



From Emmy to Emily Howell: The Work of David Cope



CS 275B/Music 254

Experiments in Musical Intelligence

1980-2006

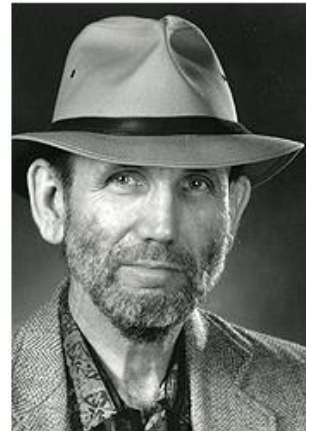
Emmy (overview)

► Background

- Exploratory work: 1980-85 (mainly on a Mac in Lisp)
- Originally employed augmented transition network (ATN); linguistic model
- Developed its own grammar: SPEAC

► Main steps

- Encoding (basis = MIDI)
- Classification by genre
- Parsing of encoded works into signatures
- Storage of signatures in genre-specific, composer-specific lexicons
- Generation of new pieces in specific genre and style



Formative influences



David Cope at work in his California home. Photograph: Catherine Karnow for the Observer

Observer, 2010: “You pushed the button and out came hundreds and thousands of sonatas...”

<http://www.guardian.co.uk/technology/2010/jul/11/david-cope-computer-composer>



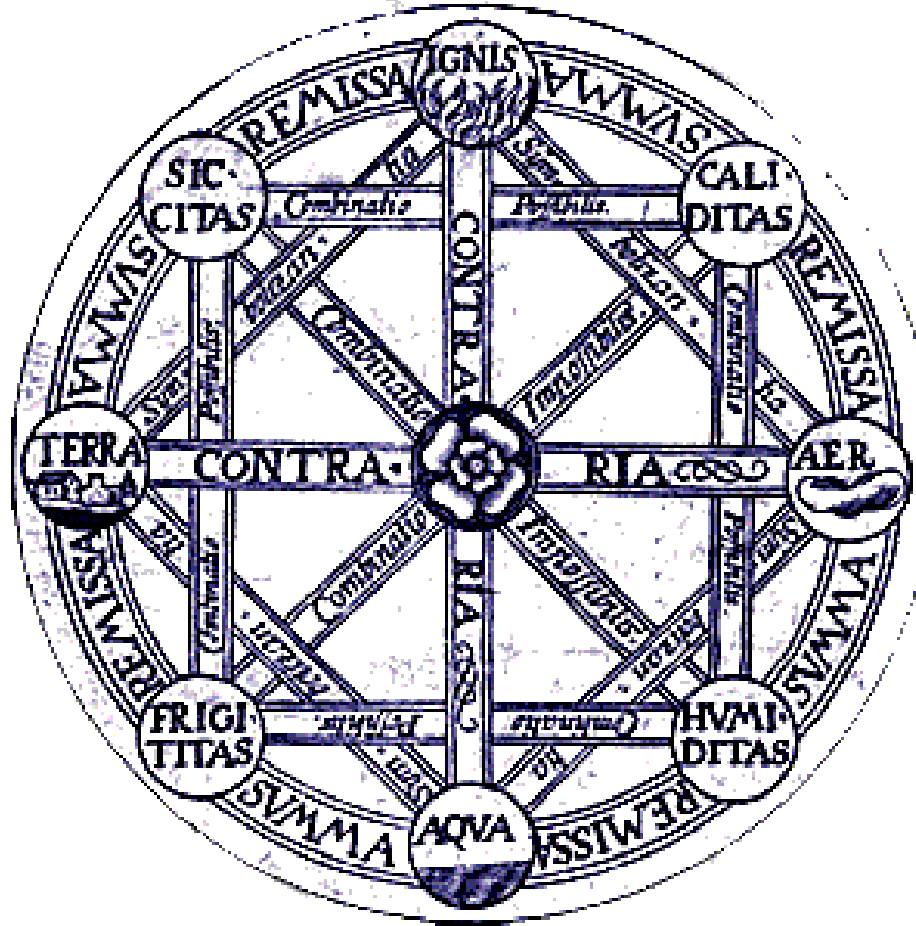
Wind chimes (L)
Rhythmicon (top)
Aeolian harp (below)

Aleatoric
instruments



Process: Ars combinatoria

Leibniz:
Dissertation
1690



Rationale for
binary logic "of the
universe"

Musical dice games



Sample dice game:

96	22	141	41	105	122	11	30
32	6	128	63	146	46	134	81
69	95	158	13	153	55	110	24
40	17	113	85	161	2	159	100
148	74	163	45	80	97	36	107
104	157	27	167	154	68	118	91
152	60	171	53	99	133	21	127
119	84	114	50	140	86	169	94
98	142	42	156	75	129	62	123
3	87	165	61	135	47	147	33
54	130	10	103	28	37	106	5

70	121	26	9	112	49	109	14
117	39	126	56	174	18	116	83
66	139	15	132	73	58	145	79
90	176	7	34	67	160	52	170
25	143	64	125	76	136	1	93
138	71	150	29	101	162	23	151
16	155	57	175	43	168	89	172
120	88	48	166	51	115	72	111
65	77	19	82	137	38	149	8
102	4	31	164	144	59	173	78
35	20	108	92	12	124	44	131

<http://www.schott-music.com/wuerfelspiele/tabelle.htm#>

Augmented transition network

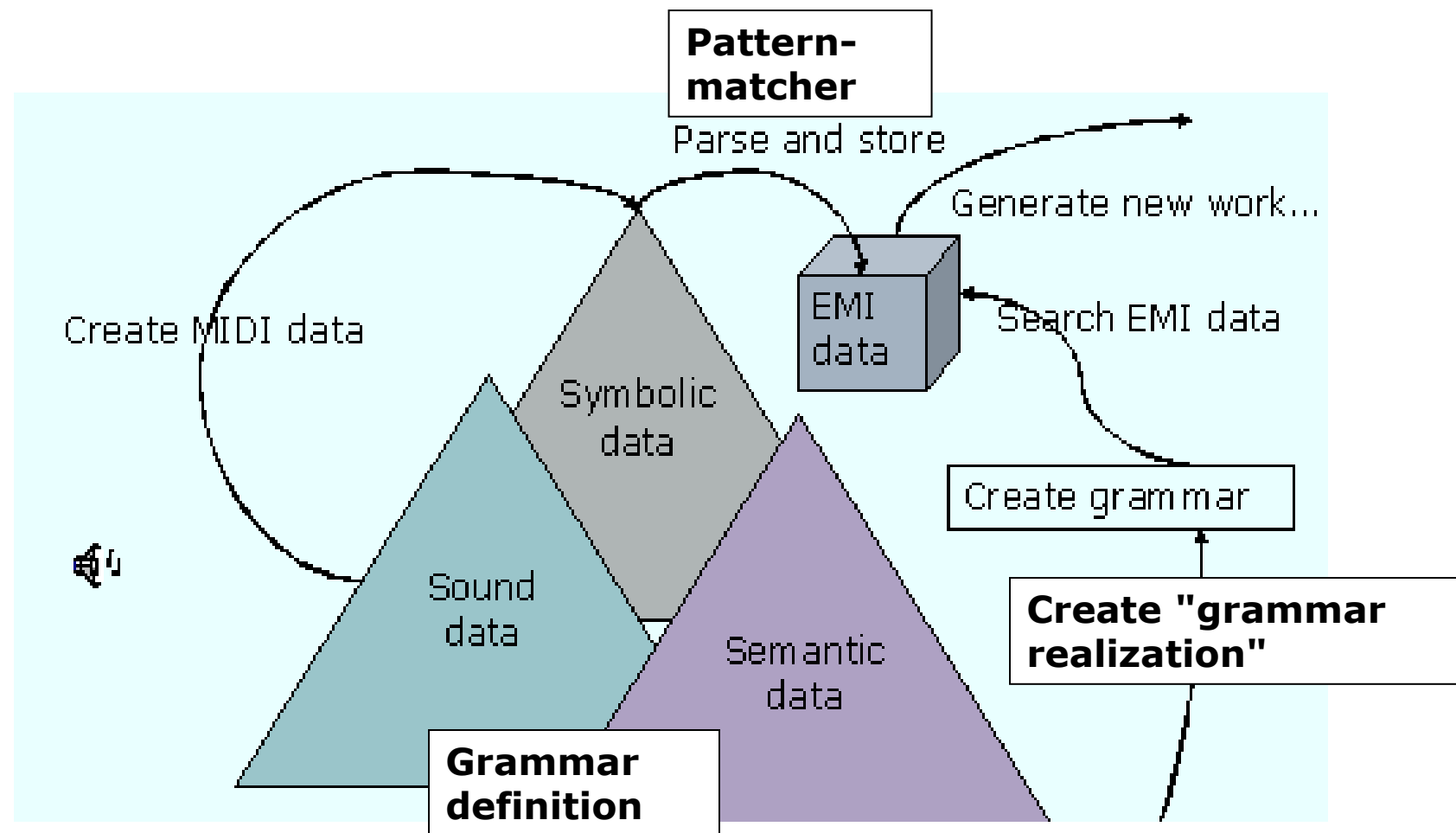
Once upon a time there was a _____ (adj.) _____
(noun). ____ (pronoun) lived in a giant _____ (noun).
One day a _____ (noun) came along. ____ (pronoun)
wanted to know whether _____ (pronoun) could
_____ (verb) in the _____ (noun).

- *nouns*
- *adjectives*
- *pronouns*
- *verbs*

Computer implementation (Emmy's SPEAC)

- ▶ Select a repertory (one composer, one genre)
- ▶ Encode several pieces
- ▶ Parse them into five elements of musical grammar
 - ▶ Statements
 - ▶ Preparations
 - ▶ Extensions
 - ▶ Antecedents
 - ▶ Consequents
- ▶ Discover and store “signatures” (identify “earmarks”)

Experiments in Musical Intelligence

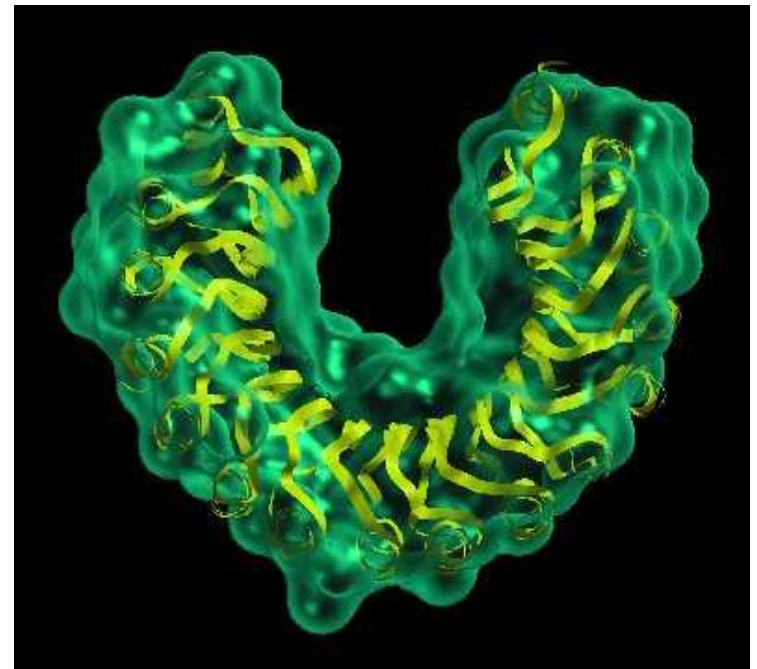


EMI's grammatical parts

- SPEAC
 - Statements
 - Preparations
 - Extensions
 - Antecedents
 - Consequents
- BEAD model (genetic algorithms/lattices)

“recombinant music”

**Structural encodings
enabling fluid sequencing**



Signature properties

- ▶ Are relatively **short** (2-5 events)
 - ▶ Are shorter than themes
 - ▶ Are stored with **approach** and **departure** info
 - ▶ Are described by intervallic relationships
 - ▶ Are **not** described by key or mode
-
- ▶ **Lexicon built by recursion**

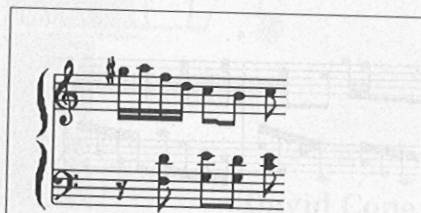
Signature specification (pattern matching)

- ▶ Appropriate motives

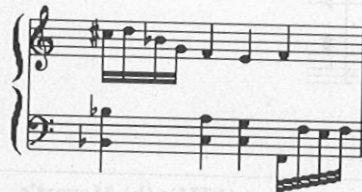
- ▶ No. of events = 2-5
- ▶ recurrence
 - ❑ < 3 times
 - ❑ Less than ubiquitously
 - ❑ Not pervade all pieces

Signatures

Sample signatures



(a)



(b)

Figure 4. Two versions of a Mozart signature from (a) K. 330 and (b) K. 547a.

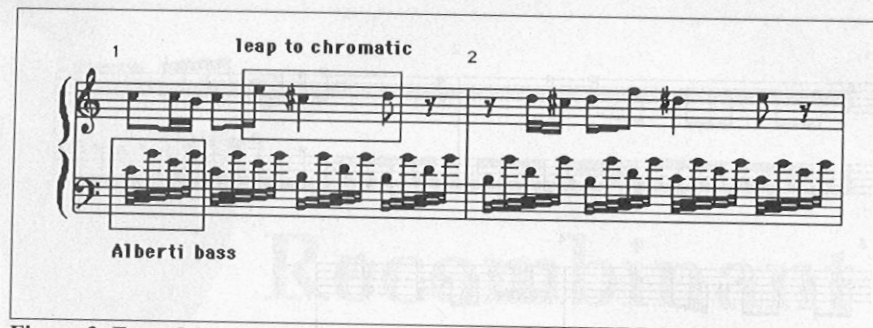


Figure 3. From Mozart's Sonata K. 279, first movement (1774).

Signatures

Composer specific

Genre specific

Movement specific

Texture specific

The image displays two musical score excerpts, labeled (a) and (b), each consisting of two staves (treble and bass clef). Excerpt (a) shows measures 1 through 4 of the second movement of Mozart's Sonata K. 283. Excerpt (b) shows measures 1 through 8 of the third movement of Mozart's Sonata K. 330. The notation includes various musical symbols such as notes, rests, and bar lines.

(a)

(b)

Figure 1. From (a) Mozart's Sonata K. 283, second movement (1774); (b) Mozart's Sonata K. 330, third movement (1778).

Lexicon (stores)

- **Individual** signature information
- **Approach** information
- **Departure** information
- **Relationship** information



Figure 2. Random recombinant music and its analysis. “A” here refers to Figure 1a, “B” to Figure 1b; the numbers represent the location, first by the measure number and then by the beat number.

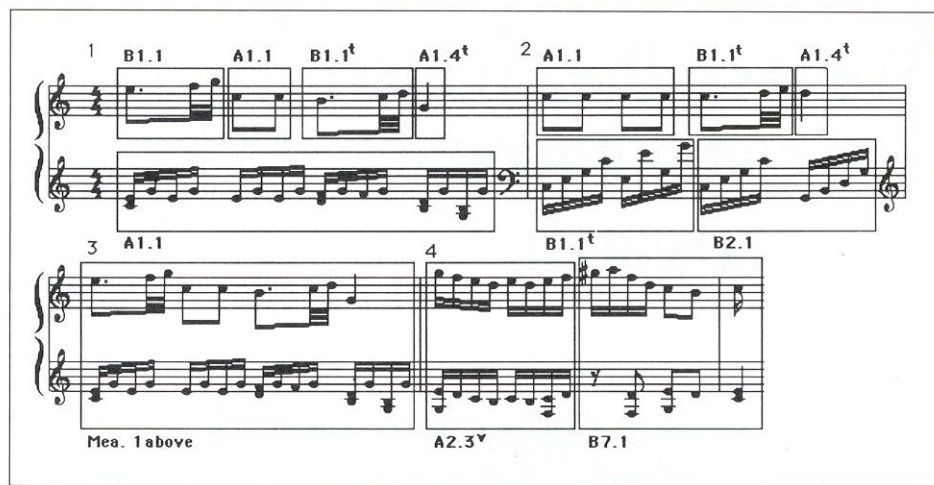


Figure 6. EMI's recombination of segments in Figure 5, with signature (B7.1) and suggested sources (t = transposition; v = variation).

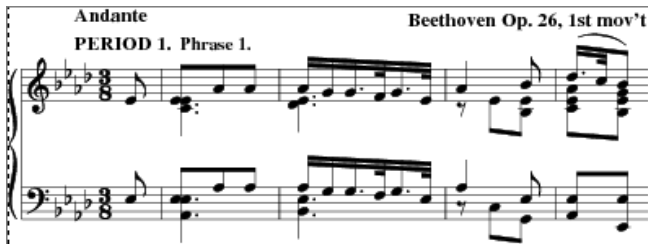
Composer = Mozart
Genre = Piano sonata
Movement type = Allegro

SPEAC Grammar

Statement plus extension

Andante
Beethoven Op. 26, 1st mov't

PERIOD 1. Phrase 1.



Antecedent/consequent structure

Allegretto.
Beethoven Op. 32, No. 3, 2nd mov't

Antecedent Phrase.

Semi Cadence

Consequent Phrase.

Perfect Cadence



Listening to recorded SPEAC examples

▶ Bach invention



▶ Bach Brandenburg



▶ Chopin Mazurka



▶ Brahms Deutsches Requiem



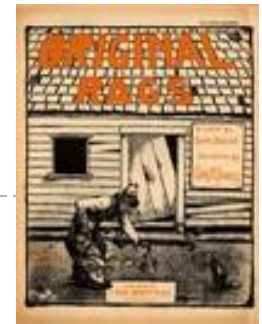
▶ Joplin rag



EMI examples

Joplin

Exp. Mus. Intell.



Ways of experiencing Emmy

- ▶ Listening to MIDI performances
- ▶ Listening to live performances
- ▶ Viewing the notated music
- ▶ Performing the music

<http://artsites.ucsc.edu/faculty/cope/mp3page.htm>

Reactions to EMI

From MIDI files

- ▶ “Mechanical”
- ▶ Too fast
- ▶ Too slow
- ▶ Too soft
- ▶ Too loud
- ▶ Not human

From live concerts

- ▶ That’s by a computer?

1. Adagio (♩ = 72)

Flutes *ff* zu 2

Oboes *ff* zu 2 *p*

Clarinets in Bb *ff* zu 2

Bassoons *ff* zu 2 *p*

Horns in F *ff* zu 2

Trumpets in Bb *ff*

Timpani *ff*

Violin I *ff* *p*

Violin II *ff* *p*

Viola *ff* *p*

Cello *ff* *p*

Contrabass *ff*

Emmy: Beethoven Symphony



Alternative approaches

Berggren (Sweden)



Piano sonata in style of Mozart



Emily Howell

2010—

Computer Models of Musical Creativity

- ▶ Initiates process of **signature capture from interactive** user responses
- ▶ Evolves **its own lexicons**
- ▶ Models **broader processes** of grammatically-founded processes including
 - ▶ Speech
 - ▶ Poetry
 - ▶ Lyrics

Hidden Structure

- ▶ Takes comprehensive view of 20th-century analytical concepts
- ▶ Makes them available for compositional algorithms
 - ▶ Post-tonal music
 - ▶ Generative algorithms

Emily Howell

- ▶ Debuted in March 2010
- ▶ Represents the second incarnation of Emmy
- ▶ Composes modern, original music

<http://www.miller-mccune.com/culture-society/triumph-of-the-cyborg-composer-8507/>

[Ryan Blitstein=former student of this class]

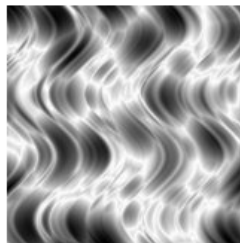
Pieces by Emily Howell

- ▶ *From Darkness, Light*
- ▶ *Land of Stone*
- ▶ *Shadow Worlds*

<http://www.centaurrecords.com/>

http://www.amazon.com/Beethoven-Symphony-No-10/dp/B0098WYOQ2/ref=sr_l_5?ie=UTF8&qid=1367265156&sr=8-5&keywords=DAvid+Cope

Latest release:



Variations on a Theme by Emily Howell by David Cope (Apr 9, 2013)

\$3.96 MP3 Music

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Computer Models of Musical Creativity

▶ David Cope

★★★★★ (2)

Hardcover

\$44.16



Well Programmed Clavier

1-12

▶ David Cope (Emmy)

Audio CD

\$10.00

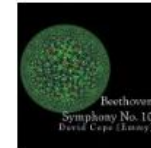


Virtual Rachmaninoff

▶ David Cope

Audio CD

\$12.99



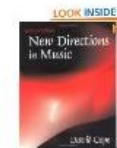
Beethoven Symphony No. 10

▶ David Cope (Emmy)

★★★★★ (1)

Audio CD

\$10.00



New Directions in Music

▶ David Cope

★★★★☆ (4)

Paperback

\$44.96