Algorithmic Composition of Classical Music through Classification

Tom Donald Richmond

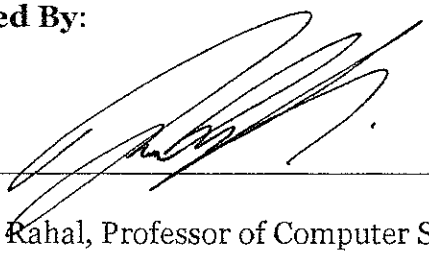
College of Saint Benedict and Saint John's University

15th October 2017

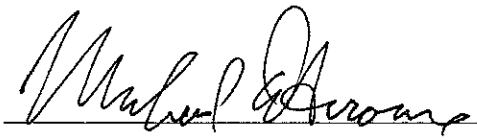
Algorithmic Composition of Classical Music through Classification

By Tom Donald Richmond

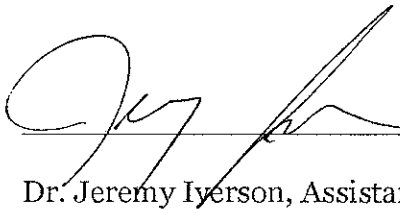
Approved By:



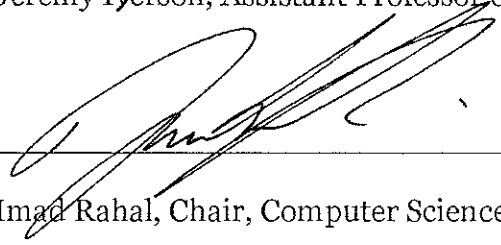
Dr. Imad Rahal, Professor of Computer Science



Dr. Mike Heroux, Scientist-in-Residence of Computer Science



Dr. Jeremy Iverson, Assistant Professor of Computer Science



Dr. Imad Rahal, Chair, Computer Science Department

Molly Ewing, Director, All-College Thesis Program

Jim Parsons, Director, All-College Thesis Program

Statement of Purpose:

The purpose of this project is to explore the capabilities of an algorithmic classical music composition system based upon the data mining technique of classification. Being able to base this composition process upon data derived from classification takes automation one step further, allowing the computer to understand out how to compose the music itself without the necessity of a human to feed the computer information about how to compose.

Preliminary Outline:

The first part of my thesis will focus on the research that has preceded this project, and was necessary to the development of this system. Preliminary research was conducted on the state of the field of algorithmic music composition, as well as music classification techniques. This search included finding acceptable datatypes for processing, accuracy of respective classification techniques, and proposed music generation techniques. To demonstrate the potential of an algorithmic composition process based upon classification, a system has been devised with the following premise:

A large number of **kern files (textual representations of musical scores), are parsed using Linux command lines and a toolkit called Humdrum, extracting the frequency with which each interval class occurs (from unison intervals to octave intervals). These frequencies are then used as the attributes, to be fed into a chosen classifier to predict a class.

The classifier splits our **kern files into 6 distinct classes, one for each era of classical music: Medieval, Renaissance, Baroque, Classical, Romantic, and Modern. After analyzing the accuracy, results and outputs of many classification methods, including SVMs, Logistic Regression, Decision Trees, and rule based classifier models, the model chosen to proceed with the composition process was a Naïve Bayes approach, which had upper tier accuracy (82% ROC), as well as a relatively easy to understand output, which is friendly to the generation process.

These results are then merged with a four-cell-wide cellular-automata-inspired system, using 0 and 1 states to represent a four-bit binary number, which is then mapped to a certain note value (0001 is C, 0010 is C#/D-, etc.). The user interacting with the system selects the era of music they wish to replicate in their composition. With rules derived from the Naïve Bayes classifiers results, a new binary sequence is generated to represent the likely next note in sequence, based upon the previous note value. This process is continued, with a visual and audible output that proceeds linearly with the composition process until told to terminate.

The results of the composer are then calculated upon termination, and run back through the classifier to see if the composition will be correctly classified according to the desired era of composition. Future trends and works are then explored.

Preliminary Bibliography.

1. J. Lan and A. Saied. "Music Classification by Composer," *Stanford*. 2012.
2. D. Chiu, et al., "Bartok: Music Time Period Classification".
3. R. Basili, et al., "Classification of Musical Genre: A Machine Learning Approach," *Universitat Pompeu Fabra. Roma*. 2004.
4. W. Herlands, et al., "A Machine Learning Approach to Musically Meaningful Homogeneous Style Classification," *AAAI Conference on Artificial Intelligence. Association for the Advancement of Artificial Intelligence*. 2014.
5. D. Herremans, et al., "Classification and Generation of Composer-Specific Music Using Global Feature Models and Variable Neighborhood Search," *Computer Music Journal*, vol. 39, no. 39, 2015, pp. 71-91.
6. M. Alfonseca, et al., "A Simple Genetic Algorithm for Music Generation by means of Algorithmic Information Theory," *2007 IEEE Congress on Evolutionary Computation*. 2007.
7. J. Lebar, et al., "Classifying Musical Scores by Composer: A machine learning approach," *Stanford*. 2008.
8. L. Mearns, et al., "Characterisation of composer style using high-level musical features," *Proceedings of 3rd international workshop on Machine learning and music*, Firenze, Italy. ACM. 2010 pp.37-40.
9. C. McKay and I. Fujinaga, "Automatic Genre Classification Using Large High-Level Musical Feature Sets," *Universitat Pompeu Fabra*, 2004.
10. J.D. Fernandez and F. Vico, "AI Methods in Algorithmic Composition: A Comprehensive Survey," *Journal of Artificial Intelligence Research*, vol. 48, 2013, pp. 513-582.
11. J.D. Fernandez and F. Vico, "AI Methods in Algorithmic Composition: A Comprehensive Survey," *Journal of Artificial Intelligence Research*, vol. 48, 2013, pp. 513-582.
12. M. Edwards, "Algorithmic Composition: Computational Thinking in Music," *Communications of the Acm*, vol. 54, no. 7, 2011, pp. 58-67; DOI 10.1145/1965724.1965742.
13. T. Collins, et al., "Developing and evaluating computational models of musical style," *Ai Edam-Artificial Intelligence for Engineering Design Analysis and Manufacturing*, vol. 30, no. 1, 2016, pp. 16-43; DOI 10.1017/s0890060414000687.
14. I.D. Matic, et al., "Automatic Melody Generation using Neural Networks and Cellular Automata," *Eleventh Symposium on Neural Network Applications in Electrical Engineering (Neurel 2012)*, 2012.
15. P. Tan, et al. *An Introduction to Data Mining*. Pearson Nueva Delhi (India). 2016.

Four Sentence Proposal Summary:

This project aims to further automate algorithmic music composition techniques through the use of classification. Musical scores are classified into respective epochs with a Naïve Bayes system based upon the frequencies of certain interval classes occurring within the piece, and the results are used in conjunction with a cellular-automata inspired system to generate classical music. The results are then run through the same classifiers to see if they are still classified according to the desired era dictated upon composition. The system shows the potential of fully automating such a composition system, and approaches the task by means of hybridizing two fields that have already drawn significant interest.