

Music and Algorithms

Lecture I 19.04.06 (PC)

Introduction and Course Overview

What is an algorithm?

Etymology – Process (French) vs Numerical (Arabic)

Arithmós (Gr. ‘number’) and *algorism* (Ar. ‘number series’). *Algorithm* is thought to be a corruption of algorism referring to the rules of performing arithmetic using Arabic numerals (cf Abu Ja’far Mohammed ibn Musa al-Khwarizmi: *Rules of Restoration and Reduction from the 9th century* (Rosen, 1988, p.49ff).

Definitions and Interpretations

Today defined as ‘a set of rules for solving a problem in a finite number of steps’ (Webster 1991, p.35) ‘A set of instructions or steps designed to provide a method of solving a problem or achieving a result; a step by step method for solving a problem, often in the form of a flow chart’ (Chambers 1997). We use algorithms whenever we reduce an activity to a series of rules or instructions that automate that activity (Ames 1987; Buxton 1978; Cope 1991a; Sedgewick 1983). The key word here is possibly ‘reduce’! *Explicit algorithms*, such as speech – a complex activity accomplished by a set of mental rules or instructions – need to be distinguished from *implicit algorithms* (involuntary actions, which nonetheless follow rules). Explicit written algorithms that do not use computers are often called *paper algorithms*.

Uses in music

Formalisation / Stylistic constraint

Many aspects and compositional techniques of music can be defined as algorithmic.

Basic algorithms can include: composing is specific scales / modes.

More complex algorithms include using specific application of such scales / modes following the varying ‘rules’ of theory, harmony, counterpoint etc.

More complex still are those processes that involve composing according to algorithms of strict form, such as canon or fugue.

The most complex of all, and arguably only algorithmic to a limited extent involve composition that follows ‘free’ forms such as ‘sonata form’.

(Meistersingers example at this point!)

Process, Rationalisation, Creation

In terms of computer application / extension of these parameters, a distinction needs to be drawn between a) programs / systems that seek to replicate these processes in specific pre-existent styles; b) those that seek to understand /

analyse ('rationalise') the grammar of pre-existent compositions and c) those that seek to replicate or even replace the human creative process, sometimes without regard to previous conventions / styles.

Examples of a) include: Biles *Genjam* (1994)

Examples of b) include: Allen Forte's pitch class set analysis (cf *The Structure of Atonal Music*; *The Harmonic Organization of The Rite of Spring* etc.)

Examples of c) include: Tim Blackwell *Swarm music* (2003)

(Perhaps something on Genetic Algorithms to conclude)

References /Further Reading

- **Biles, J.A.** *Genjam: A genetic algorithm for generating jazz solos*. In *Proceedings of the International Computer Music Conference*, pp.131-137. Aarhus, Denmark. Available online at: <http://www.it.rit.edu/~jab/GenJam94/Paper.html> (1994)
- **Blackwell, T.** *Swarm music: improvised music with multi-swarms* In *Proceedings of the AISB 03 Symposium on Artificial Intelligence and Creativity in Art and Science*, pp.41-99. University of Wales UK (2003)
- **Burton, A.R and Vladimirova, T.** *Generation of musical sequences with genetic techniques* In *Computer Music Journal*, 23(4), 59-73 (1999)
- **Cope, D.** *Computer Modeling of Musical Intelligence in EMI*. *Computer Music Journal*, 11(4): 30-46 (1991)
- **Cope, D.** *The Algorithmic Composer* A-R Editions, Inc., especially chapter 1, pp 1-37 (2000)
- **Forte, A.** *The Structure of Atonal Music* New Haven and London (1973)
- **Forte, A.** *The Harmonic Organization of The Rite of Spring* New Haven and London (1978)
- **Gartland-Jones, A. and Copley, P.** *The Suitability of Genetic Algorithms for Musical Composition* In *Contemporary Music Review*, 2003, Vol.22, No3, 33-55