A Mental Model for Algorithmic Music Composition

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Abstract

A theory exists by L. B. Meyer[1] that the human brain enjoys listening to mid-complex melodies as opposed to very simple or overly complex patterns. The mid-complex melodies can be empirically calculated using the second law of thermodynamics; entropy. The simplest mental model for the way we reason about patterns and complexity is explained by Philip N. Johnson-Laird[2] and is based on the Turing machine. Using a similar technique called, cellular automata, it is possible to come up with patterns or sets, that exhibit both stability and chaos. These particular sets have the potential to produce beautiful sounding melodies. A set can be defined as a collection of objects. In Racket you can think of a set as a list where each object of the set is an element or member. In algorithmic composition, sets or collection of pitches can be manipulated to achieve a compositional result. Racket provides a number of functions that perform operations on lists or sets that are very useful in composing music based on sets. At a more applicable and refined level, the hexachord is a set class with six elements. In the twelve-tone technique, a transformation technique developed by Arnold Schoenberg, all twelve notes of the chromatic scale have equal weighting or importance. There are also variations of the twelve-tone technique based on derived sets which can contain invariant tones with respect to the initial hexachord. These techniques are used to illustrate the principle of combinatoriality, a side effect of a derived row. Combinatorial and semi-combinatorial properties are not dependent on the order of the notes within a set, only on the content of the set, such as two hexachords. This side effect is used to form aggregates, a representation of all twelve tones. There are four main types of combinatoriality; prime, retrograde, inversion, and retrograde-inversion. Semi-combinatorial sets are sets whose hexachords are capable of forming an aggregate with one of these basic transformations. We will concentrate on hexachordal sets that are inversions of the prime. Inversional-combinatoriality is a relationship between two rows, a principal row and its inversion. The principal row's first half, or six notes, are the inversion's last six notes, and not necessarily in the same order. The first half of each row is the other's complement. When combined, these rows still maintain a fully chromatic feeling and don't tend to reinforce certain pitches as tonal centers. For example, using Racket functions, the row, 0 1 3 4 6 9, inverts to, 0 e 9 8 6 3, then add eleven and generate the complement, t 8 7 5 2. Thus forming the twelve-tone row; 0 1 3 6 9 t 8 7 5 2. An aggregate or complete twelve-tone matrix can be produced and rows or columns can be chosen for a melody; one that can act as a computer program and propagate over time under a set of rules in cellular automata and constrained by the second law of thermodynamics.

1. Meyer, L. B. (1956). *Emotion and meaning in music*. Chicago: University of Chicago Press.

2. Philip N. Johnson-Laird (1983). *Mental Models*. Harvard University Press.