Computers in Systematic Musicology

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SysMus 2019
HdPK Berlin
Sep 12, 2019

Agenda for today

- Let's talk
- A little bit of input
- Hands-on exercises for everyone

Well, so, let’s talk

Some questions

- Which computer programs do you use and what for?
- Would your current work be possible without computers?
- Which computer programs would you like to learn/use?
- Which tasks would you really like to with computers, which seems not possible yet (assuming Martian technology)?

Some more questions

- Who has heard of the following tools/frameworks?
  - R
  - Python
  - Sonic Visualiser
  - PRAAT
  - Tony
  - Librosa
  - MIRToolBox
  - MIDIToolBox
  - Music 21
  - MeloSpyGUI
  - humdrum

Computers in Musicology

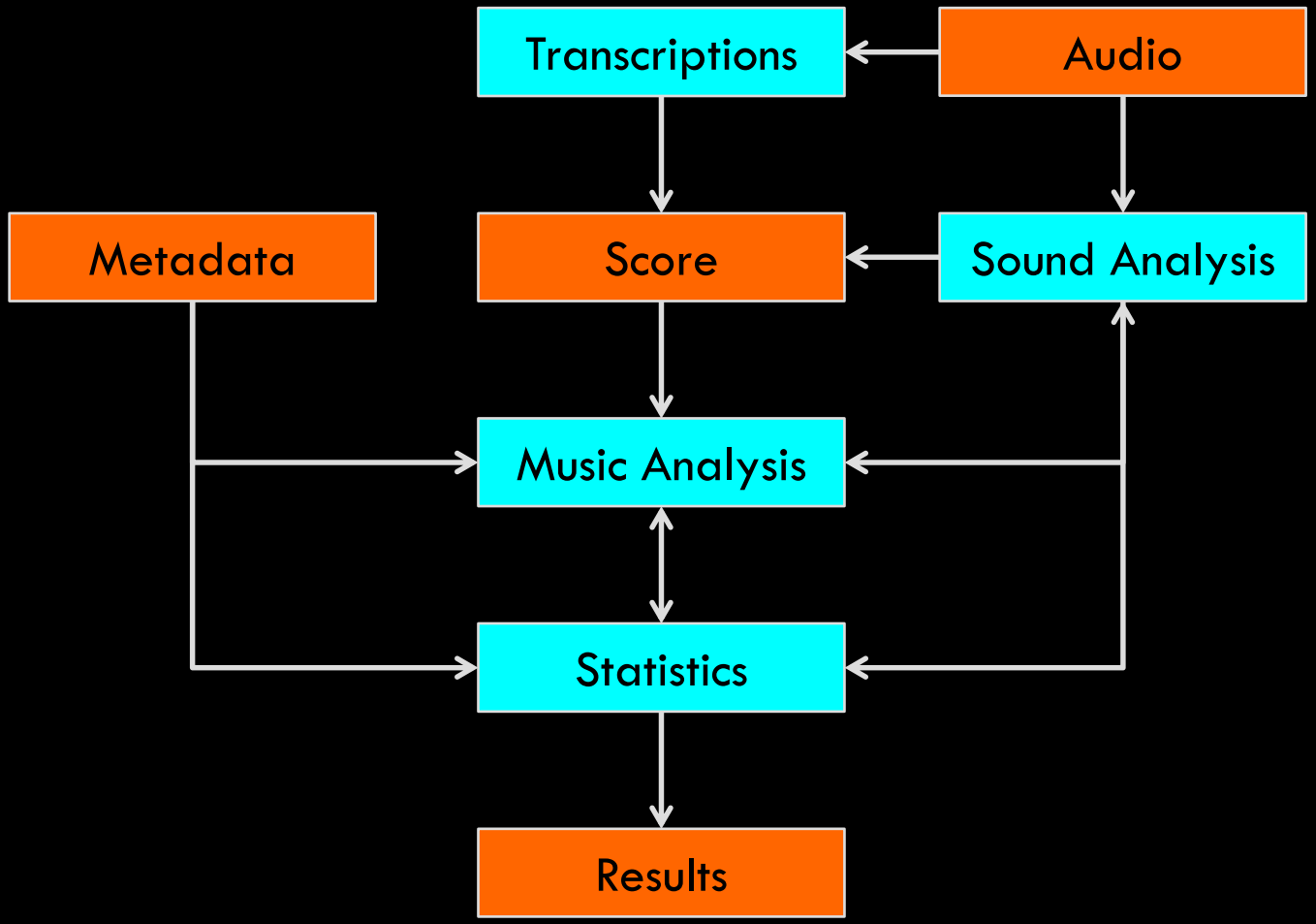
- Experiments
  - Stimulus preparation (Audio tools, PD, MAX/MSP…)
  - Experimental control and presentation (Inquisit, MediaLab, DirectRT, E-Prime…,)
  - Device controller (fMRI, EEG, TMS, EMG, motion capture, eye tracking …)
  - Online surveys (Qualtrics, LimeSurvey, Mechanical Turk…)
  - Databases (WJazzD, EsAC, MuseScore, Million Song Dataset ….)
- Data analysis
  - Statistics (SPSS, Excel, R, SAS…)
  - Computational analysis (humdrum, Praat, Sonic Visualiser, MeloSpyGUI…)
- Communication & Presentation
  - Text-processing (Word, OpenOffice, LaTex…)
  - Presentation tools (Power Point, KeyNote, Prezi…)
  - Communication (E-mail, Skype, Twitter, Blogs, Journals…)
  - Online Search Tools (PsycNet…)

Computational Musicology

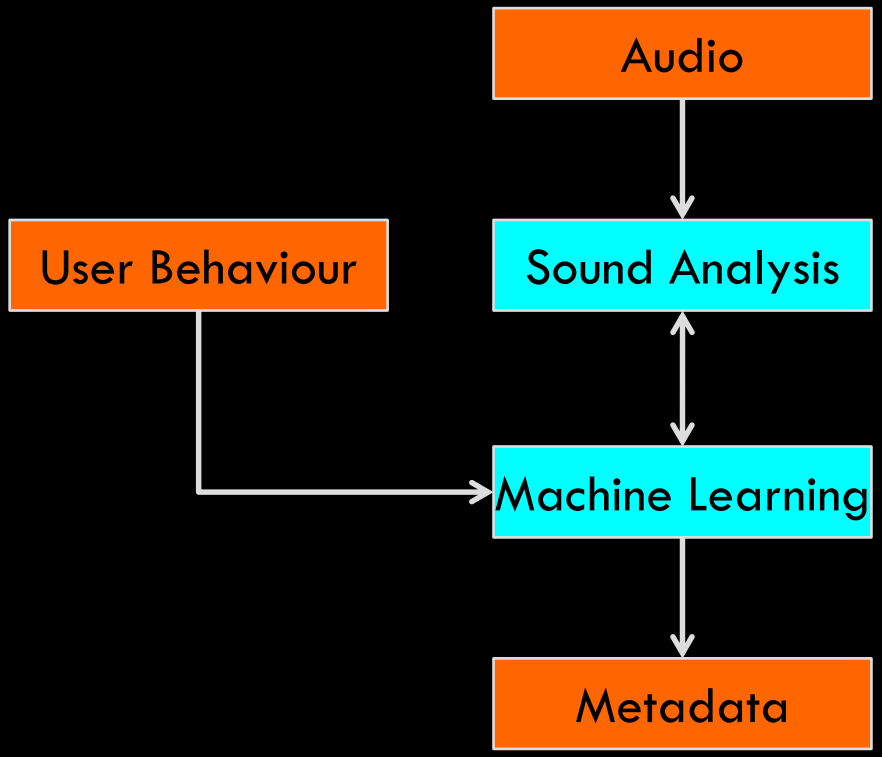
Computational Musicology

- Complements and enhances existing and provides new analysis methods.
- Pioneered by corpus-based sub-fields of musicology (e.g., ethnomusicology, Early Music research).
- Boost since the early 2000s driven by Music Information Retrieval and by pervasion of computers and the internet („Music Google“).
- Very active research field.
- Connections to many different subfields of musicology.
- Computational ≠ digital musicology!

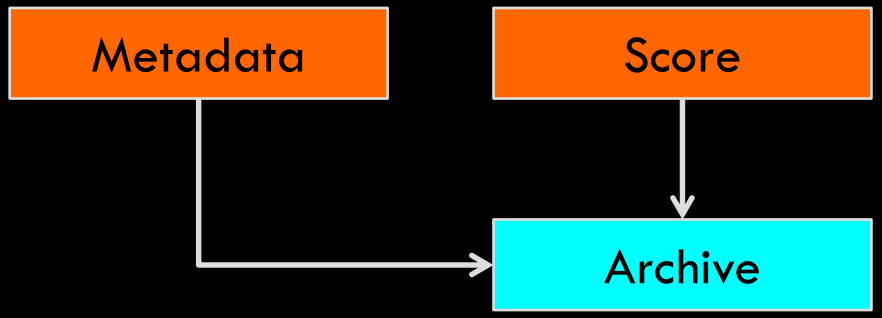
Computational Musicology



Music Information Retrieval



Digial Musicology



Computational Musicology

- Advantages:
  - Facilitates collection and curation of big data sets (improved reliability).
  - Necessary to analyse big musical data sets.
  - Acceleration of research processes.
  - Development, test and simulation of models.
  - Enables analysis pathways that are otherwise hard to obtain (e.g., timbre, intensity, intonation).

Computational Musicology

- Issues:
  - Focus on quantitative methods.
  - Often simplified and specific definitions of concepts are needed to suit them for computer-use (can also be an advantage!).
  - High entry threshold (extra knowledge in maths, computer science, stats, machine learning, signal procession etc. required).
  - „Proving the obvious“ (but: „hindsight bias“).
  - Fear of “trivializing” the music and the musician.

Features

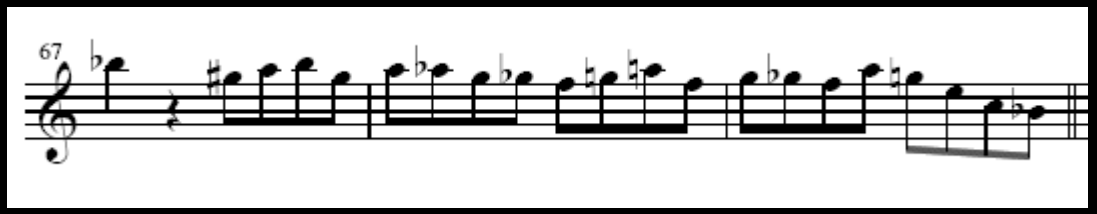
- Features are numerical or categorial properties of entities, here: of melodies (or music in general).
- Mostly based on some transformation of the melodical surface.
- External metadata also considered features.
- Possibility space for feature is virtually infinite (modular construction system: „feature machine“).
- Currently, over 600 pre-defined features in the MeloSpyGUI.
- MIR uses mostly sound features derived directly from the audio.

Tonal transformations

- Pitch (pitch):
  - Absolute pitch (MIDI encoding).
- Extended chordal diatonic pitch class (cdpcx):
  - Root = 1, Thirds = 3, Fourth = 4 etc.,
  - Chromatics: #11: Tritone, #9: m3 over major chord, #10: M3 over minor chord, #7= M7 over minor chord, b7= m7 over maj7 chord, b13: m6 over major chord, b9 = flat ninth
  - Example: Lydian scale over major → 123[#11]567.
- Intervals (int):
  - Difference of subsequent pitches as semitones.
  - Example: Major scale → +2 +2 +1 +2 +2 +2 +1.

Transformations

Excerpt from Bob Berg's solo on „Angles"



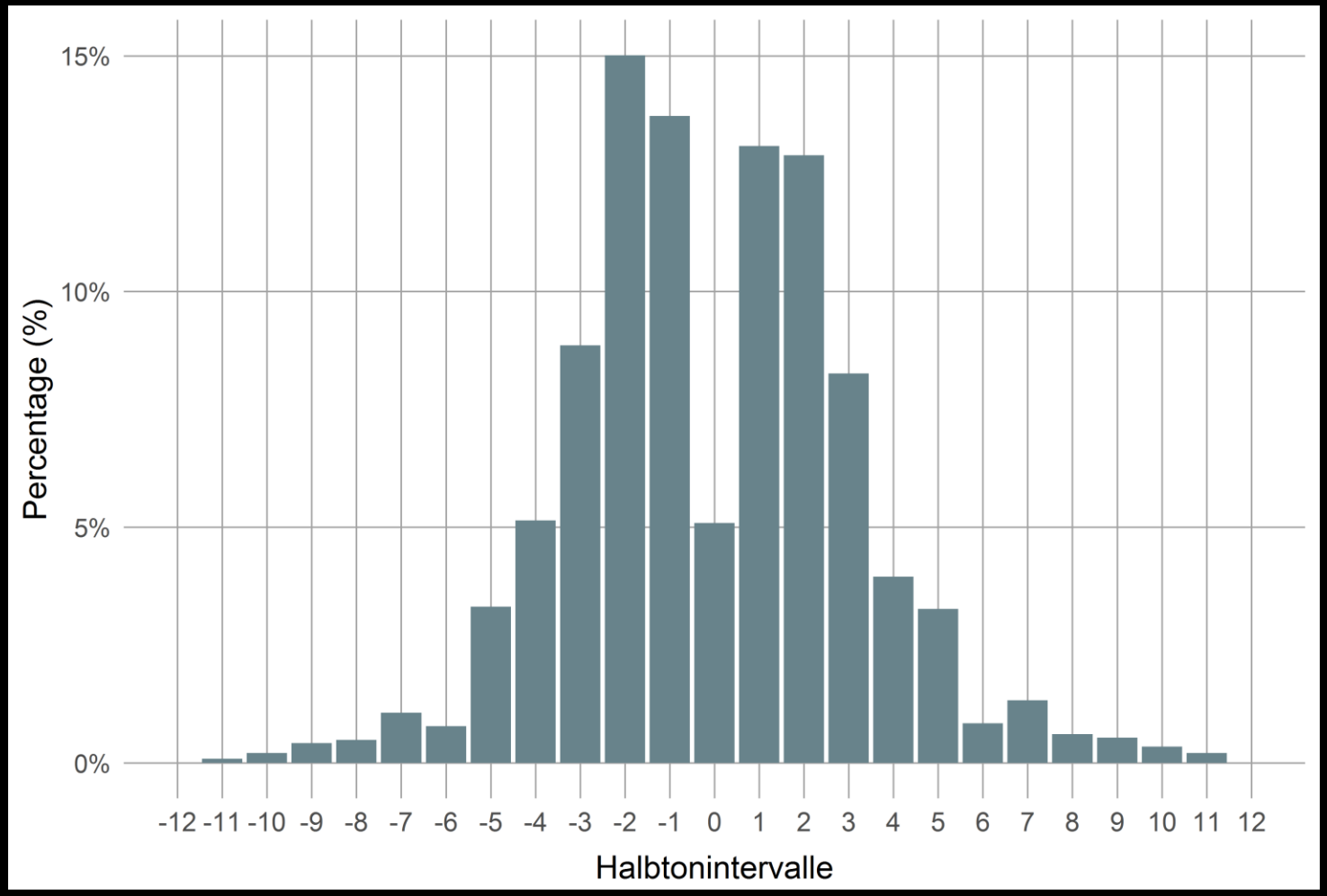
pc: 10 8 9 10 8 9 8 7 6 5 6 9 5 7 6 5 9 7 4 0 10

cpc : 7 5 6 7 5 6 5 4 3 2 4 6 2 4 3 2 6 4 1 9 7

cdpcx: 5 4 T 5 4 T 4 3 B 2 3 T 2 3 B 2 T 3 2 6 5

int: -2 1 1 -2 1 -1 -1 -1 -1 2 2 -4 2 -1 -1 4 -2 -3 -4-2

Example: Interval Distribution



Hands-on for everyone

JRP/DTL Web Tools

Tools to be used

- Feature History Explorer
- Pattern History Explorer
- Dig That Lick Pattern Search
- Dig That Lick Similarity Search

  Links: https://jazzomat.hfm-weimar.de/interactive.html
- Sonic Visualiser (https://www.sonicvisualiser.org/)
- Tony (https://code.soundsoftware.ac.uk/projects/tony)

Feature History Explorer

- Visualizes development of solo features in the WJD over time.
  - x-axis: recording year (or decade).
  - y-axis: selected feature.
  - Scatterplot with (polynomial) regression line.
  - Goodness-of-fit values: R^2, p value, AIC.
  - With or without aggregation.
  - Filtering, colouring, and presentations options.
  - Selecting area in plot displays data table for selected solos (only for unaggregated data).

Pattern History Explorer

- Contains selection of 653 common interval patterns by eminent performers and its instances in the WJD.
- See “Help” tab for further details
  - Listen & See: Shows pattern instances (score, audio, metadata)
  - Instances: More detailed info on instances
  - Stats: Stats for the pattern and its instances
  - Timeline: Distribution of instances over recording time and performers
  - General Stats: Stats of all patterns

Dig That Lick Pattern Search

- Allows very flexible search for patterns in the WJD, the Essen Folk Song Collection and the Omnibook.
- Entry via abstract notation or virtual keyboard.
- Many different types of patterns. (“transformations”)
- Secondary search (search in search results).
- Metadata filter
- Displays scores and audios + additional metadata.

Dig That Lick Similarity Search

- Allows similarity search for patterns in the WJD.
- Entry via abstract notation or virtual keyboard.
- Interval, fuzzy interval, pitch and CDPCX patterns.
- Metadata filter.
- Filter for extra conditions.
- Displays audios + additional metadata.
- Timeline and network visualizations.

Exercises

- All questions and exercises (+ more) can be found here:
  https://github.com/klausfrieler/digthatlick_lecture
- Exercise are of different difficulty levels and mostly open ended.
- Please choose freely exercises and tools you want to work on.
- Group work highly recommended.
- Ask me anything anytime.
- Send me your results by e-mail, if you want to have feedback.
- Have fun!

Feature History Explorer

Questions & Tasks (select as you wish)

1. What does abs_int_range mean? Give an intuitive explanation.
2. What drives the trend in abs_int_range?
3. What does CDPCX mean?
4. Which CDPCX values show significant trends?
5. How do trends changes when you select “Mean” aggregation? Why?
6. Find a feature with a much better quadratic trend (= larger R^2 and smaller AIC).
7. Which solo has the highest event density, which the lowest?
8. Which feature has the strongest aggregated trend?

Pattern History Explorer

Questions & Tasks (select as you wish)

1. Find the longest arpeggio patterns. Who owns it?
2. Find the longest "non-trivial" (non-trill, non-repetition) pattern. What can be said of its start pitch, harmonic context, accent pattern?
3. Find the most frequent pattern with the longest stretch of an ascending or descending whole tone scale. Who owns it? Who played it first (in the WJD)? Which are more common: ascending or descending?

Dig That Lick Pattern Search

Questions & Tasks (select as you wish)

1. Find "The Lick" in the WJD. Does it exist in the Essen Collection and the Omnibook? (Find the Lick on the internet).
2. Find the beginning of "Hänschen Klein" in the WJD. Which is the most similar instance, why? Why are other instances not similar at all?
3. Repeat one of the previous searches with tone context of 2 or more tones before and after. How does it change the pattern impression? What are the most common pre/successions?
4. Find the longest ascending whole tone scale segment (within a single phrase) with only one search request.

Dig That Lick Similarity Search

Questions & Tasks (select as you wish)

1. How would you define pattern similarity? How did we define it?
2. Search for an interval pattern of choice with 5 elements. How many instances for similarity thresholds 1, .75, .5 and maximal length difference 0, 1, 2 do you get?
3. Search for "The Lick" with min sim = .8, max diff = 0. Then repeat: Start new similarity search (right click on the pattern) for the most frequent and most similar but not identical pattern. Does "The Lick" disappear from the result set? What happens? Why?
4. Find the most frequent 8-interval pattern by Chris Potter and play it at half speed. Who owns the pattern? How might it reflect influences? What is the most common start pitch? How does is mostly fit the chords? (Tip: Don't forget the PHE).

SV: Tatra Tempo Curve

- Tools: Sonic Visualiser.
- Background: Expressive timing is an important concept not only classical but also in folk music, e.g. music of the Gorales from the Tatra mountains in Poland.
- Question: Is there a connection between different form parts and expressive timing/rubato? How do the players actually synchronize?
- Task 1: Generate a tempo curve.
- Task 2: Identify and annotate form parts
- Task 3: Try an automatic beat tracker plugins and evaluate their performance.
- Bonus task: How would you analyse scales, chords and overall tuning?

Tony: Hindewhu

- Tools: Tony/Sonic Visualiser.
- Background: Automated or semi-automatic transcription is one the main applications of MIR. The monophonic case is already satisfyingly solved – at least for pitches, onsets and durations. Further annotations (e.g., metrical) are still a problem.
- Task 1: Create note track using Tony (recommended) or pYIN plugin for SV (or both). Analyse pitches (scale, tuning system, precision, accucary).
- Task 2: Create a beat track, add metrical annotations by hand. Analyse rhythm statistically.
- Task 3: Prepare a full transcription of an excerpt (or all of it).