Computer-executed Genre Classification of Music
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Abstract

The aim of this project is to enable a computer to place given pieces of music into their appropriate genres. Genres are often generalities that do not necessarily fit a piece exactly, but this project could determine what music really is similar and should be grouped together. This could have applications in sorting large libraries of music or suggesting music to individuals based on what they like to listen to. Music in midi format is used as input for the program. Python was used to write classes that can read and store the information held by midi files. This is done by grouping notes into their appropriate beats. Organizing them in such a manner allows for harmonic analysis, which is a good indicator of genre, and opens up the possibility of later implementing analyses of other low-level musical qualities. Such data will be analyzed by a statistical model to determine what elements are most indicative of what genres. This project will focus on music written for solo piano, so that notes and rhythm rather than instrumentation can be used to determine genre.

Keywords: music, genre, naive, bayes

1 Introduction and Background

Current research often uses statistical models to determine how a given piece of music should be categorized. One approach has been to use Inter-Genre Similarity modeling [2]. This project attempted to categorize music by analyzing the timbral textures of a short sample of music. These textures differ due to differences in instrumentation and rhythm. Gaussian Mixture Models were used to create the statistical model, and IGS to cluster similar groups together. Their algorithms grouped a 0.5 to 30.0 second sample of music into one of nine genres. Longer samples yielded better results, up to 64 percent correct. This somewhat low success rate is attributed to the difficulty of machine analysis of sound samples. Music has also been represented through a model of rhythmic complexity [5]. With this method, rhythm was represented in a tree structure and its overall complexity was determined. Results were moderately successful, but the method of organizin notes could be useful in other attempts at classifying music. Another approach attempted an automatic method of classification that is completely general [3]. This was done by looking for mathematical similarity, rather than features specific to music. Midi files were used for musical analysis, and very successful results were shown when grouping music into rock, jazz, or classical genres. Results were moderately successful when attempting to group pieces by composer, but got worse as sample size increased. Interestingly, the algorithm could even cluster like file types together (sorting out java class files, gene sequences from different species, and widely different styles of music). One especially successful experiment was "On musical stylometrya pattern recognition approach" [1]. Different musical aspects of pieces were analyzed, and a statistical model was created to group new pieces into their appropriate period. By analyzing more musical characteristics, their model became more fine-tuned. These characteristics included harmonies, dissonance, note entropy, and types of intervals. No method has yielded or should be expected to yield perfectly successful results even many people cannot successfully place music into its correct genre.

2 Project Design

The first step of this project was to write code for reading and organizing the information stored in a midi file. A midi file is a sequence of commands preceded by how long to wait until they are executed (delta-time). For the purposes of this project, I will only need the note-on and note-off commands and their delta-time values. This will allow the code to determine which notes are playing at the same time and what rhythms are found in the piece. This information is organized by storing it in a Beat class. Each instance of a Beat knows which notes sound on its downbeat and off the beat. It also contains which beat it represents from the piece (beat 1, beat 2, etc.), and can be sorted according to this number. When the notes that sound within a beat are passed to a chord identification method, it returns what chord most accurately represents that combination of notes. This is roughly how harmonic analysis is performed by a human, and harmonies present in a piece of music are a good indicator of what style or genre the music belongs to. Harmonic analysis is now working smoothly. Chord identification code accurately returns the key, quality, and inversion of a given combination of notes (e.g., B Flat Dominant Seventh, Third Inversion). One issue I addressed was the possibility of the notes combining to form more than one type of chord. I did this by modifying my code to prioritize the results based on the lowest note in the chord, allowing it to return consistent results. I also have a method of dealing with non-chord tones. When a group of notes does not form any known chord, my code analyzes every possible combination of three notes from the group. This chooses the most representative key for that beat, yielding an appropriate result (major, minor, dimished, etc.) without being thrown off by non-chord tones. I tested my code by having it analyze a Bach chorale and print out information about each beat. This output includes the beat number, the notes within the beat, and what chord they form. I could verify the information by looking at the music. I have found and fixed many issues with my code thanks to this method of testing. To categorize the music, there are a couple of options. One is using a Nave Bayes classifier. This model treats each probability vector as independent and not correlated with any others. While this is not true, Bayesian classifiers have still been shown to provide useful results. To apply the Bayes classifier to music, probability vectors will be calculated by analyzing the combinations of notes and harmonies a piece of music contains. However, I will initially construct a neural network to analyze these data. Machine learning methods have been shown to be the most reliable and useful in analyzing music.

3 Results

Code successfully inputs a midi file, identifying how many tracks it has, and what commands they contain. The command types, arguments, and delta-time values are all stored accurately. Code then iterates through the note-on and note-off commands, using the delta-time values to group them into their appropriate beats. Once finished, each beat passes the notes it contains to the chord identification method, which returns what chord best represents that combination of notes.

4 Discussion

This project could be a valuable tool in organizing libraries of music. Genres are often generalities that do not necessarily fit a piece exactly, but this project could determine what music really is similar and should be grouped together. It could also provide interesting insights into how we interpret music and what gives different styles their distinct feel. Another application could be composer identification. Sometimes, new manuscripts of music are discovered, but their composer is not known. Successful implementation of this project could aid in identifying the composer of any newly discovered composition, or composition whose actual composer is in question.

References

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