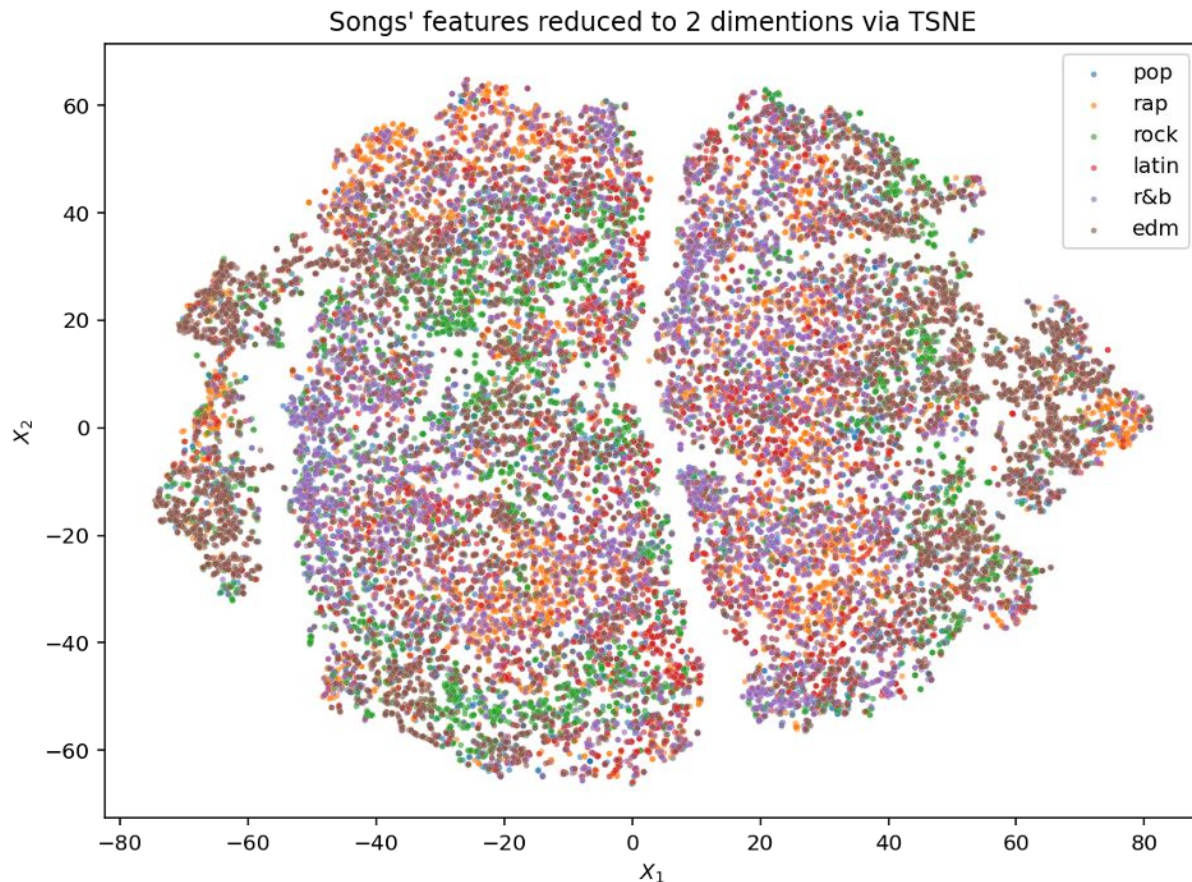
Spotify Data

- Features are not highly correlated (except for loudness and energy)
- We have a good set of features that measure the songs in different ways!



Spotify Data

- Song genres seem inseparable when songs features are observed in 2 dimensions



Clustering methods

K-Means

- Assumes clusters are globular or spherical
- Tuned to provide optimal $k = 5$

DBSCAN

- Unclassified songs
- Too many clusters

Gaussian Mixture

- Assumes clusters have a Gaussian distribution
- Tuned to provide optimal $k = 8$

Clustering methods

DBSCAN

- Unclassified songs
- Too many clusters

K-Means

- Assumes clusters are globular or spherical
- Tuned to provide optimal $k = 5$

Gaussian Mixture

- Assumes clusters have a Gaussian distribution
- Tuned to provide optimal $k = 8$

Clustering methods

DBSCAN

- Unclassified songs
- Too many clusters

Gaussian Mixture

- Assumes clusters have a Gaussian distribution
- Tuned to provide optimal $k = 8$

K-Means

- Assumes clusters are globular or spherical
- Tuned to provide optimal $k = 5$

Evaluation Metrics for Clustering



Davies-Bouldin Score

Evaluates intra-cluster similarity and inter-cluster differences

Silhouette Score

Measures the distance between each data point, the centroid of the cluster it was assigned to and the closest centroid belonging to another cluster

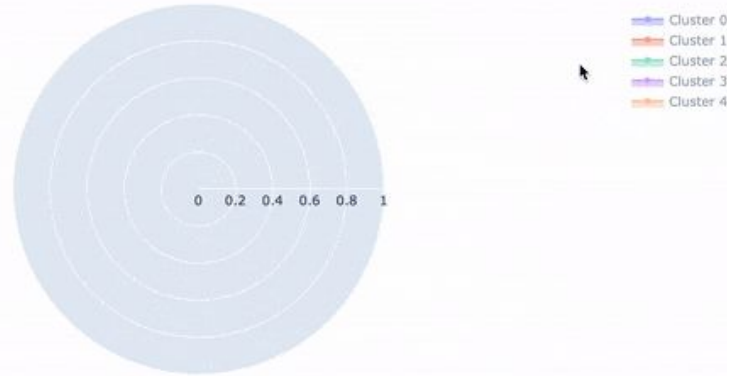
Evaluation Scores



	K-Means	Gaussian Mixture Model
Davies Bouldin Score	2.166	1.999
Silhouette Score	0.105	0.09

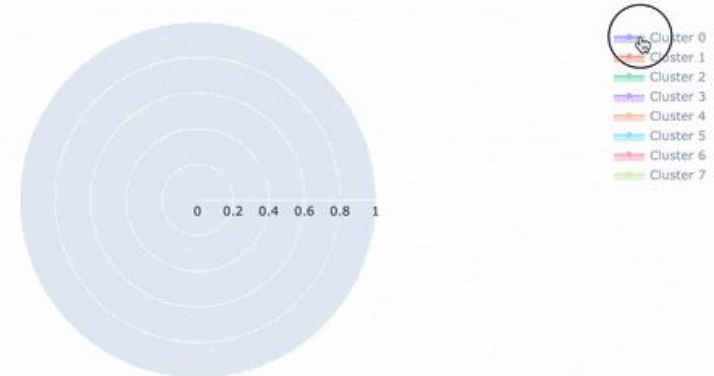
New genres obtained with K-means

K-Means Clusters: Radar Plot of Feature Medians Per Cluster



New genres obtained with Gaussian Mixture Models

Gaussian Clusters: Radar Plot of Feature Medians Per Cluster



Supervised ML Results

A logistic regression model was used for prediction of new genres for unseen music



Classification Summary

	Precision	Recall	F-Score	Support
Cluster 0	0.97	0.99	0.98	497
Cluster 1	1.00	0.99	1.00	903
Cluster 2	0.99	0.99	0.99	995
Cluster 3	0.99	0.99	0.99	1841
Cluster 4	0.99	0.99	0.99	2331

Accuracy			0.99	6567
Macro Average	0.99	0.99	0.99	6567
Weighted Average	0.99	0.99	0.99	6567