What is Digital Musicology and what can be expected from it?

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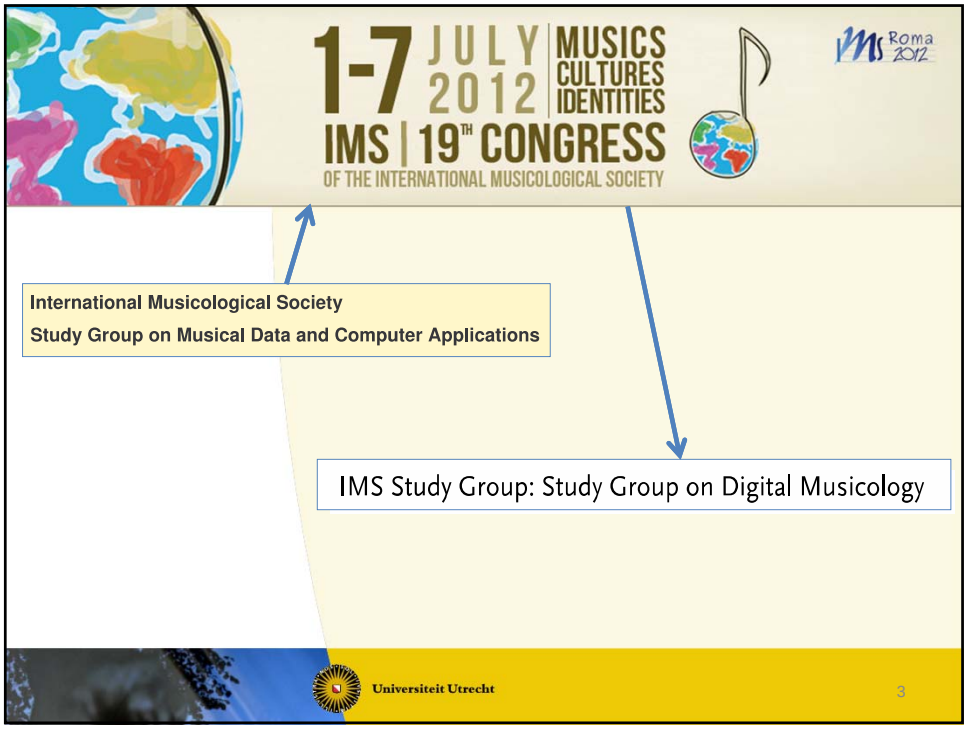
Abstract

For years I used to be unsure how to describe myself academically. In the end, I decided to call myself a computational musicologist, but not long after I made this decision I discovered that the expression 'computational musicology', seemed to be losing ground quickly and to be replaced widely by 'digital musicology'. Maybe it is just a matter of the terminology being modernized—computational musicology has been around for decades—but in my analysis there may be a difference in approach as well. Briefly, the way I see it is that digital musicology is much stronger tied than computational musicology to the interactive paradigm in computing. Therefore, digital musicology could be more closely tied to how (musicological) end-users might use advanced computer technology in their daily work. In practice, such use of technology does not yet seem to happen very often, for reasons that have to do with both technology and the (lack of) attention to human factors, scholarly work practices in particular. To illustrate this I will discuss some computational methods for searching musical content. It has been suggested that the inclusion of a Find facility in (for example) Sibelius might stimulate imaginative new research, but how exactly should such a facility be designed to work?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IMS | 19TH CONGRESS
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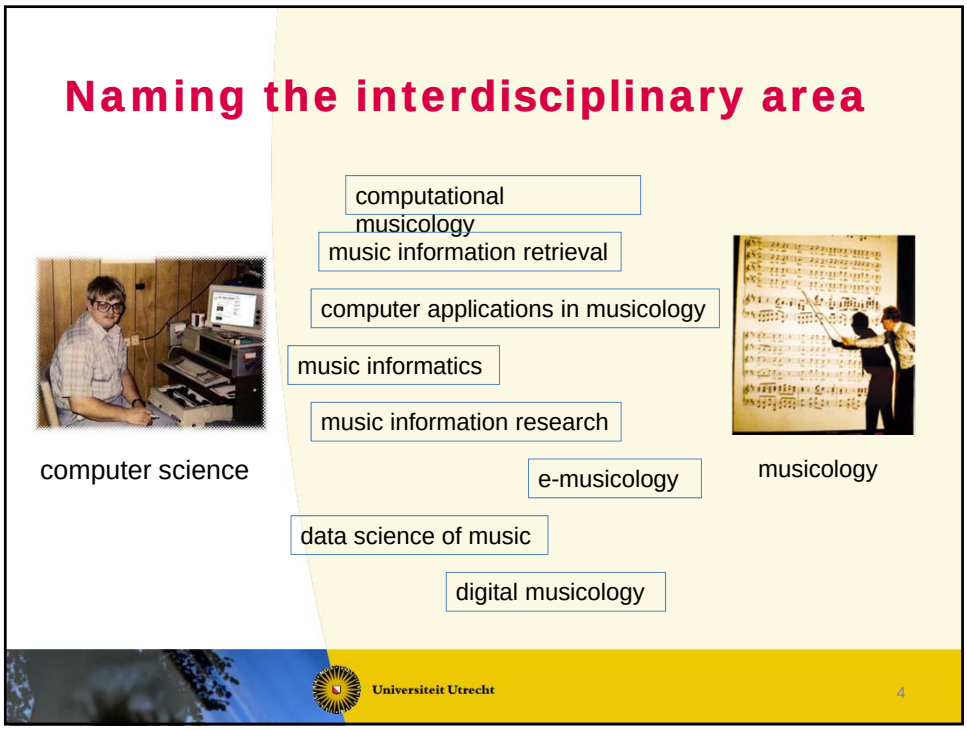
Naming the interdisciplinary area
computational musicology
music information retrieval
computer applications in musicology
music informatics
music information research
e-musicology
data science of music
digital musicology
computer science
musicology
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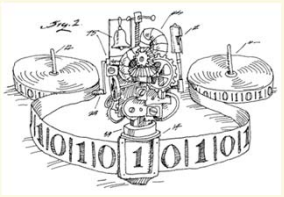
Computer science paradigms

- Algorithmic paradigm
  - Turing machine
  - emphasis on computability, mathematical proof
  - 'autistic' behaviour in closed world



- Interactive paradigm
  - Interaction machines add input and output to Turing machine
  - interaction with real world, sense of history
  - only partial, empirical proof of computational properties

- Peter Wegner (1997) *Why interaction is more powerful than algorithms* Communications of the ACM 40/5

Computational Musicology

- roots in the 50/60's
- core
  - design of encoding schemes for music notation
  - corpus building
  - automatic processing
    - printing
    - indexing
    - analysis
    - pattern discovery and searching
    - stylistics…

Isolated

- often seen as subdiscipline within Systematic Musicology
  - 'positivist' approach
  - focus on musical work
  - weakly connectied to new musicology
  - fair (but decreasing) share in Music Information Retrieval
- despite the Internet, most computational musicology (and great deal of MIR) falls within algorithmic paradigm
  - closed computational world difficult to create and interpret
  - are results meaningful from musical viewpoint?

Elsewhere in the humanities

- mass digitisation of cultural heritage
- Internet as a scholarly resource
- Digital Humanities
  - interoperability
  - digital media studies
  - builds on 'normal' digital literacy
  - end users become end makers (Willard McCarty)
- much more serious about interactive paradigm

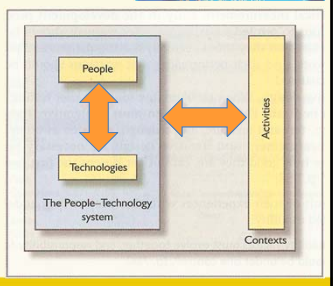
Digital Musicology

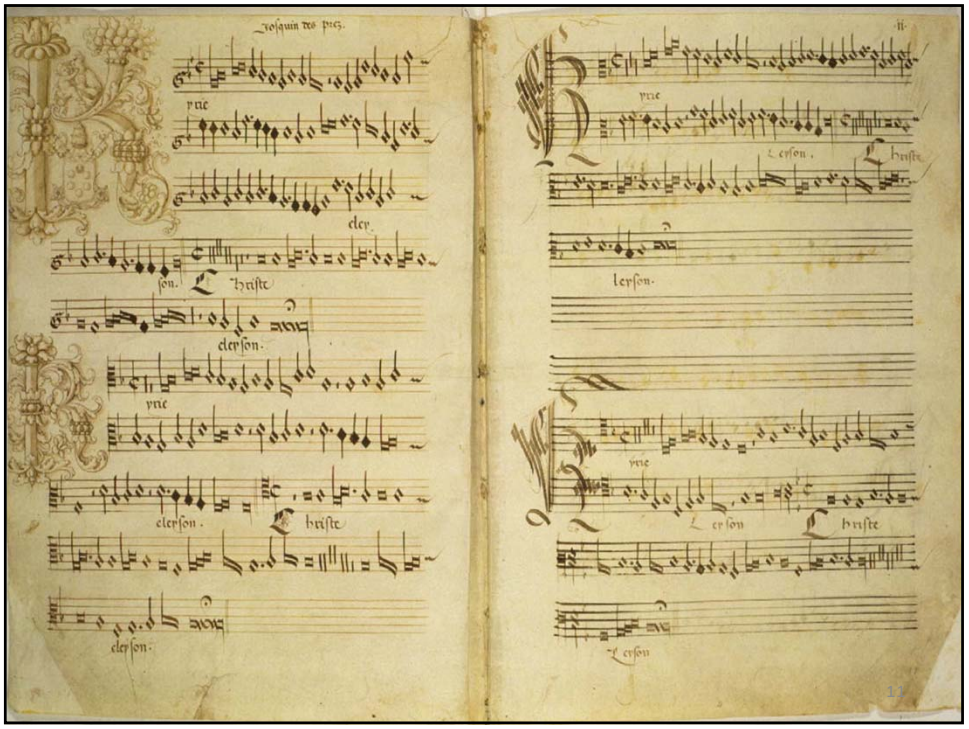
- similar re-orientation as in Digital Humanities
  - exploit the Internet
  - creative use of existing technologies
  - not primarily about notation data processing
  - support musicological work processes
  - interactive paradigm
- from closed systems to human-centred design
- hopefully, autistic subdiscipline becomes widespread professional skill

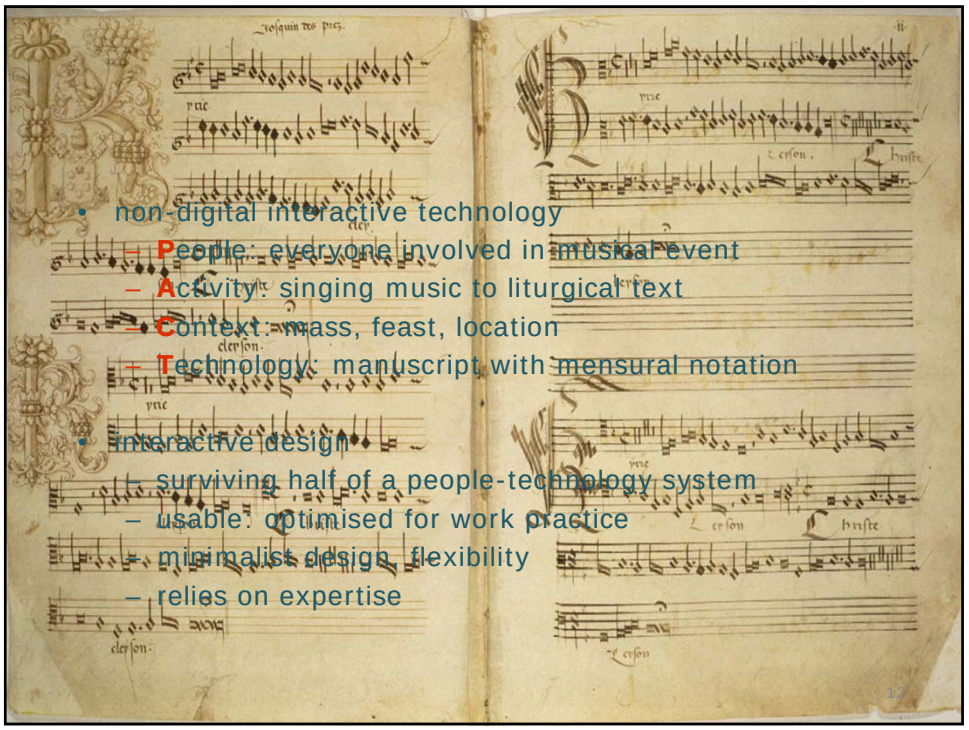
Interactive systems design

- David Benyon, *Designing Interactive Systems.* 2nd ed., 2010
- human-centred design
  - aim: people-technology system
- PACT analysis of domain
  - people
  - activities
  - contexts
  - technologies

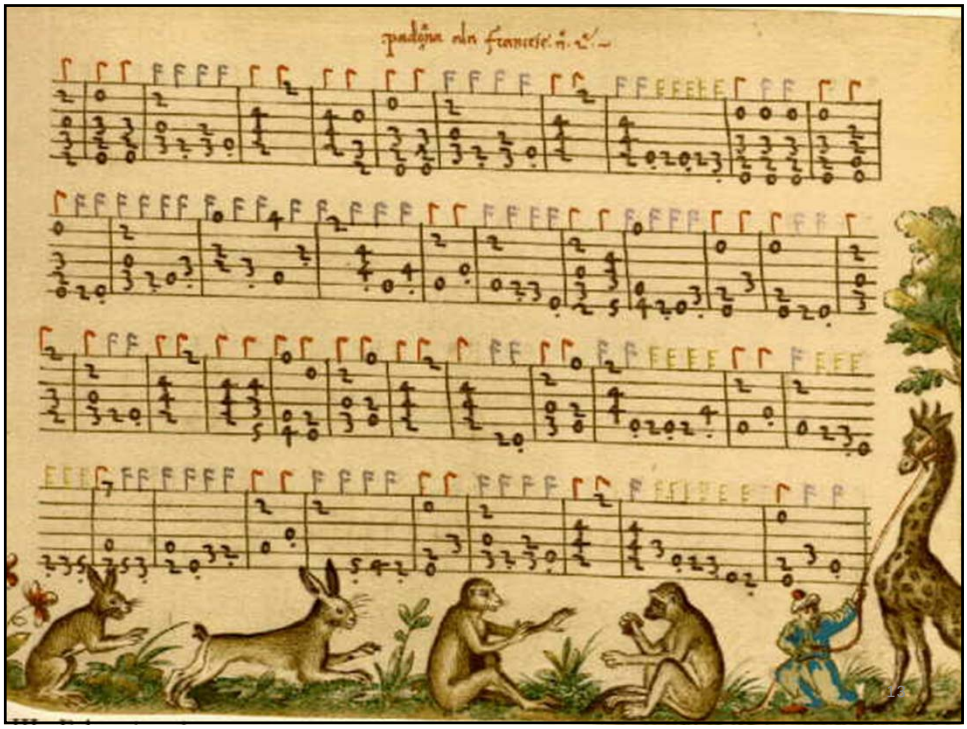
interactive systems are everywhere







- non-digital interactive technology
  - **P**eople: everyone involved in musical event
  - **A**ctivity: singing music to liturgical text
  - **C**ontext: mass, feast, location
  - **T**echnology: manuscript with mensural notation
- interactive design
  - surviving half of a people-technology system
  - usable: optimised for work practice
  - minimalist design, flexibility
  - relies on expertise



What if Sibelius had a find facility?

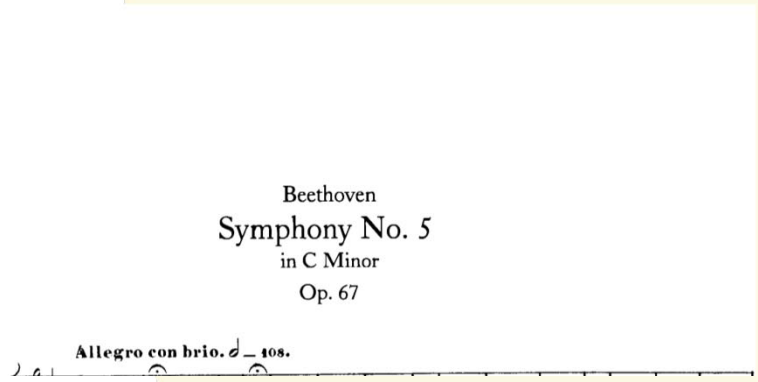
From the ways that scholars have described how they use software such as spreadsheets, it's clear that computer users will adapt software in ways that makes sense to them. A possible approach to attempt, therefore, may be to supply more simple and generic tools which allows scholars to appropriate them in any way they like. As an example of this [borrowed from Tim!], how would musicologists react to a Find facility in Sibelius?

Richard Lewis. Understanding Technology Adoption in Musicology. Paper presented at IMS 2012, Rome

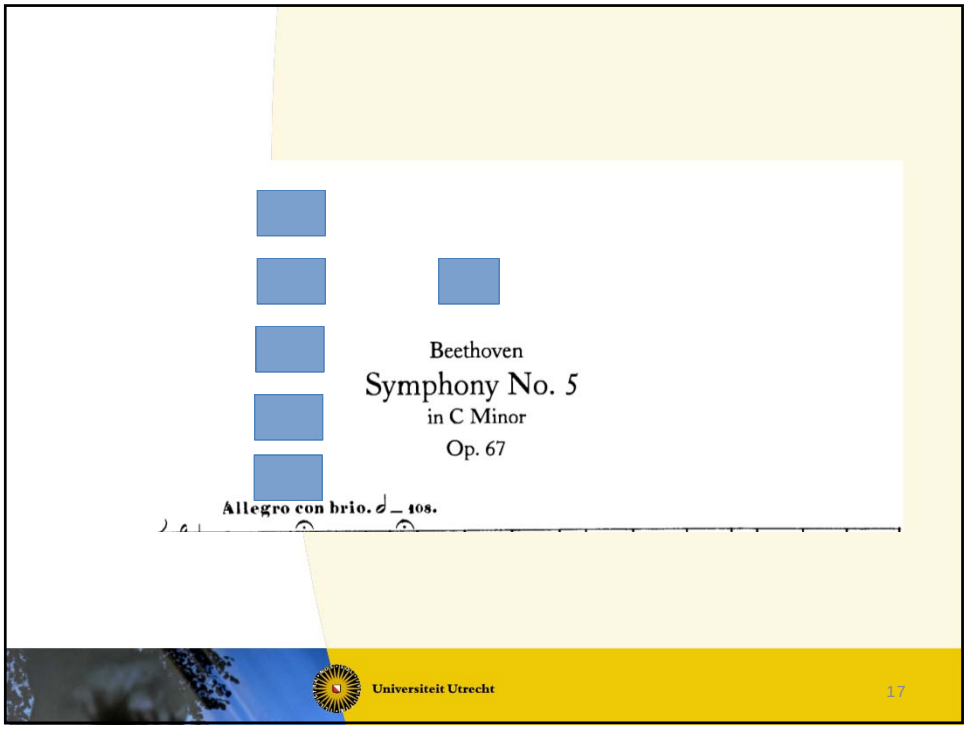
Designing a find facility

- PACT analysis thought experiment
  - user study with simple prototype
  - technology review
  - some conclusions

Lo-fi prototype



search pattern:


Beethoven
Symphony No. 5
in C Minor
Op. 67
Allegro con brio. ♩ = 108.
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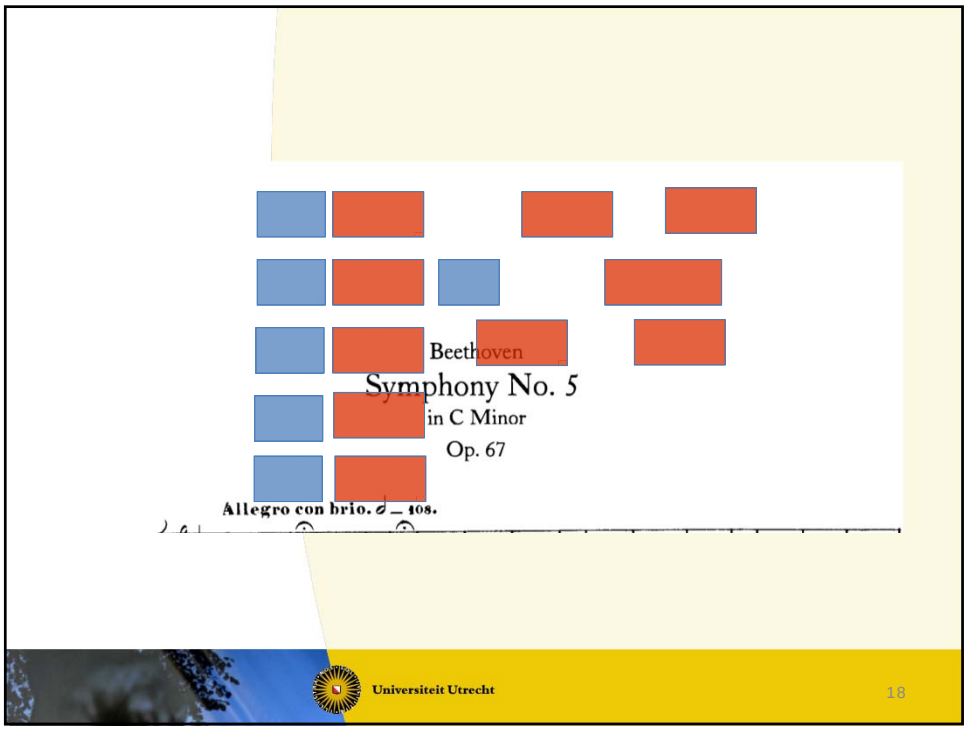
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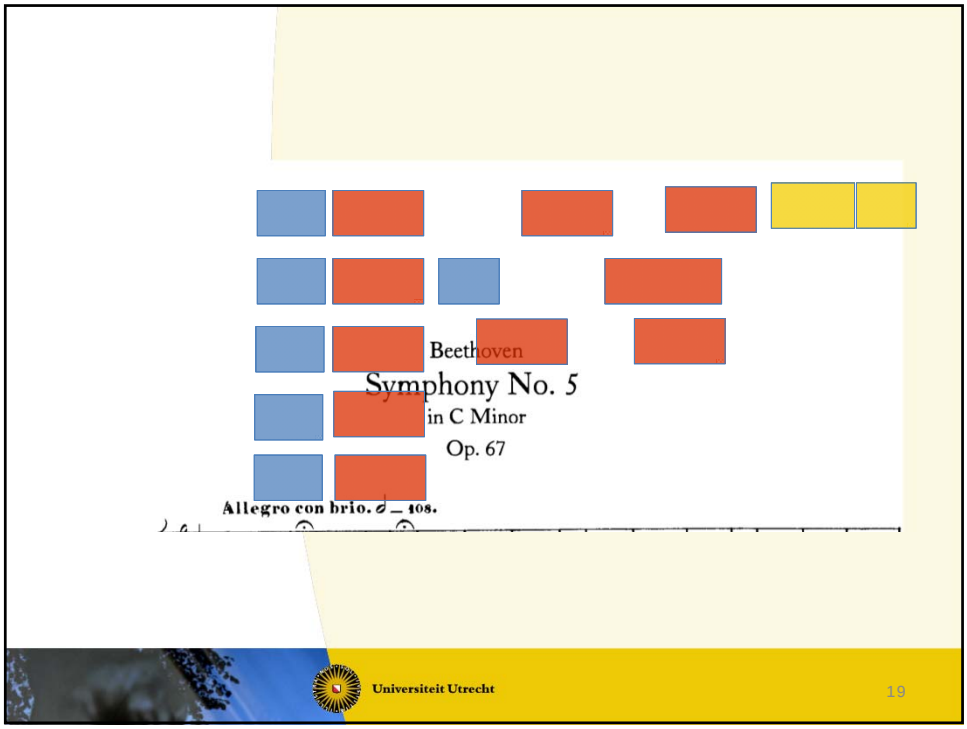
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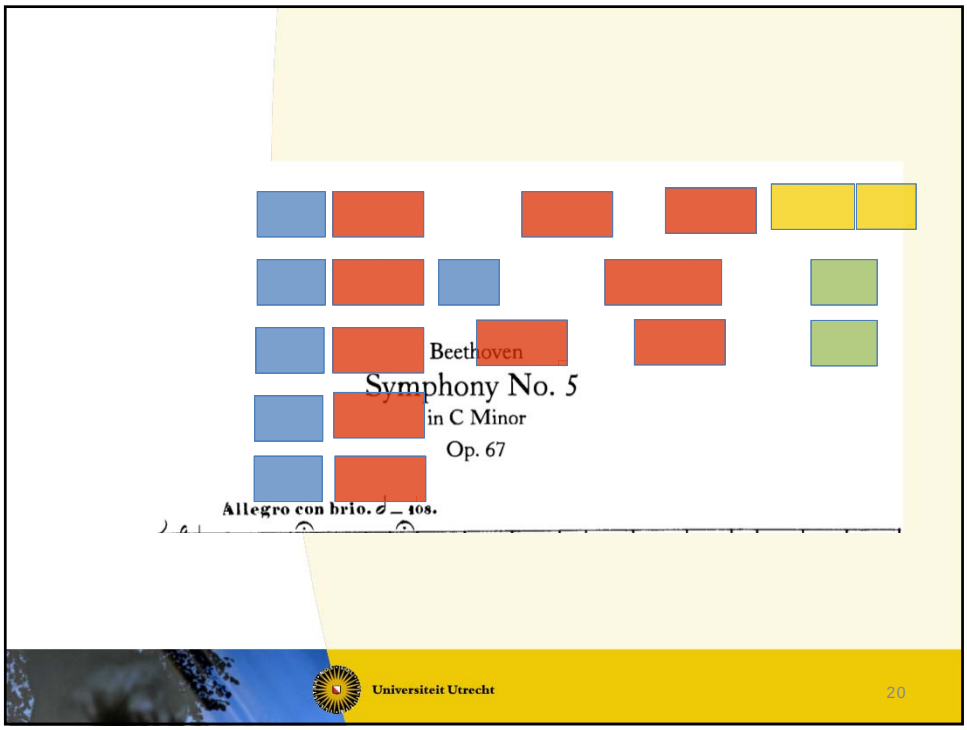
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Hypothetical user study outcomes

- different kinds of patterns
- similarity rather than identity
  - where does it stop?
  - what is similarity, computationally and perceptually?
- tuning of parameters → insight

- next step: high-level visualisations
- → consequences for score presentations

- A. Volk, W.B. de Haas, P. van Kranenburg. Towards modeling variation in music as foundation for similarity. *Proceedings ICMPC* (2012)
- F. Wiering. Digital critical editions of music: A multidimensional model. In: *Modern methods for musicology: Prospects, proposals and realities* (2009)

Technologies

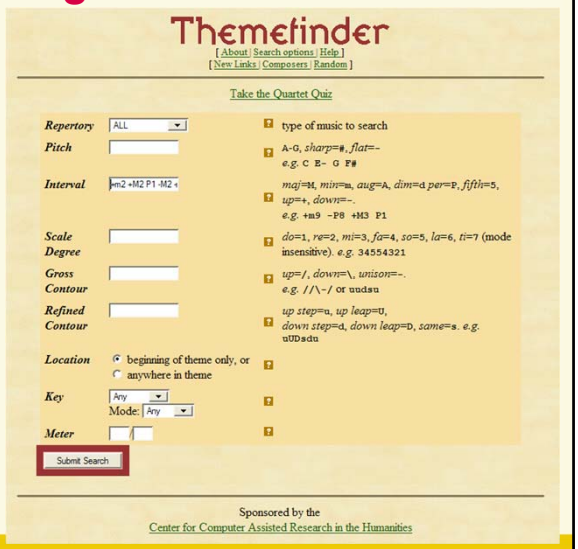
- much Computational Musicology/MIR research into similarity measures
  - different media (audio/notation)
  - different features (melody, harmony, rhythm, timbre…)
  - different granularities (section-work/song-genre)
  - negotiating perception and computation in modelling

- big question: are these measures uselful?
  - heuristically
  - providing understanding

- so far, mainly technology-driven
  - solutions in search of a problem

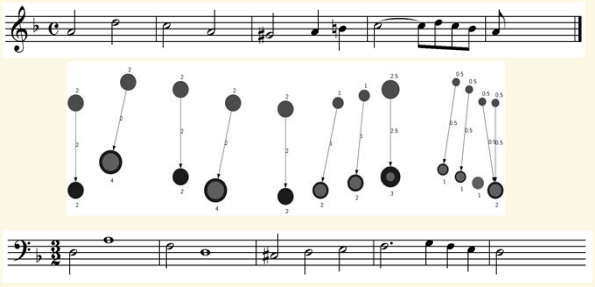
Pattern matching

- www.themefinder.org
- monophonic patterns
- simple and intuitive
- limitations
  - binary decision
  - 1 dimension
  - flexibility (wildcards) is not musically intuitive



Geometrical models

- idea: capture melodic contour
- 2-dimensional space (pitch, time)
- e.g. EMD/PTD
- weight represents duration (or other features)

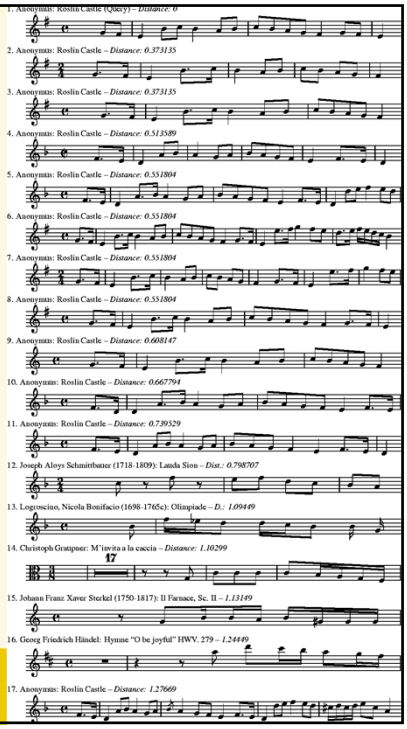


Earth Mover's Distance (EMD)

- used in RISM A/II incipit search
  - http://yahmuugle.cs.uu.nl
- R. Typke, F. Wiering, R.C. Veltkamp (2007) Transportation distances and human perception of melodic similarity. *Musicae Scientiae Discussion Forum 4A*

Geometrical models

- pros
  - OK handling of variation and ornamentation
  - suitable for patterns in polyphony
  - suitable for very large collections
- cons
  - how to extend feature space (everything becomes weight)
  - optimal weight flow need not be musically meaningful
  - insertions and deletions not handled well



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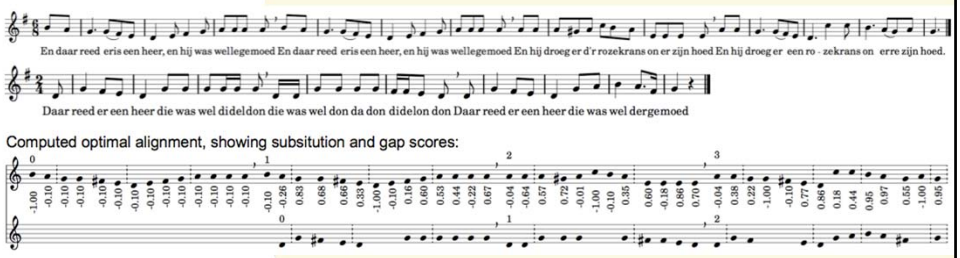
Sequence alignment



Computed optimal alignment, showing subsitution and gap scores:

- determine optimal alignment between 2 sequences of symbols
  - insertion, deletion and substitution scores
- implemented in folk song search engine
  - http://www.liederenbank.nl/index.php?wc=true
- P. van Kranenburg. *A computational approach to content-based retrieval of folk song melodies.* 2010.

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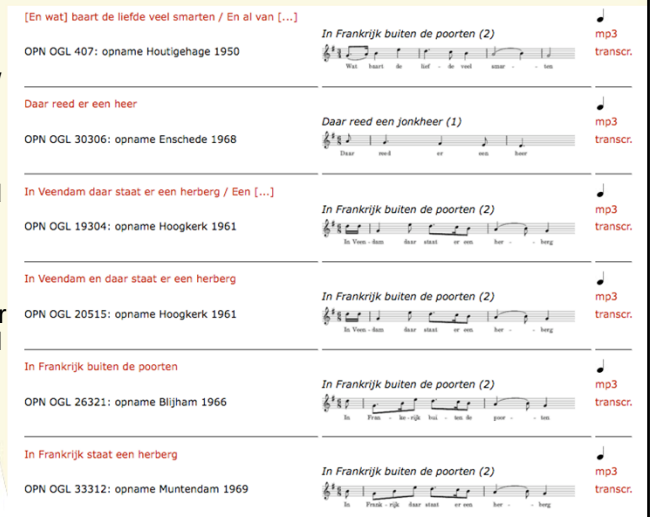
Sequence alignment

- pros
  - raters for new features easy to add
  - handles insertions and deletions well
- cons
  - restricted to monophony or 1-dimensional sequence
  - not yet tested outside folk song



Grammar of tonal harmony

- idea
  - define grammar
  - sequence of chord labels
  - create parse trees
  - compare trees
- application
  - cover song detection
  - improve audio chord transcription
- pros
  - error correction
  - grammar easily configurable
- cons
  - insertions and deletions not handled well
  - modulation weakly supported

4 $Ton_{\text{Maj}} \rightarrow I_{\text{Maj}} \mid I_{\text{Maj}}\ IV_{\text{Maj}}\ I_{\text{Maj}}$
5 $Ton_{\text{Min}} \rightarrow I^m_{\text{Min}} \mid I^m_{\text{Min}}\ IV^m_{\text{Min}}\ I^m_{\text{Min}}$
6 $Dom_{\mathbf{m}} \rightarrow V^7_{\mathbf{m}} \mid V_{\mathbf{m}}$ $\quad \mathbf{c} \in \{\varnothing, m, 7, 0\}$
7 $Sub_{\text{Maj}} \rightarrow IV^m_{\text{Maj}} \mid II^m_{\text{Maj}} \mid \ldots$
8 $Sub_{\text{Min}} \rightarrow IV_{\text{Min}} \mid II^m_{\text{Min}} \mid \ldots$

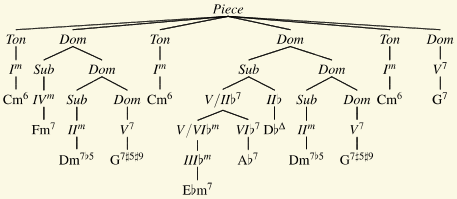


Figure 2. An analysis of the jazz standard *Blue Bossa* in C minor. Every chord belongs to a Tonic, Dominant, or Subdominant category (*Ton*, *Dom*, or *Sub*) and the V/X^7 denote chains of secondary dominants.

W.B. de Haas. *Music information retrieval based on tonal harmony*. 2012

Back to Sibelius' find facility

- many relevant features
  - what is a pattern?
- many computational methods
  - each with its limitations
- not a simple design task
  - balancing PACT elements in domain

- role of Digital Musicology
  - investigate work practices and needs
  - envision interactive solutions
  - incremental design
  - create new search technologies only if all else fails

What can be expected from Digital Musicology?

- in terms of technology, quite a lot
  - searching (notation, audio)
  - databases, digital editions
  - modelling of musical expertise
- weak on
  - non-musical data
  - contextualisation
  - opportunities of standard tools
  - relevance to musicology at large
- ambition
  - cover range from meaningful application of technology to computational design
  - skill and subdiscipline