Musical Creativity Tool "Open Melody"

Raymond Whorley and Robin Laney
The Open University

Abstract

We have recently written a software tool for amateur musicians whose desire to compose is thwarted by their limited musical knowledge or ability. Three musical styles are available as a result of machine learning from small J. S. Bach, W. A. Mozart and Charlie Parker corpora. Specific multiple viewpoint systems (Conklin & Witten, 1995) were constructed for each style by means of an automatic viewpoint selection procedure (Pearce, 2005) that seeks to minimise the mean cross-entropy of an n-fold cross-validation of a corpus. In conjunction with this, the maximum length of variable-length n-grams was optimised: prediction probability distributions of variable-length n-grams are constructed by Prediction by Partial Match (Cleary & Witten, 1984) from counts of n-grams from maximum-order down to 0^{th}-order (no context), or even to the uniform distribution if necessary. Rather than generating complete pieces from viewpoint systems, we generate phrases that are assembled into a piece (Collins & Laney, 2017), as a way of ensuring repetitive and phrasal structure.

Relevant parts of the main Common Lisp program (developed from previous work, including the implementation of rests) are accessed by means of a Java (Swing) graphical user interface. The user can choose musical style, key, time signature, starting beat and number of bars per phrase. Musical phrases are then generated one at a time as MIDI files by random sampling of the prediction probability distributions, modified by the use of probability thresholds (Whorley et al., 2013) to reduce the likelihood of malformed phrases. Iterative random walk (Whorley & Conklin, 2016b) is not used, primarily because it takes too long for an interactive application. The user listens to a phrase by pressing 'play' in the application (or by opening the relevant MIDI file in a separate scoring/sequencing program), and then either accepts it as fit for purpose or rejects it.

When at least five phrases have been accepted and at least five rejected, the user is given suggestions as to the suitability of phrases (which, of course, may be ignored). The suggestion is arrived at by creating models by machine learning of the "accept" and "reject" corpora, and then determining the cross-entropy of a generated phrase with respect to both of these models. If the "accept" cross-entropy is lower than the "reject" cross-entropy, it is suggested that the phrase might be suitable. A phrase is automatically rejected (but not added to the "reject" corpus) if its final note is not in the tonic triad (or the dominant triad for a contrasting phrase: see below).

When the user considers that sufficient suitable phrases have been saved, a succession of contrasting phrases (Laney et al., 2015) are generated and dealt with in the same way. The pitch probability distributions are modified in a consistent way such that truly contrasting phrases are more likely to be generated. The next step is to assemble a complete piece of music. The user can try different combinations of phrase A and contrasting phrase B, played from the application in AABA form. When the combination is satisfactory, the user enters a name for the piece and then saves the piece as a MIDI file. Further such pieces may be assembled, or the user may choose to start from scratch with a different set of inputs (musical style, key and so on). In future work, it would be possible to provide the user with a choice of harmonic templates to guide the generation of subject and contrasting melodies (Whorley & Conklin, 2016a).

References

Cleary, J.G., & Witten, I.H. (1984). Data compression using adaptive coding and partial string matching. *IEEE Transactions on Communications, COM-32* (4), 396–402.

Collins, Tom and Laney, Robin (2017). Computer-Generated Stylistic Compositions with Long-Term Repetitive and Phrasal Structure. *Journal of Creative Music Systems*, 1(2)

Conklin, D., & Witten, I.H. (1995). Multiple viewpoint systems for music prediction. *Journal of New Music Research, 24* (1), 51–73.

Laney, Robin; Samuels, Robert and Capulet, Emilie (2015). Cross entropy as a measure of musical contrast. In: Collins, Tom; Meredith, David and Volk, Anja eds. *Mathematics and Computation in Music.* Lecture Notes in Computer Science (9110). Cham, Switzerland: Springer International Publishing, pp. 193–198.

Pearce, M.T. (2005). *The construction and evaluation of statistical models of melodic structure in music perception and composition* (PhD thesis). Department of Computing, City University, London, UK.

Whorley, R.P., & Conklin, D. (2016a). A transformational method for chorale generation. In *Proceedings of the 9th International Workshop on Machine Learning and Music,* pp. 71–75, Riva del Garda, Italy.

Whorley, R.P., & Conklin, D. (2016b). Music generation from statistical models of harmony. *Journal of New Music Research, 45* (2), 160–183.

Whorley, R.P., Wiggins, G.A., Rhodes, C., & Pearce, M.T. (2013). Multiple viewpoint systems: Time complexity and the construction of domains for complex musical viewpoints in the harmonization problem. *Journal of New Music Research, 42* (3), 237–266.