David Cope: Experiments in Musical Intelligence

Part I of 2

David Cope



Intellectual models adapted by Cope for algorithmic composition

Computers and Musical Style
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- Components from sound synthesis c. 1990
- Components from algorithmic activities in 1980s
- Components from music pedagogy
 - New Music Composition (1977)
 - Experiments in Musical Intelligence (1996, included code and exs.)
 - Techniques of the Contemporary Composer (RE 1945-1975)
 - Virtual Music: Computer Synthesis of Musical Style (2004, lots of Emmy examples)
 - Paperbacks containing 371 Chorales, Books I and II of Well-Programmed Clavier (2015) and many more—all produced by Emmy



Experiments in Musical



Historical models of composition

- Celestial
- Empirical
- Dialectic
- Algorithmic/Aleatoric

Boethius (6th cent.): tonal relations







Zarlino (1559): correspondences of planets, muses, modes

Music = science of moving tones

- Seven liberal arts
 - Grammar Rhetoric Logic
- Role of music in the quadrivium [sciences]
 - Astronomy astrology geometry – music
 - Music = science of moving tones



Empirical models of music (*c***1750)**

- Empower composers to master rules
- Give listeners access to moral precepts
- Rise of computational theories
 - Harmony: J.D. Heinichen (1711, 1728)
 - Counterpoint: J. J. Fux (1725)
 - Melody, mechanical rules of: H. C. Koch (1793)

Probability theory: Musical dice games (c1800)

- Games of chance
- Games of skill



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2.	Wal	zer	tei

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10	65	77	19	82	137,	38	149	8
11	102	4	31	164	144	59	173	78
12	35	20	108	92	12	124	44	131

Cf: Music 253/CS 275A, Week 10

Experiments in Musical Intelligence (EMI)

- UC Santa Cruz, 1980-2008
- David Cope, professor emeritus
- Sought tool to make recommendations for own compositions
- Programming in Common Lisp on Mac (several Op Sys prior to OSX)
- Nickname changed from EMI to Emmy (at request of EMI)





Experiments in Musical Intelligence (EMI): Components

Main components

- 1. Style: **Human** separation of composers, genres, performance media
- 2. Consideration of grammars for each
- 3. Recursive identification of "signatures"
- 4. Creation of feature lexicons
- 5. Generation of new works

1. Musical style

• Cope: Features in common between two or more works by the same composer

1a. What is a musical signature?

• A short passage occurring in two or more works by the same composer with the same intervallic content.

1b. From signatures to lexicons

- Lexicons store **signatures** by composer and genre
- Signatures have associated approach/departure information
- Signatures stored by grammatical function

Brest overview: Patricio da Silva (Greece) https://eclass.uoa.gr/modules/document/file.php/MUSIC124/ %CE%94%CE%B9%CE%B1%CE%BB%CE%AD%CE%BE%CE%B5% CE%B9%CF%82/da-silva-david-cope-and-emi.pdf

2. Musical grammar as an Augmented Transition Network (ATM)

- Musical grammar as an augmented transition network:
- Variables defined by grammatical function

type of bird roasting in the _____ downstairs. I room in a house _ down the stairs to see if I could verb (past tense) help _____ the dinner. My mom said, verb "See if ______ needs a fresh ______." So I relative's name noun carried a tray of glasses full of _____ into a liquid the _____ room. When I got there, I verb ending in -ing couldn't believe my _____! There were part of the body (plural) on the ____! plural noun verb ending in -ing noun

2. Musical grammar as an ATM

adjective type of bird roasting in the _____ downstairs. I room in a house ____ down the stairs to see if I could verb (past tense) help _____ the dinner. My mom said, verb "See if ______ needs a fresh ______." So I relative's name noun carried a tray of glasses full of _____ into a liquid the _____ room. When I got there, I verb ending in -ing couldn't believe my _____! There were part of the body (plural) on the _____! plural noun verb ending in -ing noun

SPEAC grammar

[parts of speech]

- Statements
- Preparations
- Extensions
- Antecedents
- Consequents

Musical generation overview



Recombination: Synthesize features of two or more works in same style



Emmy's genetic results

- Signatures = composer's (or genre's) "genes"
- Genes can be coupled in myriad ways ("combinatoriality")
- Combinations governed by **rules**

Recombinant music



Emmy's interactive apparatus

Experiments in Musical Intelligence=Emmy Original software in Franz Lisp User-governed features:

- genre
- composer
- key, mode
- many more

Music-theoretic rules can be implemented in pertinent genres

Cope's overview of Emmy (2015, Computer History Museum)





https://youtu.be/yFImmDsNGdE

Extra examples....

- <u>https://www.youtube.com/watch?v=PczDLl92vlc</u>
 - Bach chorale

Classical Music Composed by Computer Experiments in Musical Intelligence David Cope CRC 3109 CRC 3109

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- <u>https://www.youtube.com/watch?v=CgG1HipAayU</u>
 - Beethoven symphony
- <u>https://www.youtube.com/watch?v=2kuY3BrmTfQ</u>
 - Vivaldi: 12 short pieces