CS361: Spotify Song Mood Analysis using Classification and Clustering

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1. Introduction

1.1. Motivation

"Can we teach a computer to learn how music will make people feel?" We currently use many different methods to classify the music that we listen to, such as genre, artist, etc. For us, however, a song usually induces a feeling in us that cannot be easily explained, but often we can associate certain moods with them. Identifying the mood of a song can improve the existing song recommendation algorithms, which only use the genre and similar artists.

1.2. Target Problem

We have a large collection of digital music, and while existing methods to categorize the songs are quite complex, taking into account various metrics, they often fall short in capturing the human emotions invoked by the music. Quantifying such data through statistical methods can prove to be quite a challenging task, and tackling this obstacle through Machine Learning methods is a worthwhile problem to solve.

1.3. Objective

The primary objective of this model is to accurately identify and categorize the mood associated with a user given song. Spotify is the largest music streaming platform in today's world. We focus on improving its capability of recommending a song based on the user's mood. If a user is listening to a song, our model will predict the mood associated with that song and spotify can recommend songs that come under the same mood category. This will highly improve user's engageability and will lead to increased satisfaction and loyalty. Only genre based and artist based suggestions may not resonate with the user's mood, thus integrating mood based suggestions will enhance precision and personalization in song recommendations.

1.4. Challenges

Users express a desire for playlists that align with specific moods or activities, beyond the normal genre-based playlists. Users may struggle to articulate or specify the mood they seek in music, making it difficult for traditional recommendation systems to understand their preferences completely. Users' musical preferences are dynamic and can evolve over time, making it challenging for traditional recommendation systems to keep pace.

2. Methods

2.1. Data Scraping

We aim to generate our dataset using the Spotify Web API or SpotiPy library. Through this, it is possible to get the songs in a playlist and corresponding to each song we can get its audio features such as Loudness, Liveness, Energy, Beats etc. which are good indicators of the type of music we are listening to. They also help identify the mood the song has.

2.2. Exploratory Data Analysis & Feature Selection

The API response body contains a lot of song characteristics. We will select the parameters that play a role in describing the emotional expressions related to a song. We can classify songs into the following major mood categories- Happy, Sad, Calm, Energetic, and Angry.

To do so, we will first have to find what distribution of values of features we have extracted from the API can be best used to describe all these moods. To achieve this, we will take playlists of happy songs, sad songs, calm songs, energetic songs, angry songs and then plot the selected features against all the songs in each category to be able to represent each category in a more general form as some distribution of our chosen parameters. Various playlists made for these specific moods are abundantly available on Spotify itself and we will make use of them for our analysis.

2.3. Modelling Methods

There are 2 methods to go about the problem:-

2.3.1. Multi-class Classification:

One approach is to treat mood identification as a multi-class classification problem. We can use the mood categories as defined above, and train a classifier to predict the mood label of a given song. To achieve this, we will utilize features extracted from audio data provided by the Spotify API. These features include valence, arousal, rhythm, tempo,

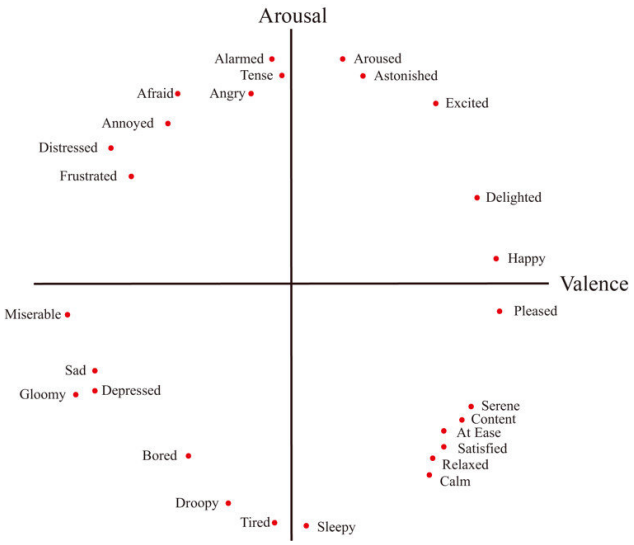

Figure 1. Russell's Circumplex Model of Emotions

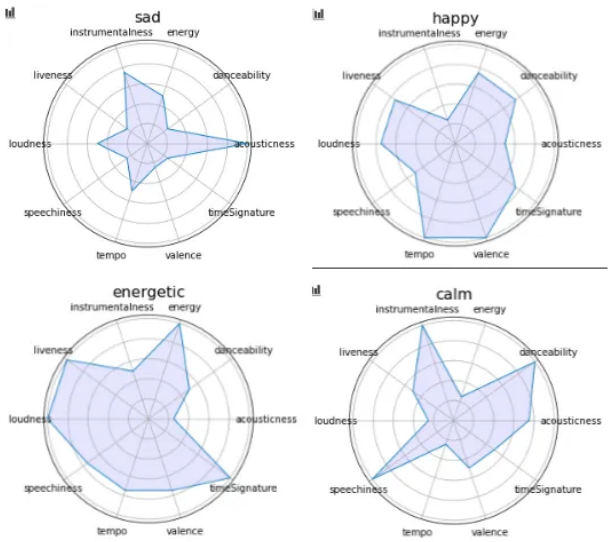

Figure 2. Representing different song moods based on the available audio features, we can see that the audio features can highlight the mood of the song.

and more, which encapsulate the emotional and rhythmic characteristics of the music.

We will implement Random Forest for the classification as it is robust to overfitting and noise which can be problematic while analysing an artistic field such as music. Moreover, it performs well on imbalanced data, for example, if we have fewer samples of a particular mood class. It can also model non-linear relations within features and mood labels.

2.3.2. CLUSTERING:

Another approach is to cluster songs based on similarities in their audio features. Instead of predefined mood categories, this method groups songs based on similar acoustic properties. By applying clustering algorithms, we can uncover patterns and similarities among songs that may indicate shared mood characteristics.

We can visualize these clusters and compare them with existing genre values present in the data to gain further insights into the relationship between musical characteristics, mood and genres of the songs.

We will use K-means for the clustering problem since it works efficiently for large dimensional feature sets such as the one for Spotify songs that we are using. It is also based on the concept of similarity and closeness between features, which can be expected based on Russell's Circumplex Model of Emotions in Figure(1).

3. Intended Experiments

We can compare the results we have obtained using multi-class classification and clustering. For example- looking at how many clusters we have obtained and how many labels we have used for classification, then we can focus on how the distribution of features in the clusters obtained is similar to that of our defined mood labels. Moreover, we will also use the models- Random Forest and K-means as present in the Scikit-learn library and compare the results(in the form of performance metrics) we get on the data with the ones we get when we have implemented the models on our own from scratch.

References

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