Louay Farah

2nd Order Markov Chain for Music Generation - Report

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Abstract

This report presents the work conducted for the first project of the music generation for IT specialists course. The project aimed to apply a 2nd order Markov chain algorithm to generate MIDI files based on the Godfather theme. The implementation used the Python programming language and the music21 library to merge three musical batches that are melody, chord accompaniment, and drums. The generated MIDI files were evaluated for their quality and resemblance to the original theme. This report provides a comprehensive overview of the method, implementation details, results, and evaluation of the project.

Introduction

The field of music generation has witnessed significant advancements in recent years after the significant development of AI algorithms. These algorithms allow computers to learn and replicate patterns in music, enabling the generation of both original and personalized compositions. The aim of this project was to use a 2nd order Markov chain algorithm to generate MIDI files based on the iconic Godfather theme.

Method

The 2nd order Markov chain algorithm was chosen because of its ability to capture higher-order dependencies in music. The Godfather theme was selected as the corpus, providing a rich musical foundation for the algorithm to learn from. Preprocessing of the corpus involved analyzing the different eight batches originally present in the input MIDI file, and extracting the melodic elements from the Piano melody part.

Then, a 2nd Markov Chain was implemented using a standard transition matrix and probability normalization, and a sequence of random melody pitches was generated based on the transition matrix.

Finally, the full score was generated by creating a melody composed of the sequence of the melody pitches mapped to a random duration pattern. automating a chord accompaniment succession (i iv i v), and applying simple bass drum rhythm.

Implementation

Implementing the project involved Python programming language and the music21 library. This library provided a robust set of tools for musical analysis, manipulation, and generation. The code used the music21 functionalities to create melodies, accompaniments, and drums based on the learned patterns from the Godfather theme. The code manipulated features such as the pitches, note durations, instruments, and tempo, allowing for the creation of diverse and personalized compositions.

Results and Evaluation

The generated MIDI files were evaluated for their quality and resemblance to the original Godfather theme. A selection of samples was analyzed to assess the algorithm's ability to capture the musical essence of the corpus. The evaluation took into consideration the melodic patterns, the coherence of the accompaniment, and the rhythmic accuracy of the drums. The results showcased the algorithm's capability to generate compositions that exhibited a strong resemblance to the original theme while incorporating variations, personal touches, and aesthetically-pleasing harmonies.

Conclusion

In conclusion, this project successfully applied a 2nd order Markov chain algorithm to generate MIDI files based on the Godfather theme. The implementation with the music21 library showed the algorithm's ability to capture musical patterns and create compositions reminiscent of the original theme. The output music showcased the potential of AI algorithms in music generation and highlighted both pros and cons of Markov Chains. Future work may include incorporating more complex musical elements, exploring hybrid approaches, and taking into consideration users’ preferences.