



# **Computational Musicology**

**(previously called Symbolic Music Analysis)**



CS 275B/Music 254

# Course context

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- ▶ Music 253/CS 275A      Symbolic Musical **Information**  
(Data)
  - ▶ Principles of **encoding** music
    - ▶ Notation
    - ▶ MIDI/sound
    - ▶ “Logical” content (intro)
- ▶ **Music 254/CS 275B**      Symbolic Music **Analysis**
  - ▶ Principles of **decoding** musical data sets
    - ▶ **Query** = data **extraction**
    - ▶ **Analysis** = data **evaluation**
    - ▶ **Style simulation** = data **manipulation, synthesis**

# Elements of the course


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## ▶ Classroom portion:

- ▶ **Query:** *Themefinder* (melody)
- ▶ **Analysis:** *Humdrum* (harmony, rhythm, melody, perceptual items)
- ▶ **Style simulation:**

Models by David Cope and others

## ▶ Project part:

- 
- (a) Review of **previous work**
  - (b) Select **research topic**
  - (c) Select **data and tools**
  - (d) Conduct research, make reports
  - (3) Present talk and submit write-up

# Topic schedule

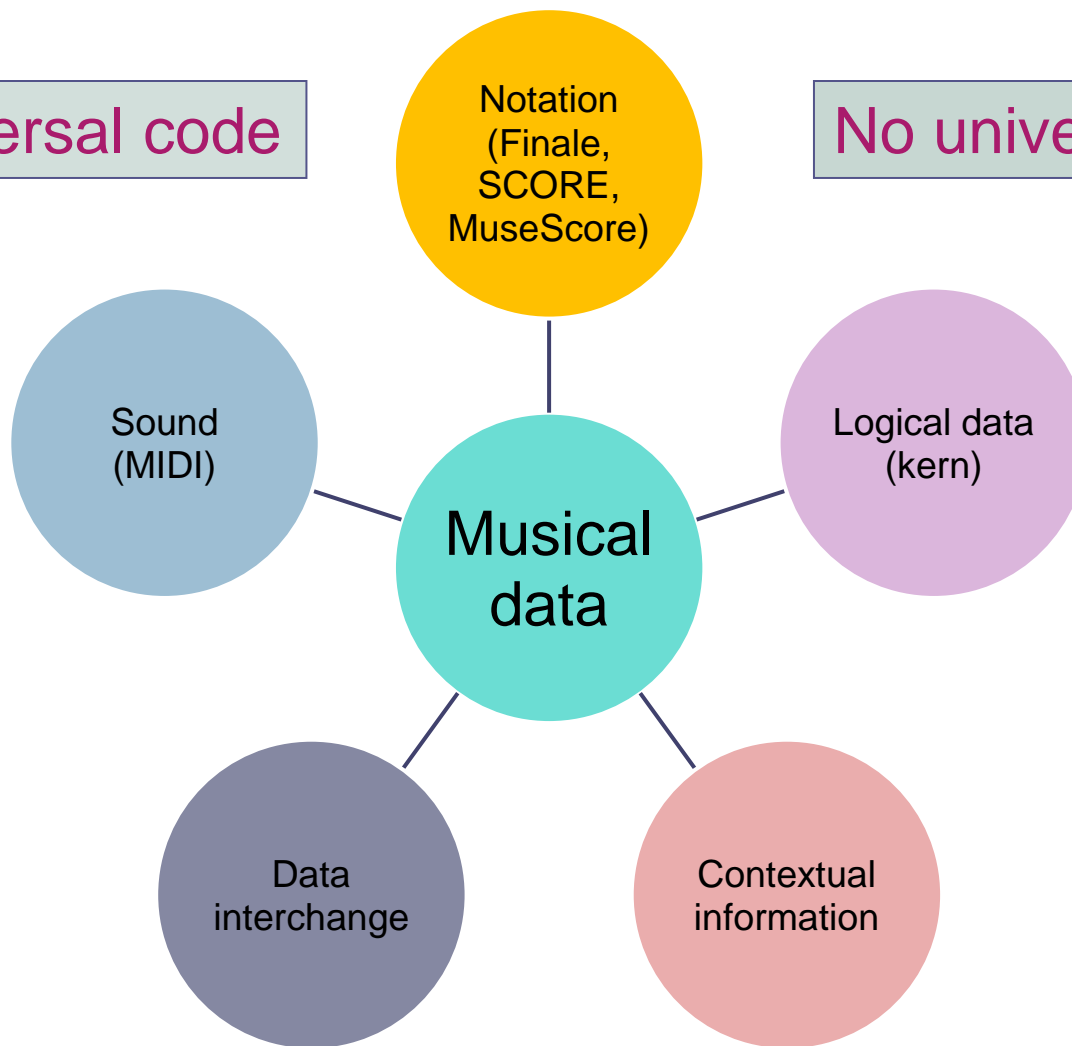
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- ▶ **Musical topics:**
  - ▶ Melody; data sources; similarity
  - ▶ Harmony; current work
  - ▶ Rhythm; current work
  
- ▶ **Methodological topics (vary from year to year):**
  - ▶ Week 5
  - ▶ Week 6
  - ▶ Week 7
  - ▶ Week 8

# Symbolic Musical Information Scheme

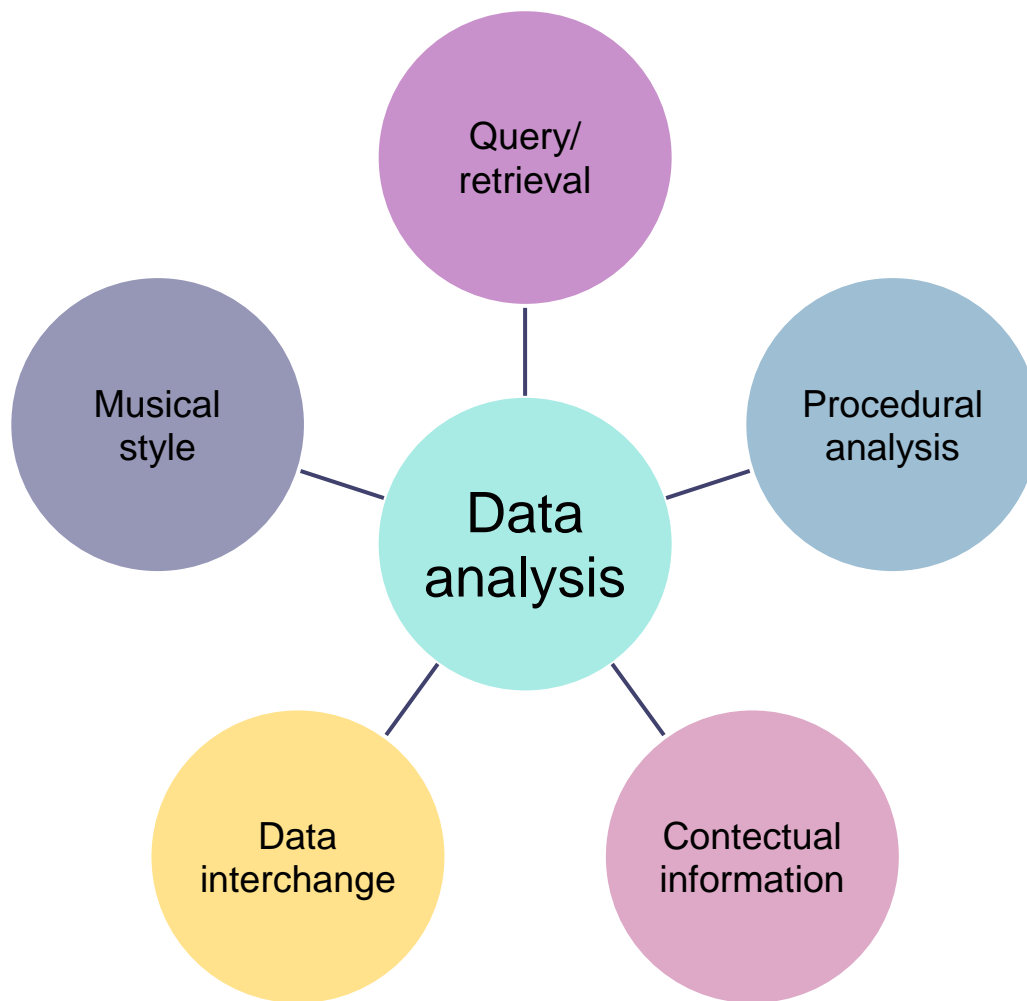
No universal code

No universal translator



# Symbolic Musical Analysis: Applications

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# Symbolic data repositories (on site)

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## ▶ Humdrum

- ▶ Encoded materials (c2500)
- ▶ Keyboard music, ethnic repertoires
- ▶ Verovio Humdrum viewer: score editing, viewing

## ▶ MuseData

- ▶ Encoded, curated fullscores (c1200)
- ▶ Symphonies, concertos, sonatas
- ▶ Online viewing and editing

## ▶ Themefinder

- ▶ Encoded incipits (c100,000)
- ▶ Classical, folk, Renaissance

# Data resources at CCARH

## ▶ Monophonic resource

- ▶ Essen database (folk music)
- ▶ *Themefinder* repertories

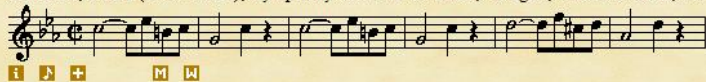
## ▶ Polyphonic resource

- ▶ *KernScores* (keyboard)
- ▶ *MuseData* (chamber, orchestral)

1. Beethoven, Ludwig Van (1770-1827), Trio in B Flat, Op. 97, Vn., Cello & Pft. "Archduke", 1st Movement, 1st Theme



2. Schubert, Franz (1797-1828), Symphony No. 4 in C Minor, "Tragic", 4th Movement, 1st Theme



3. Weber, Carl Maria Von (1786-1826), Peter Schmolz und Seine Nachbarn, Overture, 1st Theme



## Kern Scores

A library of virtual musical scores in the Humdrum **\*\*kern** data format.  
Total holdings: 7,866,496 notes in 108,703 files.

search:   
[browse](#) | [shortcuts](#)   *anchored*

[A guided tour of the KernScores website](#)  
[Recent additions to the KernScores library](#)  
[Data Collection Highlights](#)

[Online Humdrum Editor](#)  
[CCARH Humdrum Portal](#)  
[Contribute kern scores](#)




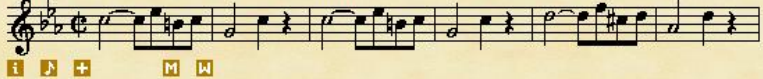
# Query (Retrieval) via Themefinder


## Search form

**Repertory**  ? type of music to search  
**Pitch**  ? A-G, sharp=#, flat=-  
*e.g. C E- G F#*  
**Interval**  ? maj=M, min=m, aug=A, dim=d per=P, fifth=5,  
*up=+, down=-.*  
*e.g. +m9 -P8 +M3 P1*  
**Scale Degree**  ? do=1, re=2, mi=3, fa=4, so=5, la=6, ti=7 (mode insensitive). *e.g. 34554321*  
**Gross Contour**  ? up=/, down=\, unison=-.  
*e.g. //\-/ or uudsu*  
**Refined Contour**  ? up step=u, up leap=U,  
down step=d, down leap=D, same=s. *e.g. uUDsdu*  
**Location**  beginning of theme only, or  
 anywhere in theme ?  
**Key**  ?  
Mode:  ?  
**Meter**  /  ?

1. Beethoven, Ludwig Van (1770-1827), Trio in B Flat, Op. 97, Vn., Cello & Pfl. "Archduke", 1st Movement, 1st Theme


2. Schubert, Franz (1797-1828), Symphony No. 4 in C Minor, "Tragic", 4th Movement, 1st Theme


3. Weber, Carl Maria Von (1786-1826), Peter Schmolll und Seine Nachbarn, Overture, 1st Theme



## Responses

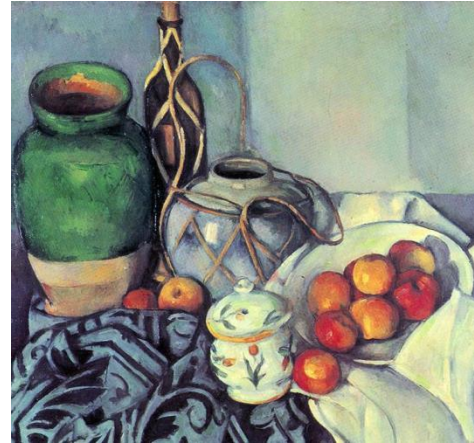
# Meta-data vs Semantic searching

## Generic objects

- fruit
- jars
- cloths

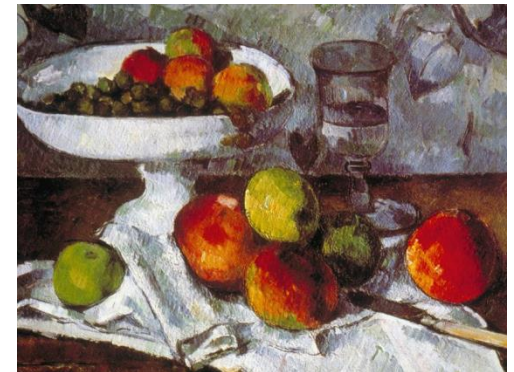


Ambiguities



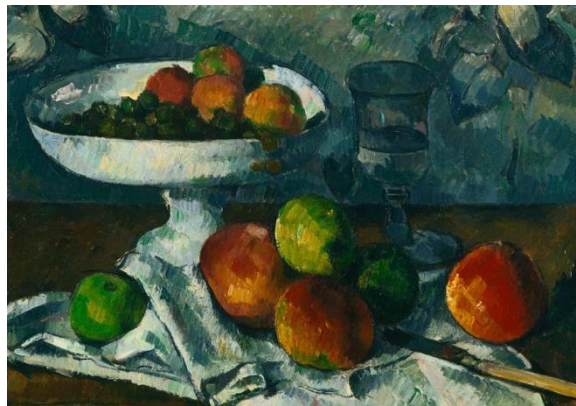
## Specific objects

- peaches
- vase
- apricot



## Basic colors

- blue
- green
- white



Categories

## Intermediation

## Gradations

## Specific colors

- teal (blue)
- forest (green)
- off-white

<http://amico.org/home.html>

# Metadata vs richer metadata

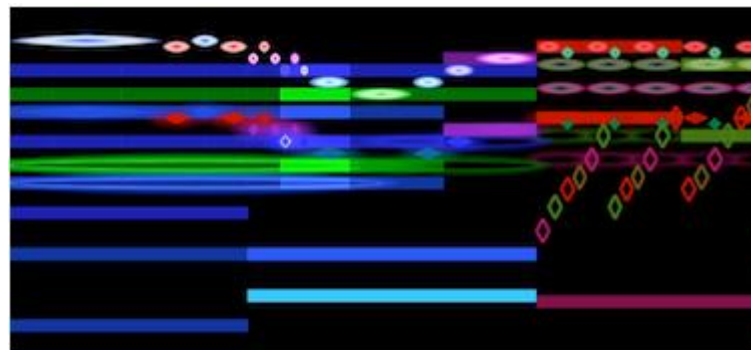
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- ▶ Gracenote: backbone of Apple Music
- ▶ Pandora: classification system for eight humanly-defined traits

# Feature depiction, extraction

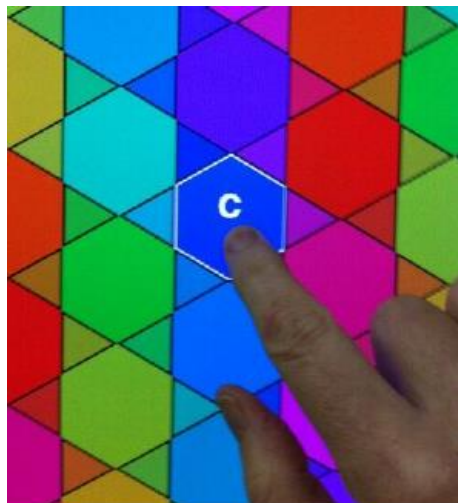


Voices, textures

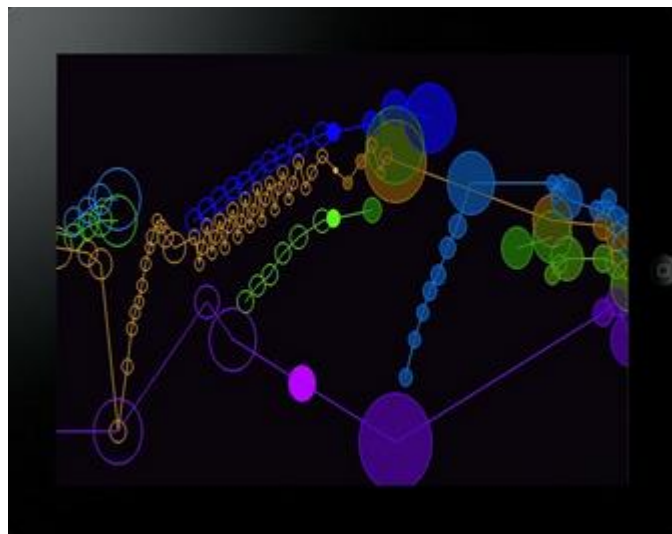


Articulation, dynamics

From the work of  
Steven  
Malinowski  
[musanim](#)



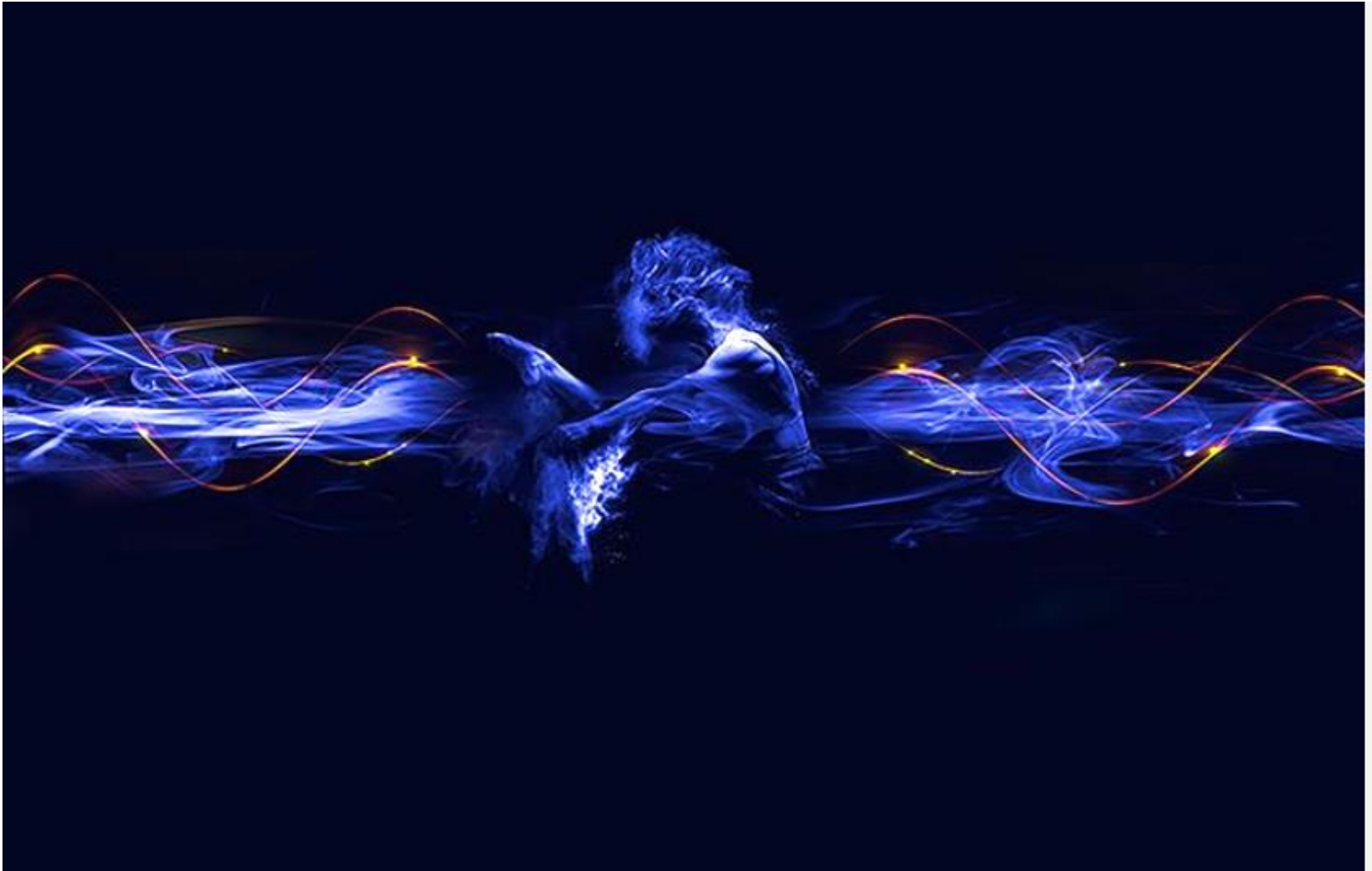
Tonal relations



Off the grid

# Malinowski video track to accompany Donald Knuth's *Fantasia Apocalyptica* (Piteå 2018)

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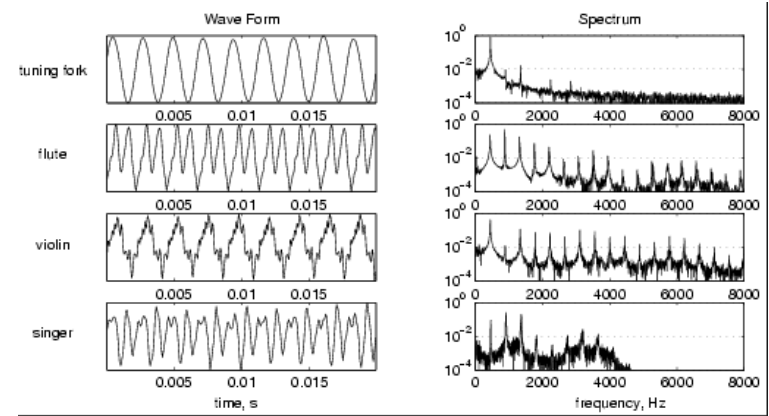




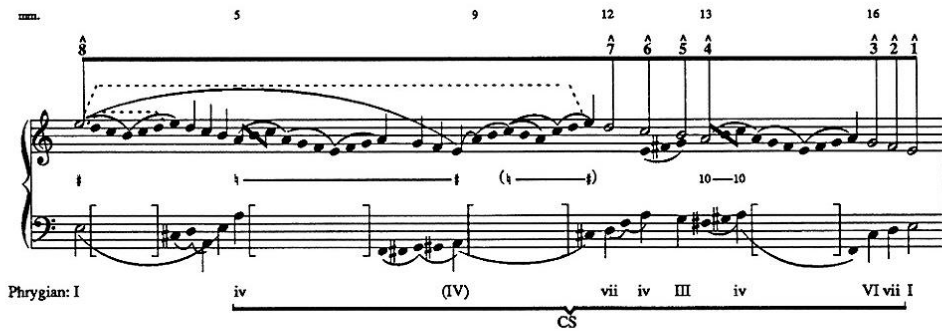
# Musical style (analysis)



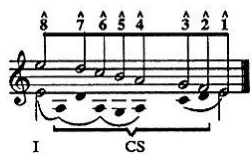
**Score-based:**  
conventional



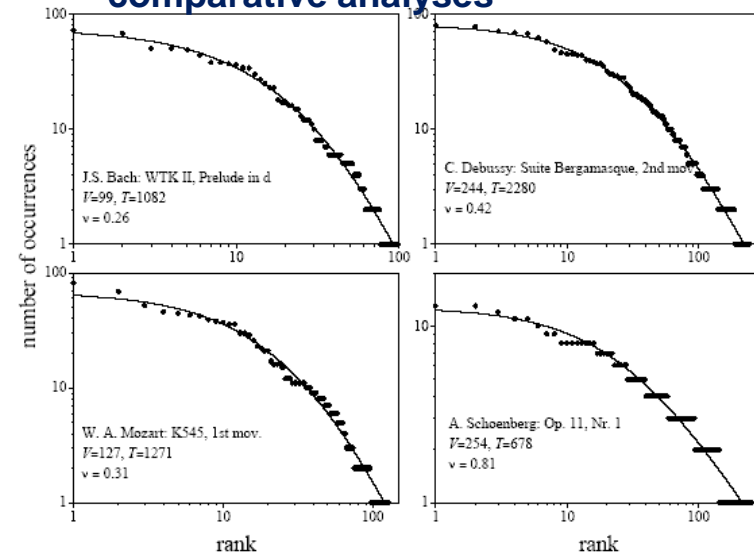
**Performance-based:** event-based,  
comparative analyses



Fundamental structure:



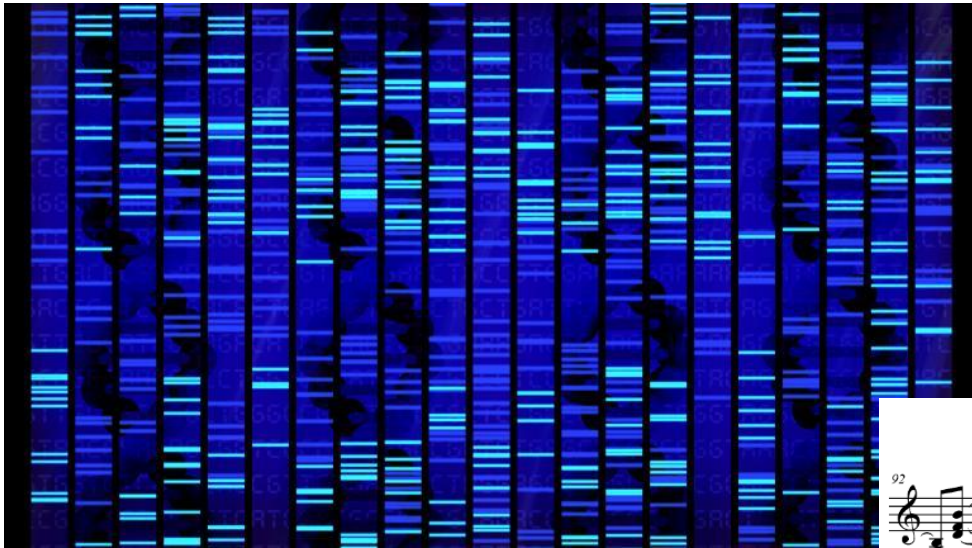
**Score-based:** Schenkerian (graphical)



# DNA-sequencing algorithms

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Dang Vu: feature propagation in  
improvised Vietnamese chamber music  
(adaptation of genetic analysis sw)



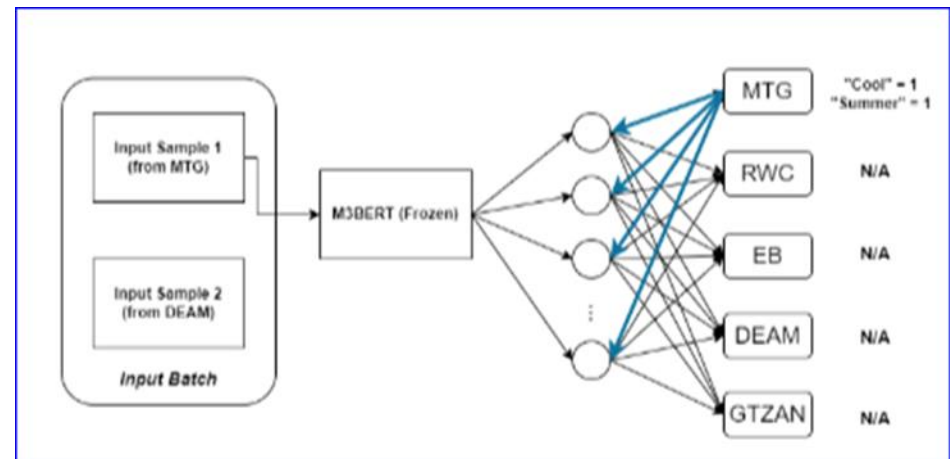
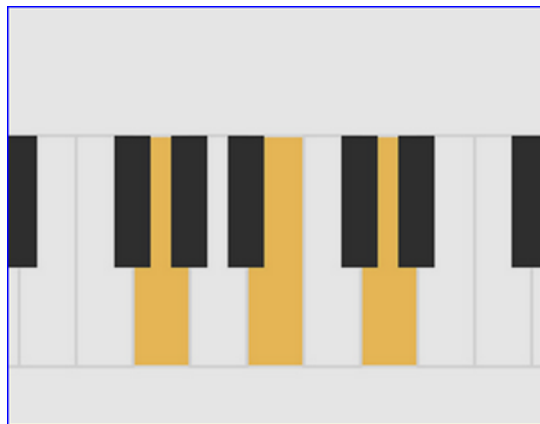
Horse hemoglobin > music  
(Gene2Music, UCLA)

Horse Hemoglobin-alpha 3



# Recent work in music and AI

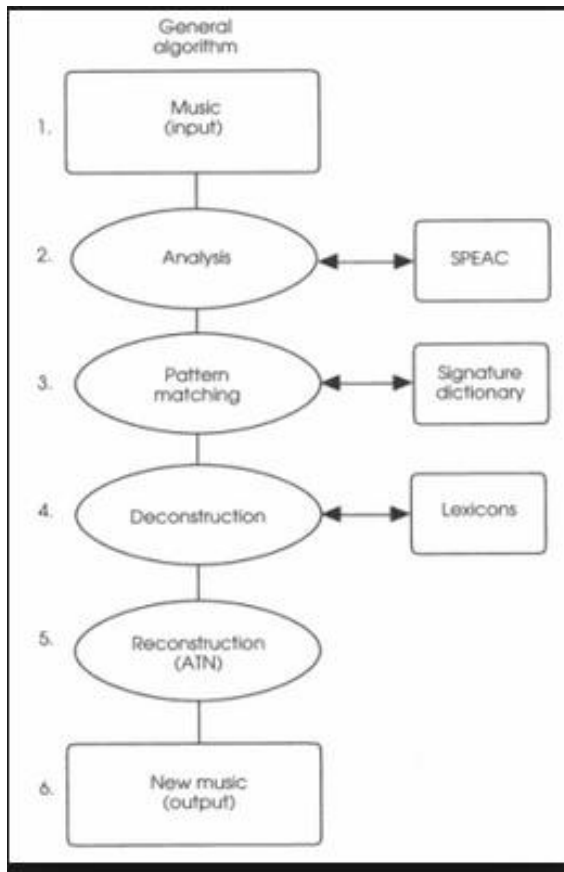
- ▶ Current examples and their approaches
- ▶ Overwhelmingly focused on generating new works
- ▶ Overwhelmingly dependent on audio data





# Musical style (simulation)

## Work of David Cope (UCSC)



- Concerts
- Website
- Books
- Recordings
- Polemics

## Virtual Rachmaninoff

*Music by David Cope*

with Experiments in Musical Intelligence

