Polyphonic music generation using machine learning algorithm.

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Abstract:
Music has enabled artists to express their inner feelings to the worlds. It expresses complex emotions of human mind to us. To create a musical piece is an intricate task which by far was not possible using machines. Machine learning algorithms have been used to compose music comparable to music composed by artists. Such system is capable of generating music in various styles. The music can be styled to specific genre using tuning. The developed system will create polyphonic music. Polyphonic music is composed of more than one note playing at a time.
The model will be developed using multi-dimensional linear regression which is an extension of linear regression. It is similar to simple linear regression but it has multiple independent variables contributing to dependent variables.
The model will be trained using music having polyphony and the output will be generated as per instruments selected by user.

Keywords: Machine learning, multi-dimensional regression, polyphonic music

Introduction:

Generating realistic pieces of music has been considered as one of the most exciting tasks in the field of AI. Recent years have seen major progress in generating images, videos and text using machine learning algorithm. Designing machine learning algorithm that produce human level music in the field of AI is difficult yet rewarding challenge. Music is combination of repeating notes over time. These notes are grouped as beats, bars, chords and measures. These repeating structures unfold over time to give us pleasant music. Categorization of music can be done as monophonic and polyphonic music which differ primarily in number of instruments or notes being used to compose musical structure. Monophonic music has a single melodic line without harmonies or melody. Polyphonic music on the other hand has more than one note being played at a time. We propose a model which is better in performance and generates music composed of more than one instrument unlike existing models.
Our main contribution is to introduce multiple tracks in a musical piece. We achieve this by combining output from five different models in such a way that overall harmonic balance is maintained. This model is beneficial for music composers to be inspired to compose original music which is yet not been produced. Also the raw output of this model can be used to customize music as per necessity. Multi-dimensional linear regression explains relationship between one continuous dependent variable and two or more independent variables. Multi-dimensional regression algorithms is useful for algorithms (such as Multi Layer Perceptron) as it enables you to train N separate MLP algorithms (one for each output signal) which might provide better mapping results than trying to train one MLP that can successfully map all N-dimensions at once.

Architecture:

The multi-dimensional regression class acts as a meta-algorithm for regression that allows several one dimensional regression algorithms (such as linear regression) to be combined together to allow a M-dimensional signal to be mapped to an N-dimensional signal. In addition to enabling one dimensional regression algorithms to be used for mapping N-dimensional signals, multi-dimensional regression can also be useful for multi-dimensional regression algorithms (such as MLP) as it enables you to train N separate MLP algorithms (one for each output signal) which might provide better mapping results than trying to train one MLP algorithm that can successfully map all N-dimensions at once. For our project, we have M=5 (previous 5 time steps) and N=5 (no. of instruments). The multi-dimensional regression algorithm is a supervised learning algorithm that can be used for any type of M-dimensional signal. The multi-dimensional regression algorithm is part of GRT regression modules.

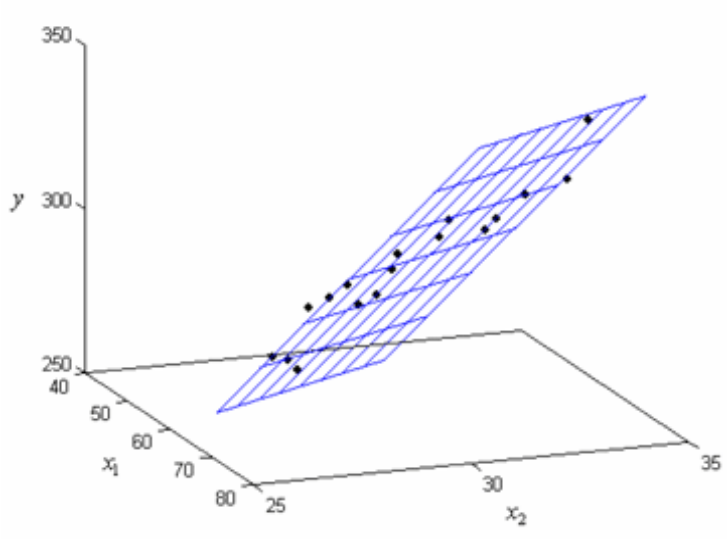

Fig. 1 Multi-dimensional regression

Algorithm:

We have divided the system in five models and each model is divided into three sub-models:

- Timer model
- Pitch model
- Velocity model

Here time model predicts the time at which note should be played, pitch model predicts the pitch and velocity model predicts the velocity of the pitch. All three sub-models present in five models are trained on three different features. This makes our system fifteen dimensional regression system.

Each model is fed five previous steps as input. The model learns relationship among input steps. These models can then be used to predict three different features time, pitch and velocity respectively. These features are then combined to give us dense matrix. This matrix is then converted to sparse matrix to be able to write MIDI file. This MIDI file is then fed to web user interface where user is logged in.

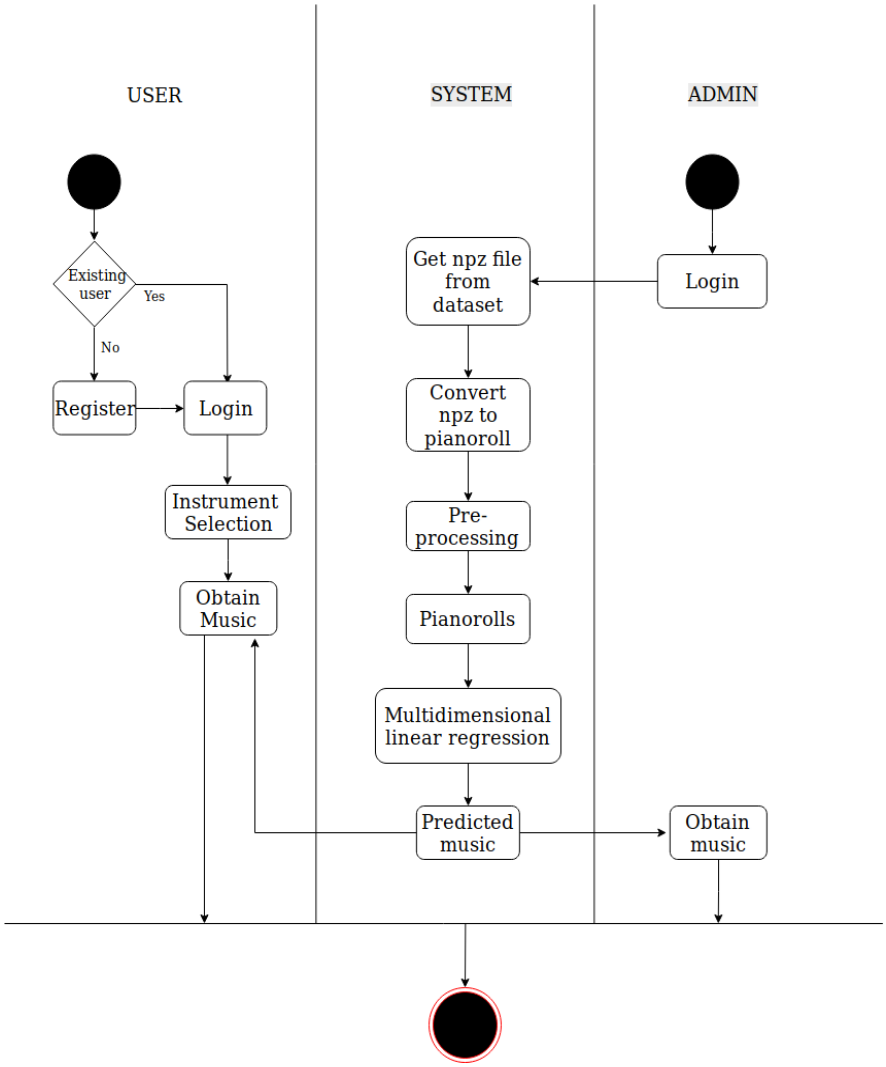

Fig. 2 Activity diagram

The activity diagram represents flow from one activity to another activity in the system.

Conclusion and future work:

A model with a goal of learning music using machine learning algorithm is created. It generates music composed of two or more instruments using multi-dimensional linear regression. The model developed is useful for music composers and filmmakers which will reduce time required to generate music. The system can also be used by novice users.

However we are unable to introduce long term musical structure. It would be interesting to use some addition to network which will solely focus on long term structure. In addition to that different representation of music should be developed to cut down training cost of model.

References:

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