Classical Composer Identification on Interval Features

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Overview

The purpose of this project was to assess the importance of musical intervals in determining the work of a given Classical composer. The works of five composers were evaluated: Bach, Beethoven, Chopin, Corelli, and Haydn. Optimal performance was achieved by inputting seventeen interval features into a three layer neural network. The output was a softmax classification that showed 83% accuracy.

Data

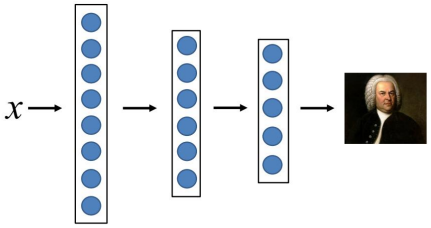
The dataset was compiled from MIDI Files from Kern Scores which is run by Stanford's Center for Computer Assisted Research in the Humanities and was preprocessed through the online open-source tool called jSymbolic. A total of 1341 total samples were collected across the five composers. The total distribution among the five composers was not even because of the availability of scores from the Kern. The data was divided into 150 for test and development each and the rest in train.

Features

The features for the model were 17 types of intervallic data based on the MIDI files. Features were assembled through the open-source program jSymbolic and evaluated as percentages or a fixed number between 1-12 to represent a note.

-Most Common Melodic Interval
-Mean Melodic Interval
-Number of Common Melodic Intervals
-Distance Between Most Prevalent Melodic Intervals
-Prevalence of Most Common Melodic Interval
-Relative Prevalence of Most Common Melodic Intervals
-Chromatic Motion
-Stepwise Motion
-Melodic Thirds
-Melodic Perfect Fourths
-Melodic Tritones
-Melodic Perfect Fifths
-Melodic Sixths
-Melodic Sevenths
-Melodic Octaves
-Melodic Large Intervals
-Minor Major Melodic Third Ratio

Model



The model above was the best performer of the models tried. It uses Adam optimization, L2 regularization with weight decay of .005, learning rate of .001, mini-batch size of 64, and epochs of 900. It uses a softmax classification for the five classes (i.e., composers) evaluated. Other models used similar parameters. The loss function is as follows:

$$\mathcal{L} = -y \log \hat{y}$$

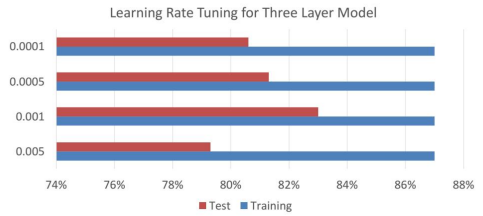
Discussion

This problem was best addressed with a shallower neural network. A breakdown of the F1 scores from the three layer model (the best performer) showed that the model was excellent at predicting works from Bach. This is in accordance with expectations since Bach had the most available data. Interestingly, Beethoven was the poorest performer; the model had a difficult time in both precision and recall. There are two possible explanations for this: 1) there were fewer examples of Beethoven, and 2) Beethoven's musical output was much more varied over the course of his life relative to the other composers and thus could lead to a much less consistent "profile" for the features. My overall results are in line with current research given a limited feature set; when compiled with 141 features of different categories, 95% accuracy can be achieved.

Results

The train set: 1041; Dev set: 150; Test set: 150 (all same distribution)

Model	Train Accuracy	Test Accuracy
Logistic Regression	73%	73%
Two Layer	82%	79%
Three Layer	**87%**	**83%**
Four Layer	84%	77%



Future

Given more time for the project, I would collect more data from the given composers (Kern does not contain MIDI files for all works by the composers) as well as incorporate more classes of other composers. Moreover, it would be interesting to classify composers on other subsets of features such as instrumentation, melodic choice, harmony, etc. to see what kind parameters are most important for composer identification.

References

[1] Kaliakatsos-Papakostas, Maximos & Epitropakis, Michael & Vrahatis, Michael. (2010). Musical Composer Identification through Probabilistic and Feedforward Neural Networks. Lecture Notes in Computer Science.6025. 411-420. 10.1007/978-3-642-12242-2_42.