R2.B.09

Real-Time Identification of Common and Extended Musical Chords using Neural Networks

JOACHIM

Before we begin, it is important to mention that the notes to be used come from the nearly universal 12-note system used around the world.

Musical chords are collections of 2 or more notes played together that follow a certain ruleset of harmony built into us, according to Leino et al (2007).

Each chord has its own name, determined by two parameters: root note and chord type. There is a third parameter, inversion, but it will not be part of the study as it does not commonly make part of the chord name.

The process of finding out the name of the chord given a set of notes is called chord identification.

Why is it important? According to Humphrey, Bello, and Cho, most music learners want to know the chords of the songs they listen to. Unfortunately, most of them cannot do this by merely listening.

This is down to a rare trait called absolute pitch, which is the ability to hear a certain pitch, recognize it, and identify its corresponding note name. For example, someone with absolute pitch will be able to identify a 440 Hz tone as the note A.

Absolute pitch is rare amongst music learning individuals and in the human population, since it commonly requires both good genes and music training at a young age.

It is then important to determine what role absolute pitch plays in chord identification, so I will give an example.

Here is a certain five-note chord. Commonly, people will only be able to pick up five different pitches spaced out a certain distance from each other. However, they cannot identify these pitches nor determine their note names.

On the other hand, someone with absolute pitch can. From there, they can determine the root note and chord type, and from that, the name of the chord. This is chord identification.

How can this be done? One way is through artificial neural networks, which model the neurons of a biological brain. Here, each neuron is represented by a processing unit called a perceptron, which takes many binary inputs and gives one binary output. Many of these perceptrons form the neural network.

Aside from the reason that they model the neurons of a human brain, neural networks were chosen because previous implementations have not included extended chords in their research, leaving an exploitable gap for research.

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LESLI

The study aims to develop a neural network that quickly identifies common and extended musical chords.

Specifically, the input must be a group of three or more MIDI signals played in real-time, and be of one root chords in the 0^{th} inversion.

The neural network must be programmed in a language that has these available libraries to facilitate ease of coding, and must be trained and run on a GPU for efficient processing.

The top-level processes include procurement of materials, neural network development, preparation and randomization of test chords, and testing and data collection.

Procurement of materials involves the acquisition of the GPU and programming tools. While the former is mentioned here, it will only be performed if the GPU currently owned by the researchers is deemed inadequate by literature.

Neural network development involves implementing a MIDI input/output and neural network in a programming language, preparing an input chord dataset, and training the neural network. Methods involving these are to be determined.

Test chord preparation and randomization will involve assignment of test chord parameters to arbitrary numbers for use by the RNG later, determination of sample size, the acquisition of a random number generator.

The following steps will be carried out after each training evolution.

Under test chord preparation, stratified random sampling of chords will occur.

Testing will be carried out on the said randomized chords, evaluating accuracy and delay time. The data will then be logged after every evolution.

The final output data will be analyzed through methods appropriate to the neural network, to be determined by literature.