Project Milestone LaTeX Sheet

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1 Abstract

Machine learning algorithms are used for training data to fit the trained model to reproduce results that fit the intended use. These techniques have been applied to many fields, such as statistics, economics, and even classifying objects in images. The paper's goal is to show the various methods used by machine learning and data science enthusiasts, such as Recurrent Neural Networks, to generate music given training data.

2 Introduction

Music is one of the oldest of the arts known to man, and has most likely existed long before the dawn of man thanks to birds and other singing animals. Humans have been generating music for at least 18,000 years, as some of the earliest known songs come from religious hymns found in the Hindu Vedas. In the late 1940's, AT&T engineers were able to create the transistor, a component that would be integral in almost all modern electronics. Fast forward to today, and humans are able to train algorithms on data and have them reproduce the results in the data. Machine learning techniques can be applied to a wide variety of fields, not just computer and data science. One of these fields, one of humanity's oldest friends, is music. Machine learning techniques can be applied to the theory of music, and given training data, can reproduce, and even generate original music of its own. It's amazing that computing technology has advanced enough where we can program and teach algorithms to generate tones and melodies that we, ourselves, have been creating for thousands of years. If machine learning algorithms can generate music, pictures, art, etc, how long will it be until machine learning techniques will be able to replicate the human thought processes? This project intends to explore the machine learning techniques in conjunction with music theory principles used to generate music.

3 Background and other related work

A popular tool that machine learning specialists have used to generate music is the Music21 Python library. It's used for its ability to render musical notation given a MIDI file. This is useful for processing sound files to be used as training data. Recurrent Neural Networks are unique in the way that hidden neurons will take it's output and feed it back into itself for additional input. This property is useful to create time-invariant music, or, each note is produced in an iterative manner so it follows some time guide. The iterative property of RNNs is also good for producing notes, which in a song are produced to follow patterns. Some machine learning folk that use RNNs are the following,

`https://towardsdatascience.com/how-to-generate-music-using-a-lstm-neural-network-in-keras-68786834d4`

`http://www.hexahedria.com/2015/08/03/composing-music-with-recurrent-neural-networks/`

In another source that I have found,"Making Music: When Simple Probabilities Outperform Deep Learning", Haebichan Jung uses Music21 and the "Markov Process" to calculate the statistical probability in note relationships. He uses this to select a random note, then based on the probabilities of notes, selects the next note and repeats this process. This particular example is interesting, because Jung tries to keep in mind that melody and harmony need to be connected, something that the previous two machine learning scientists disregarded.

`https://towardsdatascience.com/making-music-when-simple-probabilities-outperform-deep-learning-75f4e`

These examples are all very useful, as they give diagrams of the models they use, and describe the theory behind the machine learning techniques such that even a layperson would understand. They also give examples of the outputs of their generated music, and it is very interesting to hear the differences in their outputs. The input data they all utilize is various piano music selections.

4 Methodology

For this project, I want to examine the different methods in which these scientists use to develop their machine learning generated music. They all have the Githubs to their projects, making it available to others.I would like to use input data of my own. Using different genres of music and experimenting with input data will hopefully produce interesting results.

5 Experiments

Like stated previously, I want to experiment with the input data and see how the models react to different instruments, like a guitar for example, or avant-garde piano music that throws away common musical conventions. One example of this is Charles Ives, an American composer that experimented with bitonality and atonality, meaning experiments in the key that the work is written in. Also, I would like to try and synthesize some of the ideas together to create a model that takes in account of the note probabilities and the RNN properties.

6 Sources

http://www.hexahedria.com/2015/08/03/composing-music-with-recurrent-neural-networks/
https://towardsdatascience.com/how-to-generate-music-using-a-lstm-neural-network-in-keras-68786834d4c5
https://towardsdatascience.com/making-music-when-simple-probabilities-outperform-deep-learning-75f4ee1b