A Quantum Natural Language Processing Approach to Musical Intelligence

(as pdf here)

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Summary

The first part of the paper gives us information about the current understanding of music as a communicational medium and its relationship to natural language. Then the researchers moved on to present the connection between their research and approaches to computational modelling of music and algorithmic composition. They included a short part about the basics of quantum computing as well. Researchers worked on Distributional compositional categorical (DisCoCat) modelling. So the following sections introduce the DisCoCat modelling, the DisCoCat model developed by the researchers, and the process of generating musical pieces. The last part shows the results from the classification and how to use them for generating two classes of musical compositions. The appendix contains a summary of Context-Free Grammars (CFG) and Monoidal Category Theory.

Objective

The researchers aimed to program a quantum computer so that it could learn to categorise music according to different meanings. As a follow-up, they wanted to develop a technique that would lead to the possibility of composing meaningful pieces of music.

Research done

First, the group focused on generating a training corpus with context-free grammar. Musical system parts were assigned the natural language counterparts, so musical compositions played the function of sentences, musical snippets the role of words and notes from a pitch framework were as letters. The researchers worked with a pregroup converter that translates from context-free grammars to pregroup grammars and an optimiser for diagrammatic rewriting. Then they used a circuit converter for decoding musical composition into a quantum circuit. The final step was training the system to classify “melodic” and “rhythmic” music.

New contributions

The group of researchers developed *Quanthoven* – a system for composition. The machine learning algorithm can learn how to distinguish between “melodic” and “rhythmic” music. Quanthoven was used to compose four music pieces, two melodic and two rhythmic. One can find the code for the Quanthoven on GitHub and its songs on Soundclick.

Future Directions

The writers pointed out the possibility of developing their piece of software to extract a CFG from provided corpora of musical scores. Another option would be using information obtained from social media and developing effective annotation methods for more extensive databases. Following the development of quantum computers, they aim to work with more sophisticated compositions, which include more instruments, longer durations, a variety of distinct meanings and a lot more. According to them, this will probably require a generative algorithm other than just CFG. The researchers also stated that another important step would be designing a quantum generative music engine drawing directly from the classifier instead of using it as a filter.