TJHSST Senior Research Project Proposal
Music Analysis
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Abstract

Although music is one of the most universal aspects of human culture, it is very difficult to define. Most definitions of music have been dependent on attributes such as rhythm, melody, and harmony, which are extremely subjective, so the ability to identify music has been limited to humans. This project aims to better define "music" by applying machine learning techniques to music analysis and recognition, allowing computers to autonomously identify whether a given audio sample is musical in nature.

Keywords: music analysis, machine learning

1 Introduction - Purpose and Scope

1.1 Purpose

This project aims to unify machine learning and signal processing techniques in a program that will learn to distinguish between musical and non-musical audio recordings.

1.2 Scope

This project will create a program that will learn to identify audio samples of musical nature. The program will be "trained" on a number of audio

samples typically agreed upon as "music" as well as a number of non-musical samples. After sufficient training, the program will be able to distinguish between musical and non-musical audio recordings.

2 Background

Computers have already been used to perform analysis of music. In 1999, Bigerelle and Iost determined that different genres of music could be distinguished by fractal dimension. Other research has attempted to deconstruct music in terms of rhythmic and melodic patterns, and even looked at software that would generate music conforming to such patterns (Leach and Fitch, 1995). However, as Bigerelle and Iost point out, each instrument has a different sound quality, and composers write music with these timbral differences in mind. Simply analyzing the notes on sheet music precludes the use of these differences in the analysis. Audio recordings, in contrast, allow analysis of exactly what the composer intended his audience to hear.

3 Procedures

3.1 Design

The program will perform spectral and fractal analysis of the samples, and will use neural networks to detect correlations between these analyses and whether the samples are "musical" or not.

3.2 Testing

Each part of the program dealing with signal processing will be tested against input of known values to verify the accuracy of my implementation. The machine learning part of the program will be trained and tested with input samples that clearly are or are not music.

3.3 Software

This project will be written in C.

3.4 Algorithms

This project will make use of the following existant algorithms:

1. Fast Fourier Transform (FFT) to perform discrete Fourier transforms
2. Fractal dimension algorithms described by Bigerelle and Iost
3. Neural Networks

4 Schedule

In the first quarter, I will focus on the signal processing techniques and algorithms. The program will be able to apply several algorithms to audio samples and produce various charts and store the results of these algorithms for use in the machine learning phase of the program.

In the second quarter, I will apply machine learning techniques to the signal processing data. The program will begin to be able to distinguish between some audio samples, but will probably not be consistantly accurate. The program should be able to tell that silence is not music, for example, but may not be able to distinguish between music and a room full of people talking.

In the third quarter, I will hone the existant signal processing algorithms and add new ones in order to have as much data and as precise data as possible for the machine learning component of the program to utilize. The program's accuracy in distinguishing music should improve.

In the fourth quarter, I will tune the machine learning component of the program. The program should accurately and consistently identify music.

5 Expected Results

This project is expected to produce a program cabable of distinguishing between music and non-music. The final results of this project will be presented as a demonstration of the program's music-detecting capability as well as graphs of the program's accuracy given different types and amounts of training. This project will demonstrate the effectiveness of machine learning techniques in relatively subjective problems. This project will also, if successful, definitively answer the age-old question: "Is rap music?"