Uses of Humdrum

Overview

Traditional categories of music analysis

- Traditional means of analysis
  - Harmony
  - Counterpoint
  - Melody
  - Rhythm

Feature sets

Traditional categories of music analysis

- Traditional means of analysis
  - Harmony
  - Counterpoint
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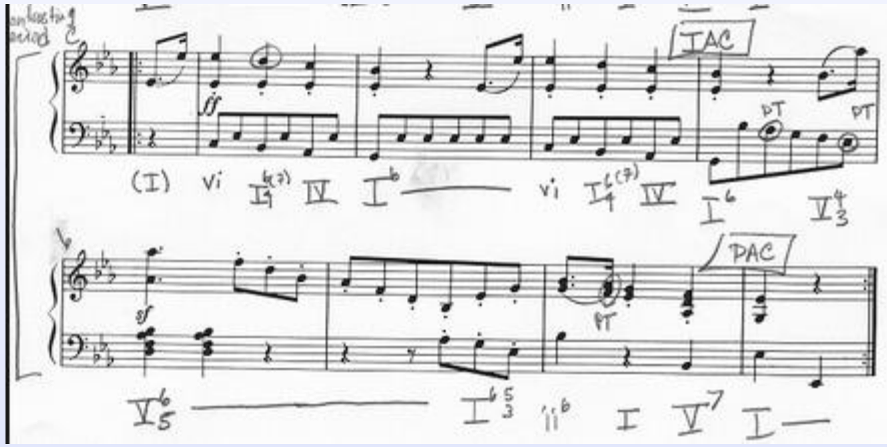
  - Rhythm

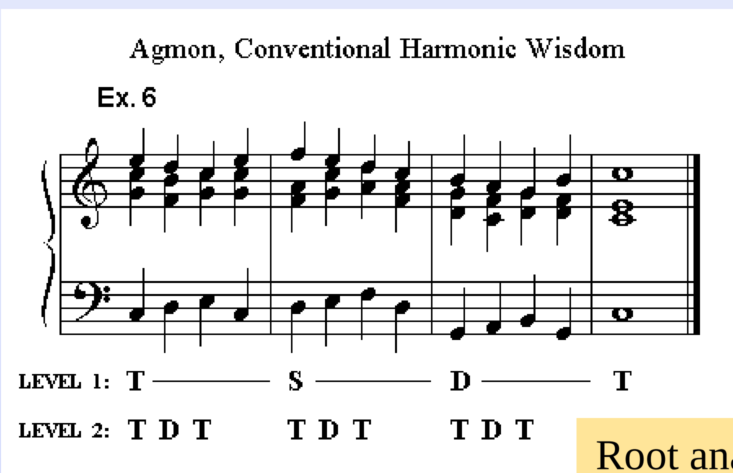
Feature sets

Humdrum = Toolset

****kern** = encoding format

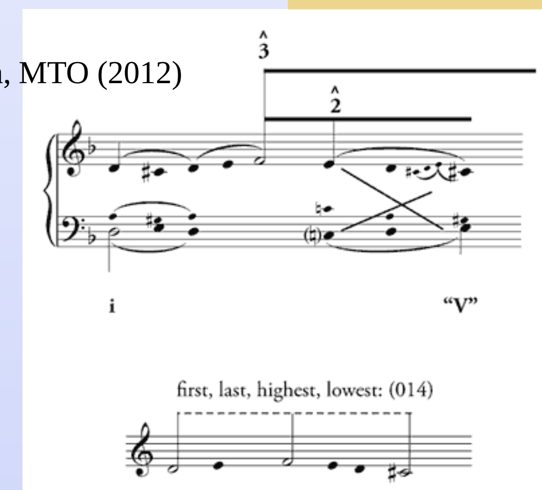
>>Manual processes in music analysis

Riemann analysis

Schenkarian analysis



Root analysis

Blair Johnson, MTO (2012)



Perspectives on music analysis: 1-2

- Traditional (*theoretical, historical*) means of analysis
  - Harmony
  - Counterpoint
  - Melody
  - Rhythm

Feature sets:
Results related to score

- **Statistical** (*systematic*) approaches

Feature sets: results reported in tables, charts, graphs
Disembodied information about music

- **Audio-based** analysis

More approaches to analysis

- Procedures imported from other disciplines
  - Often ***procedural*** or *structural*
  - Borrowed from
    - **Linguistics**
    - **Mathematics**
    - **Computer science**
    - **Engineering**
- **Cognitive** and perceptual studies
- **Performance-based** analysis
- **Data visualization**

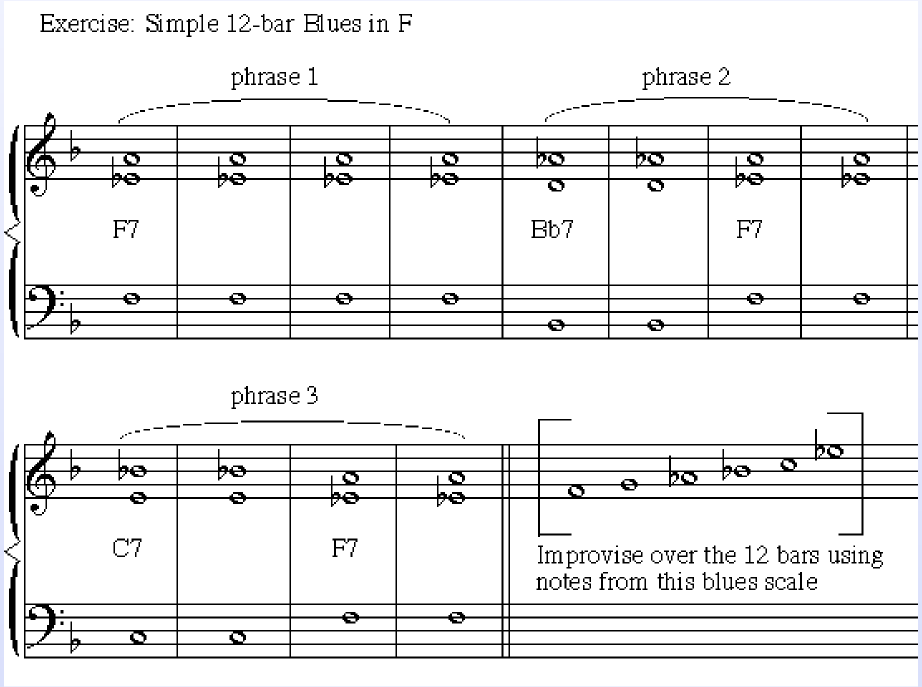
Generation of new works

- Flip side of analysis (work of David Cope)
- Emphasis on form/genre
- Emphasis on style/authorship
- Idiomatic writing for specific instrument

Other legitimate projects

- **Data translation**, enrichment
- **Linking symbolic data** with MIDI, audio, structured data
- **Style evaluation**
  - generation as proof of general concept
  - Attribution studies (e.g. Josquin Research Project)
- **Deep-learning/convolutional-network** (AI) analysis
- Generative approaches to new music

Algorithmic generation: 12-bar blues



Francesco Giomi, c. 1988

Is repertory highly **patterned**?

Phrase families (centonization)

- Panos Mavromatis (2006)
  - N.B. Lerdahl-Jackendoff touch

Linguistic orientation

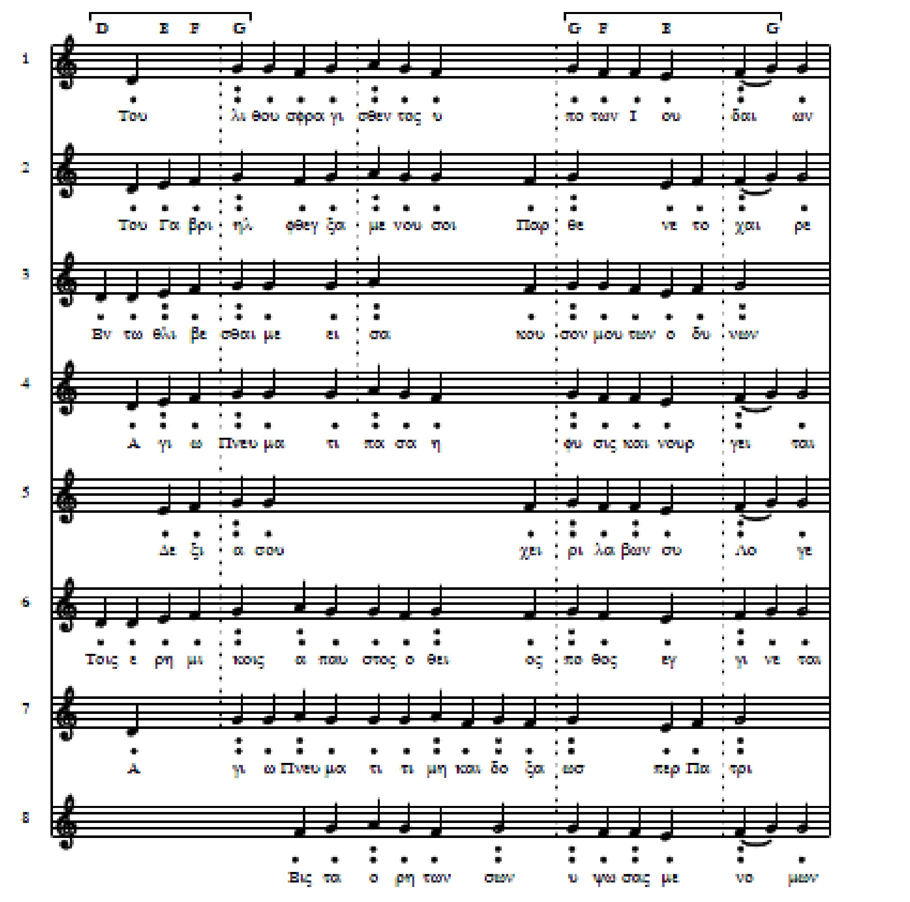
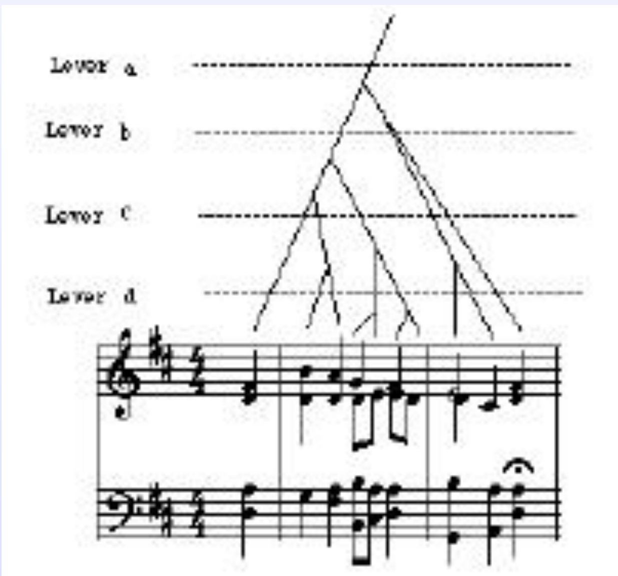
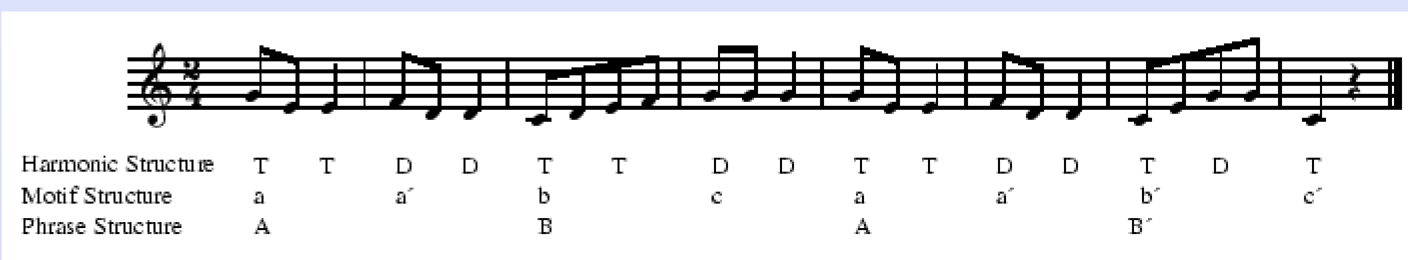


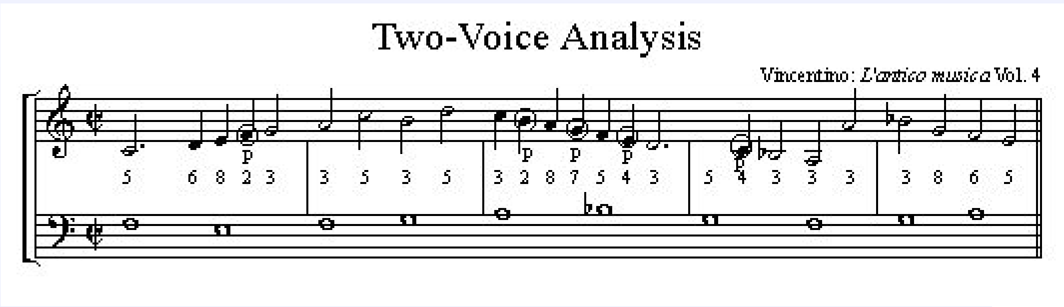
Figure 3. A Phrase family in Echos 1, illustrating formulaic variation. Brackets above the staff mark the family's opening and closing formulas.

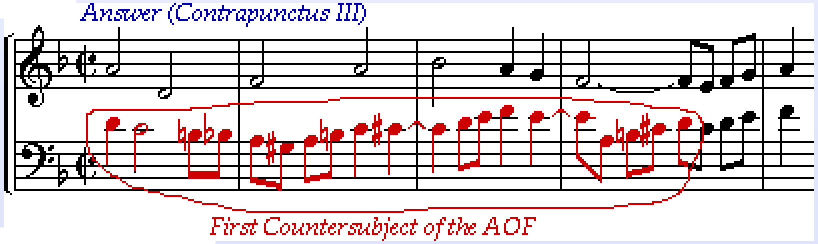
Hierarchical systems: Lerdahl-Jackendoff



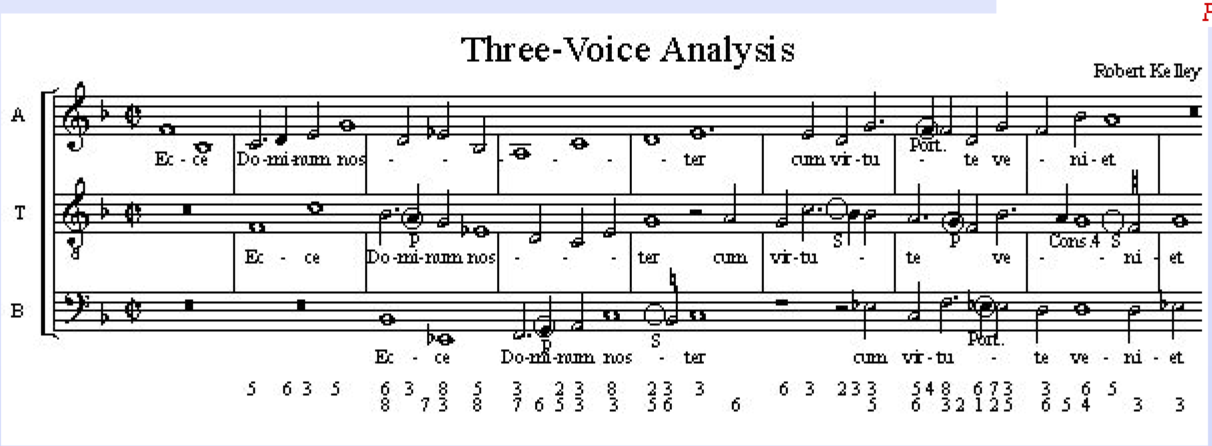
Generative theories of musical grammar (1984)



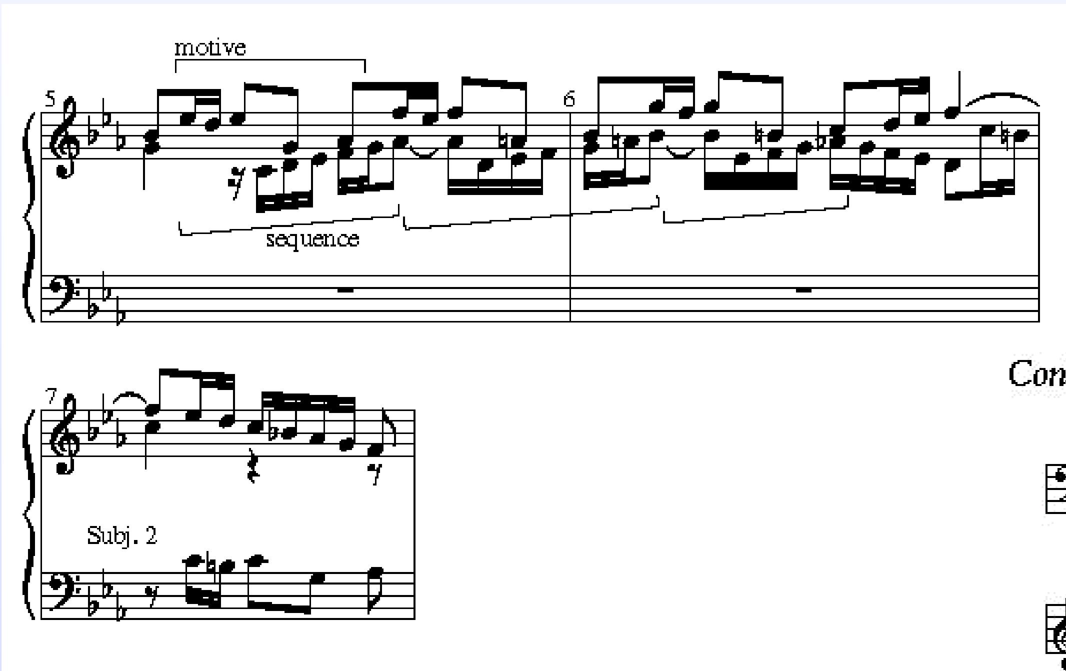
Linear systems (species counterpoint)

Several systems



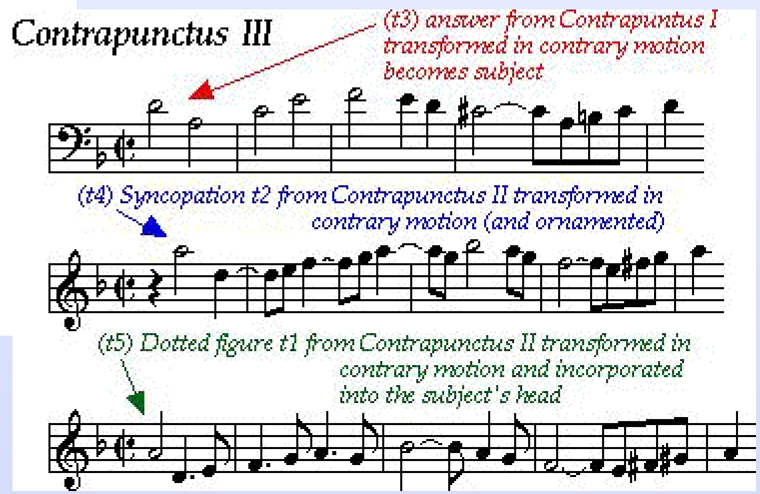
Pedagogical orientation



Imitative systems (18th-century counterpoint)



Timothy Smith, NAU

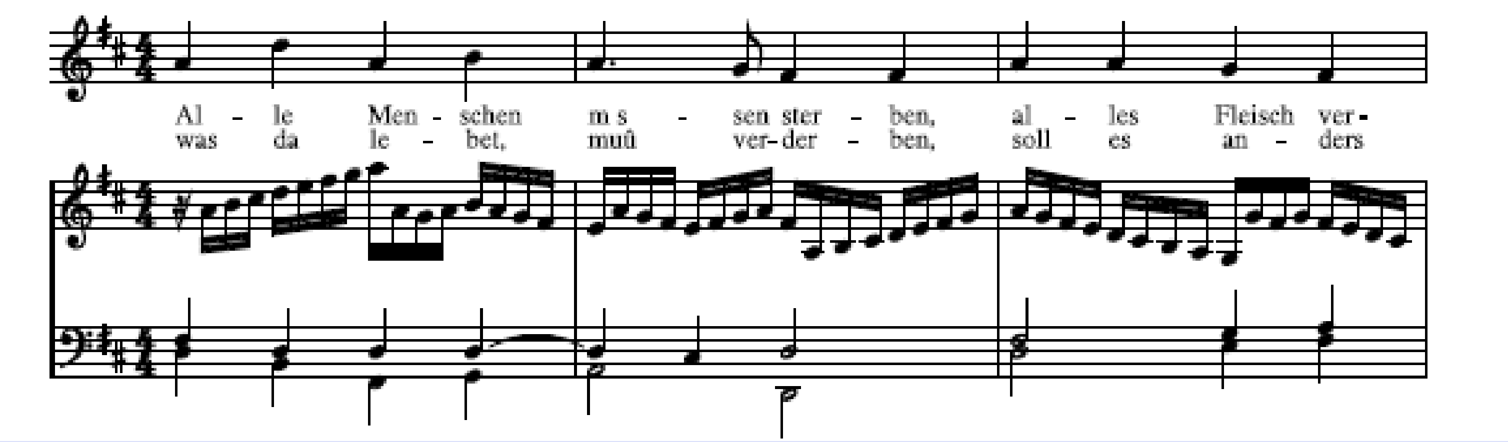


Music-theory applications

Sample Projects, Random Order

Generative chorale variations

- Dominik Hörnel (2005): Pachelbel
  - Keyboard elaboration generated from chorale melody



Chorale elaboration

Rhythm, Meter, Tempo (performance)

Simon Dixon, Gerhard Widmer, Walter Göbl (2004)

Comparative performance analysis

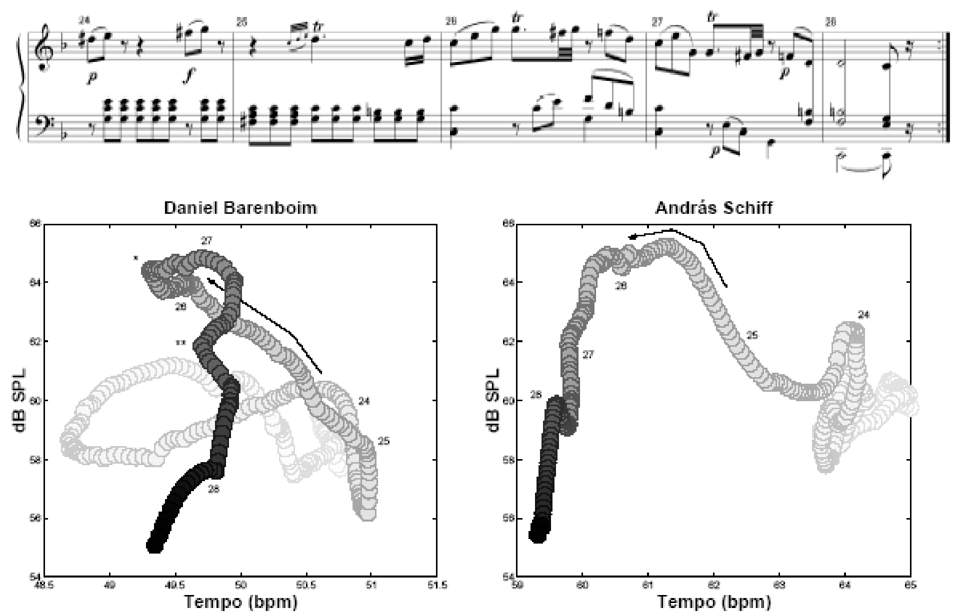


Figure 4. Expression trajectories over the last bars (mm.24–28) of the Mozart piano sonata K.279, second movement, first section, as played by Daniel Barenboim (left) and András Schiff (right). x axis: tempo in beats per minute; y axis: dynamics ('loudness') in decibel. The darkest point represents the current instant (third beat of m.28), while instants further in the past appear fainter.

Computational perception

MACHINES | By Michael Byrne | Oct 9 2016, 11:00am

Computer Scientist Publishes Manifesto for Expressive Algorithmic Music

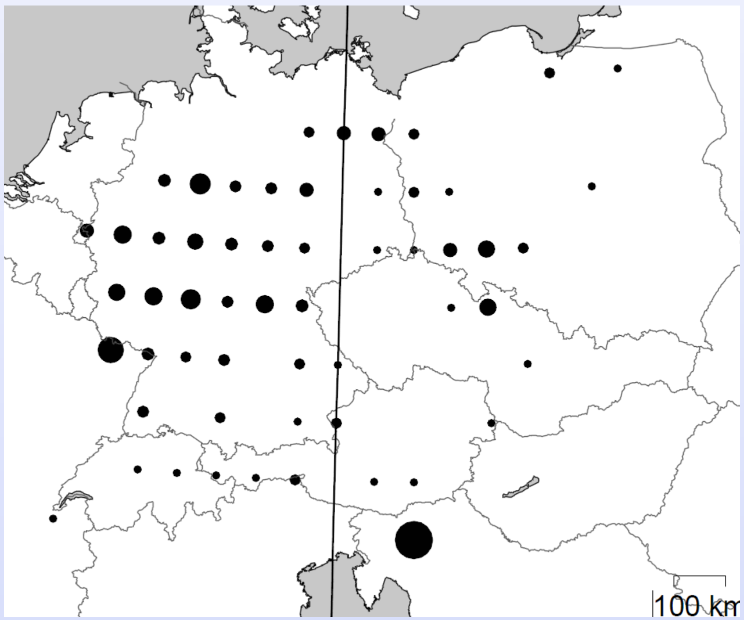
A new five-year research project aims to understand how humans compute music.

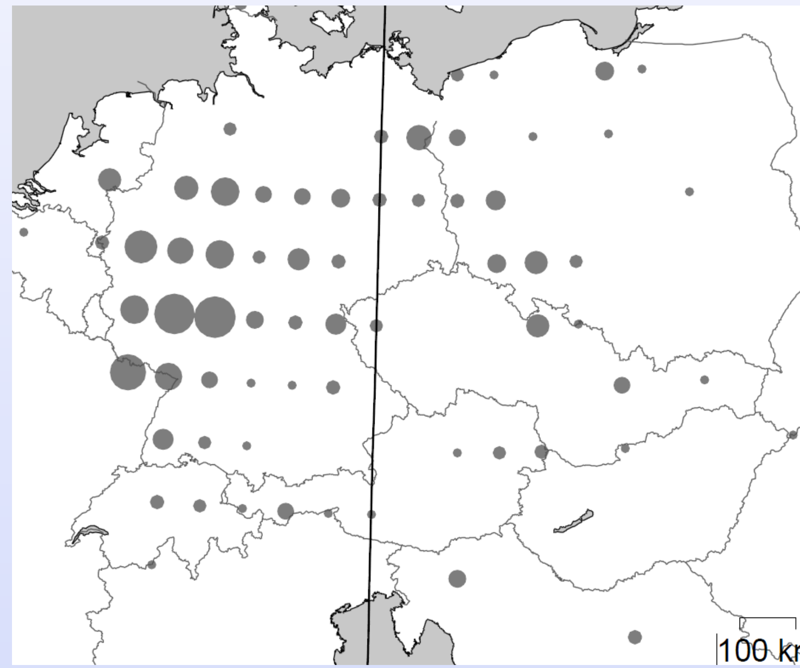
Gerhard Widmer, *Motherboard* (2016)

https://www.youtube.com/watch?v=EJn_88Ru7w4

Geospatial mapping of musical features

- Bret Aarden (1998), from EsAC data





Minor mode

Triple meter

Tabla drumming

Parag Chordia: bol processor (2006)

Non-Western repertories

Dhene ghene dheneghene nage tak dha ne dha
na ge tak 'dha ne dha 'dha kktetake dha kitetak

+ dhenegene dheneghene taketake dha ne
dha kite takedha kitetake dha

+ kr dhin O na kitetake dheneghene
na kite ta dhe te dha

+ gerenage na kite ta dhe te
kitetak gerenage na kite ta

+ dha

dha nagetake dha ne dha
dhet ta kitetake ta

natete dhet kitetak gerenage
ta gadigene dha kitetak

dha ta gadigene dha
dhe te dha ta gadigene

```
8.0 2.0 0.0 -36 0.0 0.0 -1.0
t 2 6 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04dha
t 2 21.582 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04te
t 2 28.26 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04te
t 2 36.058 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04kr
t 2 42.722 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04dhe
t 2 53.824 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04te
t 2 60.502 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04dhe
t 2 101.5 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04te
t 2 108.178 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04te
t 2 114.856 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04kre
t 2 124.474 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04dhe
t 2 136.696 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04te
t 2 143.374 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04dha
t 2 154.476 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04te
t 2 158.914 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04re
t 2 163.632 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04ki
t 2 167.468 0.0 1.0 1.03245 0.0 0.0 0.0 0.0 0.0
_04te
```

Haydn-Mozart Quartet Quiz
(machine learning/information theory)

The Haydn/Mozart String Quartet Quiz

Can you tell the difference between the musical styles of Haydn and Mozart?

This website tests how well you can distinguish between the string quartets of these two composers. You will listen to randomly selected movements composed by either Mozart or Haydn. Then, you will choose the composer you think wrote the music you have just heard.

or ...

Digital scores for the quartet quiz have been provided by the Center for Computer Assisted Research in the Humanities at Stanford University. Click the start button below to answer some questions about your musical knowledge and then start the quiz...

start

- View current identification statistics

Brought to you by Craig Sapp and Yi-Wen Liu, Stanford University.

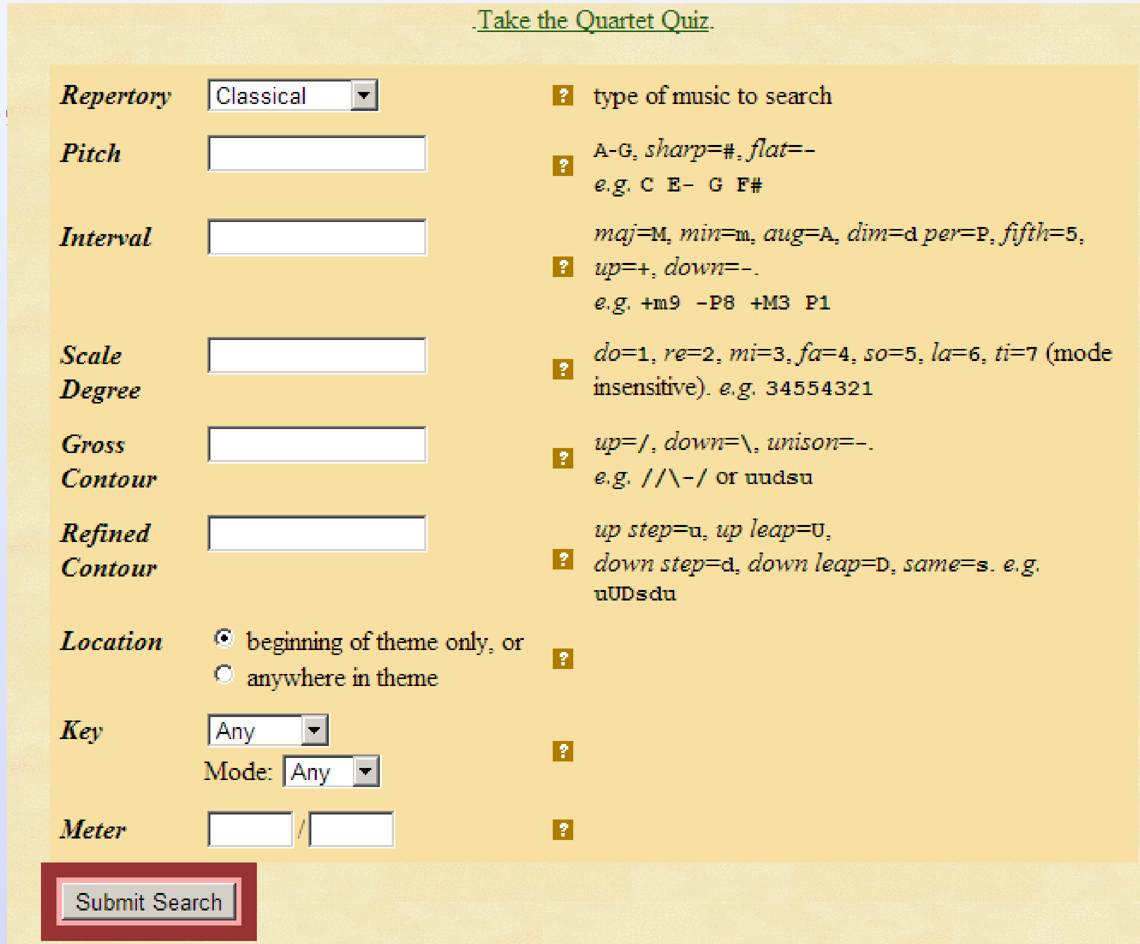
Yi-Wen Liu,
C. Sapp (2002-04)
-**entropy study (EE)**
[*qq.themefinder.org*]

Themefinder (melodic search)

- Huron, Kornstädt, Sapp, et al. (1996)

themefinder.org

Similarity studies



Computer methodologies in music search

- Music geohash
- Counterpoint/surfacing crawling
- Musical structure discovery via deep-learning algorithms (2016)
- Currently runs ETLeap (data extraction, transformation, loading)

Melodic search in big data

- Sapp, Liu, Selfridge-Field (ISMIR, 2004)

Search effectiveness in large musical databases:

http://ismir2004.ismir.net/proceedings/p051-page-266-paper135.pdf (100,000 musical incipits)

- Sapp, Shanahan:

Rhythmic search in 1m+ incipits [RISM musical incipit database]

Studies comparing analytical tools

- Claire Arthur

MEI Proceedings (2015)

- Compares, Humdrum, MEI

- Johanna Devaney, Hugh Gauvin (Springer Verlag, 2016)

- Advocates extensions to Humdrum and MEI

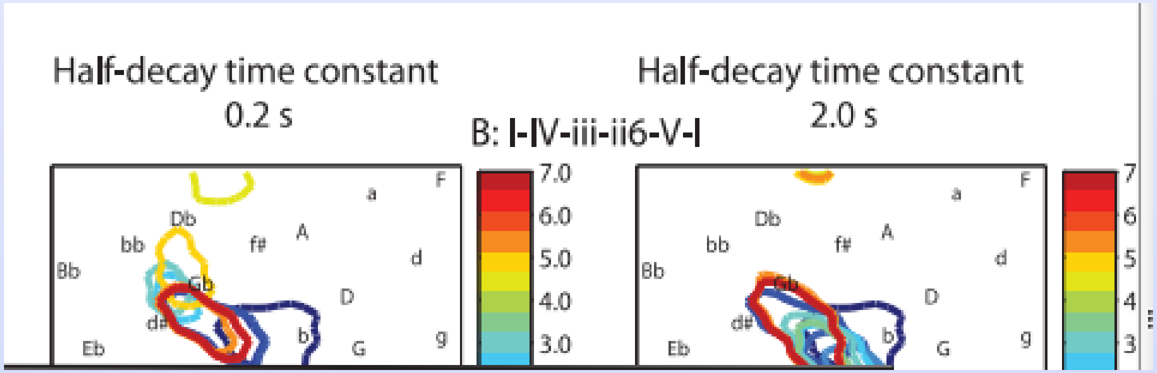
Stanford-related studies

LSJUMB (Stanford Band) repertory study

- https://youtu.be/16Fvy3qXeaM?t=56

Outside users: Neuromusicology

- Carol Krumhansl: Tonal, harmonic understanding
  - Their physiological correlates
- Petr Janata: specific-key perception
  - Neural correlates



Neuromusicology: movement/gesture

- Petri Toiviainen
  - Spatial-temporal music cognition
  - Perceived similarity and spontaneous dancing
- Ari Patel
  - Avian perception of rhythm
  - [Snowball, the dancing cockatoo]