Music Genre Analysis

Alex Stabile

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Abstract

The goal of this project is to teach a computer to learn to distinguish between music of different styles. To do this, python was used to write classes that can read and store the information contained in midi files, such as note value, duration, and tempo. These data were then organized by grouping notes into their appropriate beats. Organizing them in such a manner allows for harmonic analysis, which provides insight into how a piece is written and what it sounds like. We theorize that this information would be enough to distinguish among basic genres of music. For this project, music by Mozart was compared to music by Rachmaninoff, two great composers with very different compositional styles.

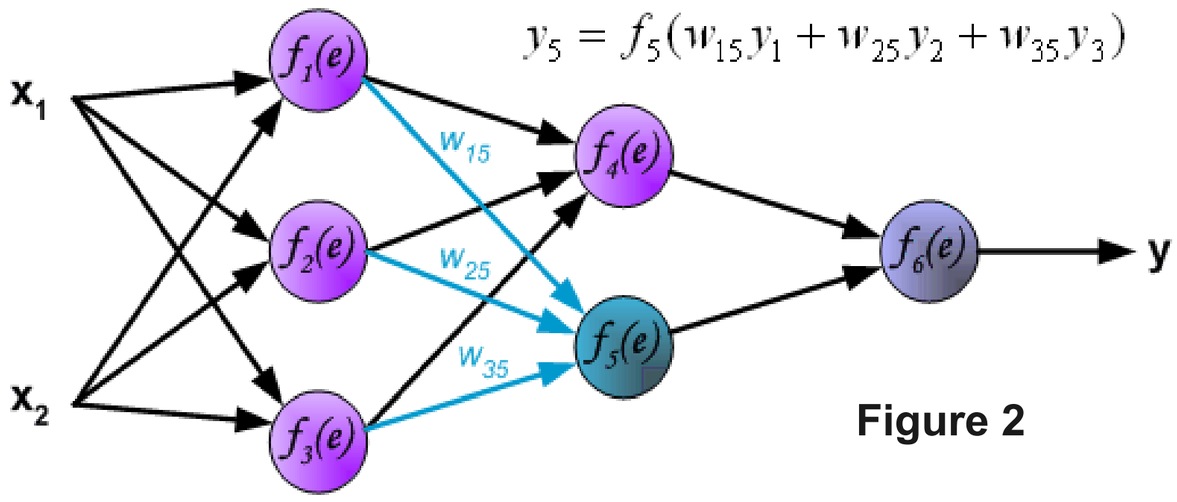


Figure 2

Source: http://galaxy.agh.edu.pl/~vlsi/AI/backp_t_en/backprop.html

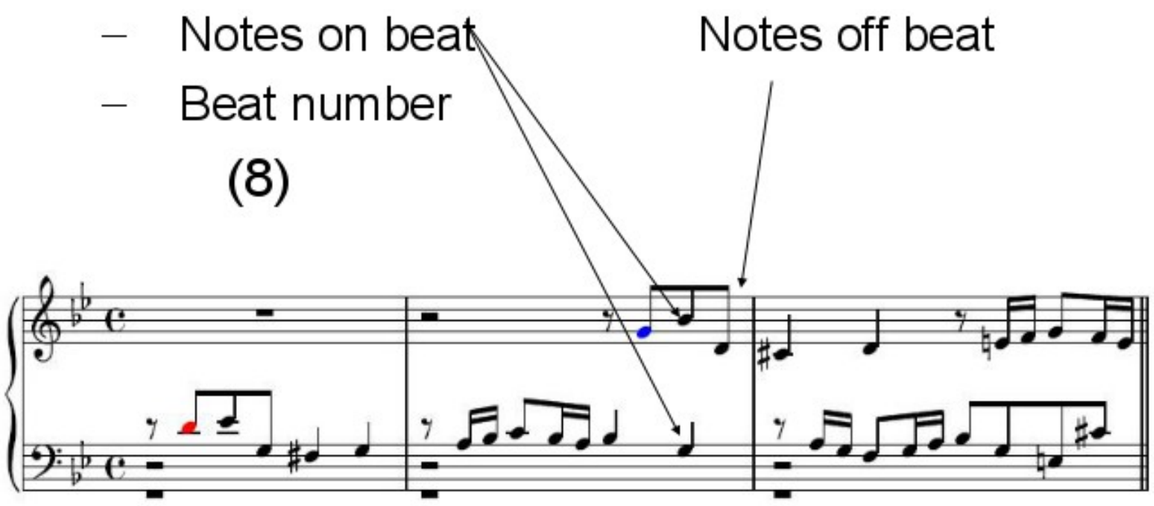
Background

Current research often uses statistical models to determine how a given piece of music should be categorized. One especially successful experiment was "On musical stylometry—a pattern recognition approach" (Backer et al). 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 yet yielded perfectly successful results, nor should it be expected to – even many people cannot successfully place music into its correct genre.

Organization/Parsing file

- Beat class
  - Notes on beat
  - Beat number



Harmonic Analysis

Code was written to read and organize 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). This information is stored 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 the chord identification method, it returns what chord most accurately represents the notes in that beat. Above, the notes in beat 8 of the music are indicated. If these notes were passed to the chord identification method, it would return “G minor, root position.”

Machine Learning

Neural networks contain different layers of "perceptrons:" nodes that contain a value and that are associated with a weight (see figure 2). The input layer consists only of the different inputs the network will receive. In this experiment, these inputs are the ratios of different types of chords found in a piece. Because there are 12 such ratios, a neural network in this experiment has an input level containing 12 perceptrons. The values of the input layer are then "fed" through the network, assigning values to all the other nodes (one step of this process is illustrated in figure 2). The output layer consists of just one node, whose final value will represent what the network has determined to be the style of the music.

When the network is created, weights are generated randomly for all the nodes. The network is then "trained" by giving it a data set containing inputs and their target outputs. In this experiment, music by Mozart had a target output of 0 while music by Rachmaninoff had a target output of 1. When the network produces a result, its weights are adjusted to lower its error.

Results after 20,000 iterations of learning:

Mozart	Rachmaninoff
0.246987378	0.910667436
0.076599769	0.78254246
0.499717472	0.997315343
0.017284228	0.997505054
0.166669487	0.987666405
0.04632631	0.927365885
0.428092399	0.034919879
Average: 0.211668148902	Average: 0.805426066072

Discussion

The above table shows that the network learned to assign music by Mozart a value close to 0, and music by Rachmaninoff a value close to 1. The results of this experiment suggest a relationship between the style of a piece of music and the types of harmonies found in the piece. Music by Rachmaninoff and Mozart was chosen to be analyzed because of their very different styles, and by using a neural network the computer could learn to reliably differentiate between these two composers.