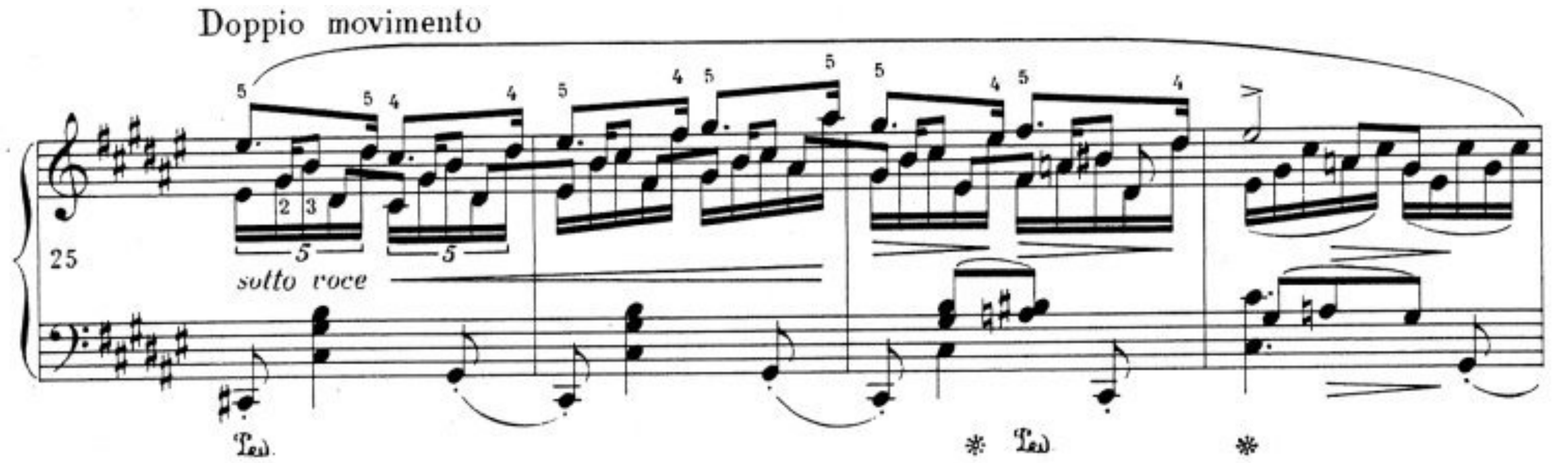
Traitement de la musique écrite et éducation musicale



Action Exploratoire Inria Codex **Équipe Vertigo, Cedric, CNAM**

Philippe Rigaux
le cnam Paris

Florent Jacquemard
Inria informatiques mathématiques

Raphaël Fournier-S'niehotta
le cnam

Lydia Rodriguez-de la Nava
PhD (Codex, Inria)

Tiange Zhu
PhD (Polifonia, H2020)

Léo Géré
PhD (ED SMI, CNAM)

JSI - 31/08/2023

Milton Babbit's trinity of music representational domains

These are 3 aspects of Music. None is Music.

acoustic
domain
physical
musical acoustics
signal processing

playback

recording

performance

listening

graphemic
domain
notated
symbolic representations
music notation language
computational musicology

score reading (audiation)

transcription

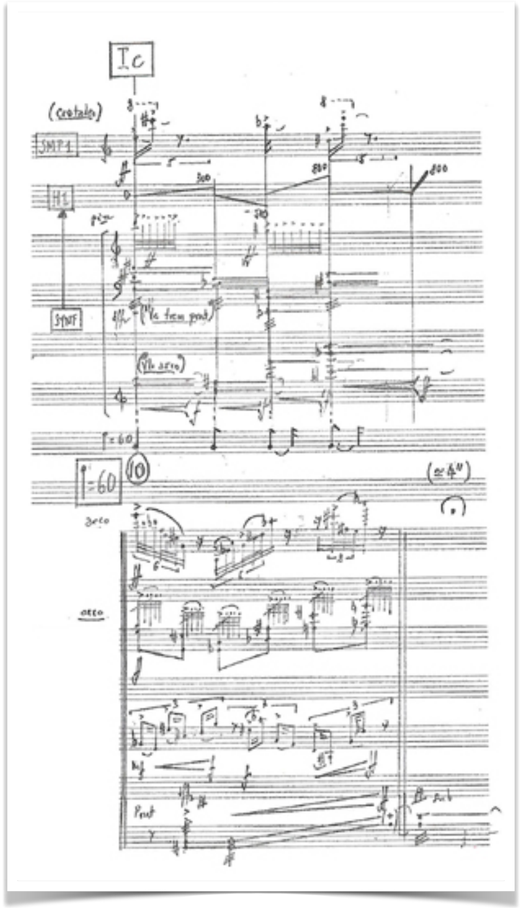
auditory
domain
perceived
cognitive studies
psycho-acoustics
neuroscience

Why studying Western Music Notation today?

writing music with

Ableton Live 11

or

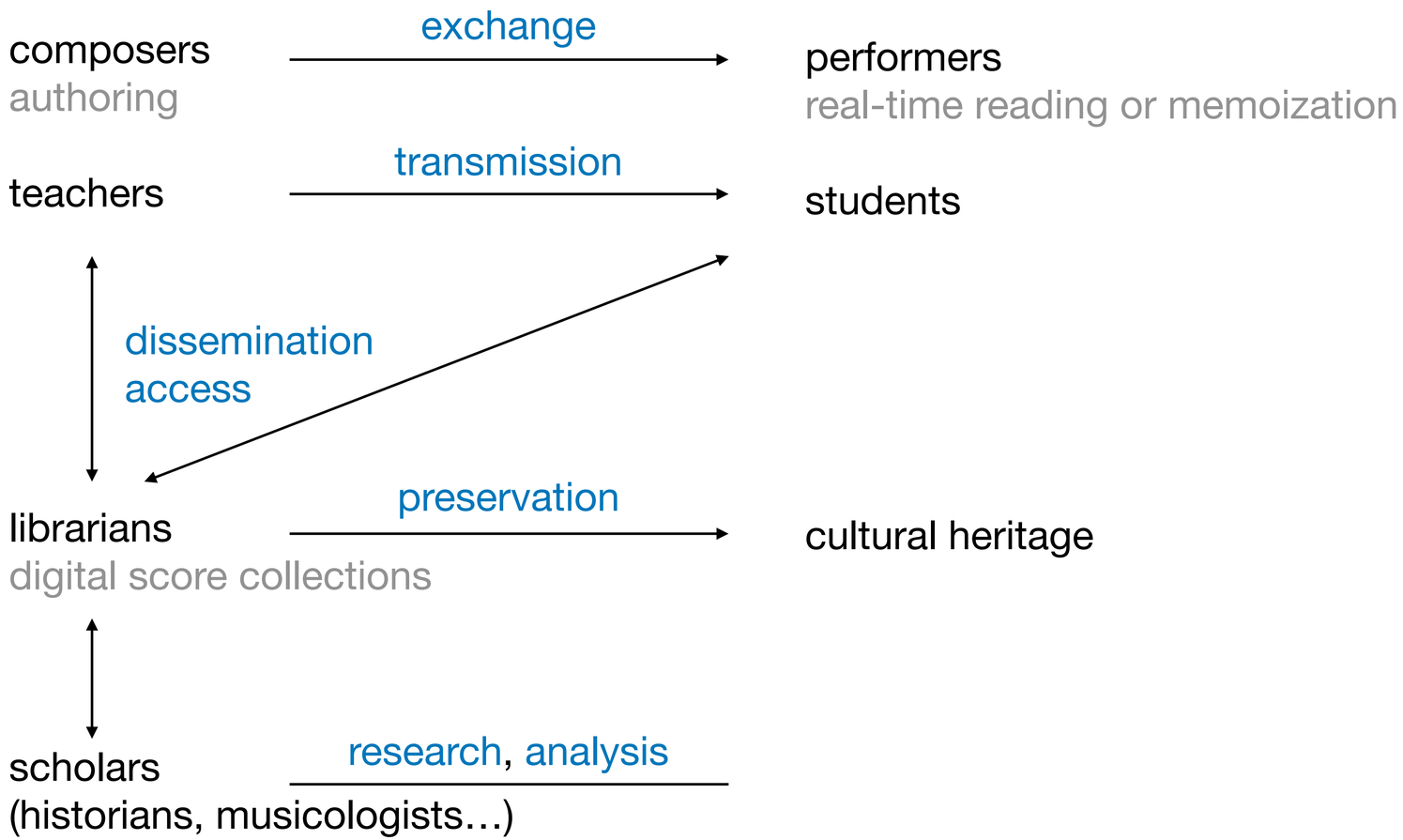


Philippe Manoury
Tensio for string quartet and electronics

Why studying Music Notation Processing?

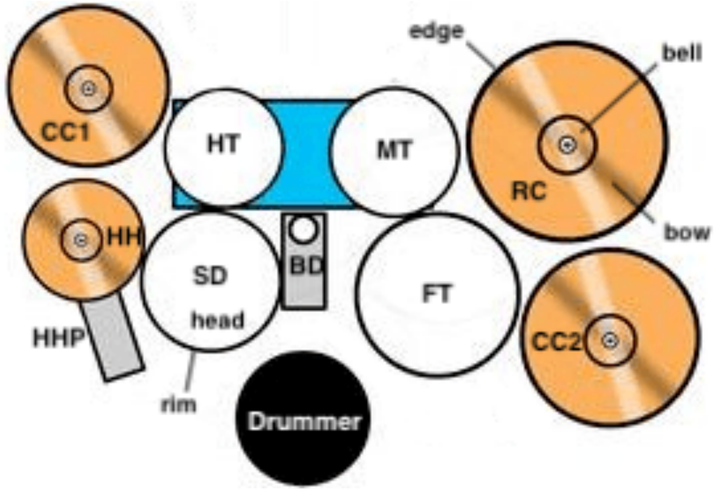
Western Music Notation = graphical language for the exchange of musical information since 1025 (*Guido d'Arezzo*)

(digital) music scores, a vector of

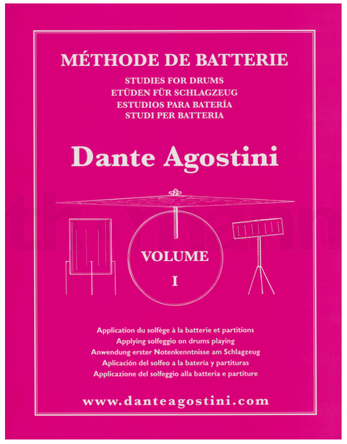


Drum kit

- born in 20th century
- has long gone without score
  drummer had to read score of other instrument
- drum schools : second half 20th century



Dante Agostini

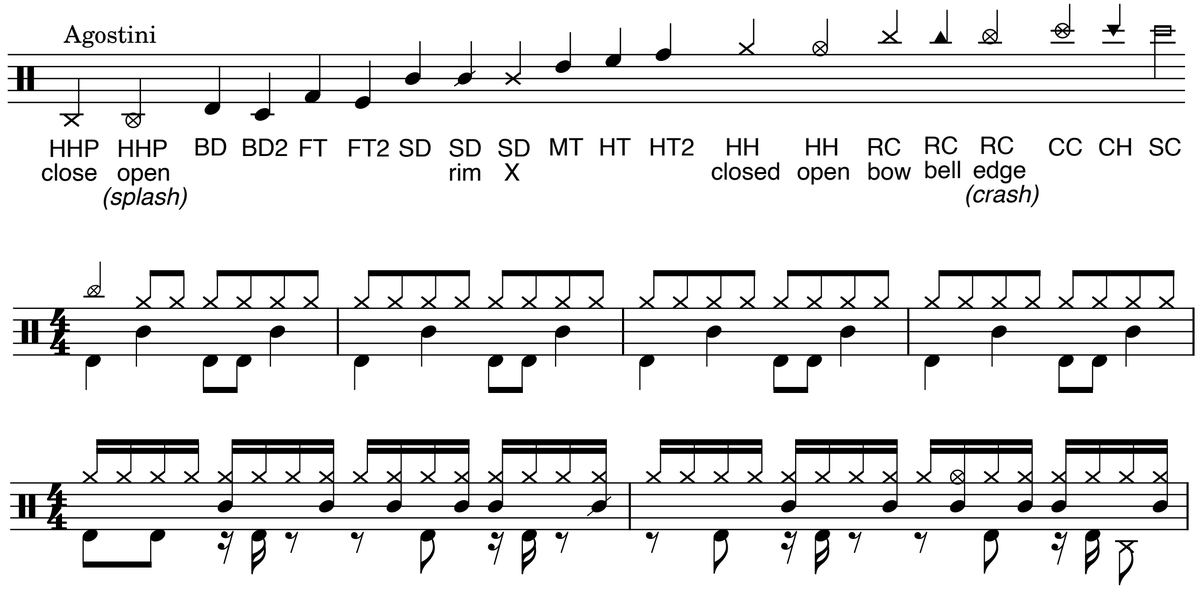


→ Drum Notation

- transmission of styles
- preservation of performances

Based on Common Western Notation

- standard rhythm notation
- *note height*: part of drum kit
- *notehead*: mode



Groove MIDI Dataset

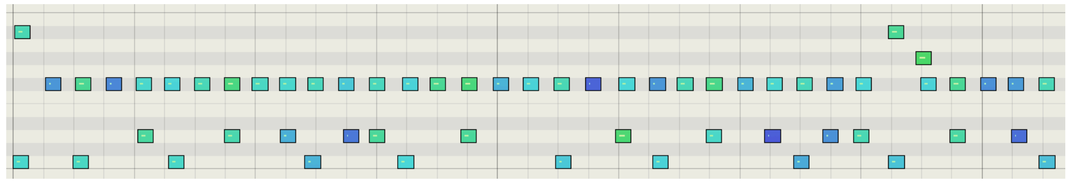
music transcription : Conversion of a recorded music performance into a music score

~ **speech-to-text** in NLP

- dataset GMD by Google Magenta
  https://magenta.tensorflow.org/datasets/groove

- 13.6 hours recorded by professional drummers
  on an electronic drum kit

- in 1150 MIDI files ~ 22000 measures



- several genres (*afrobeat, afrocuban, blues, country, dance, funk, gospel, highlife, hiphop, jazz, latin, neworleans, pop, punk, reggae, rock, soul*)

- audio (wav) files
  synthesized from (and aligned to) MIDI files
  for training and evaluation of audio-to-MIDI
  drum transcription systems

- no score files!

Scoring the Groove MIDI Dataset

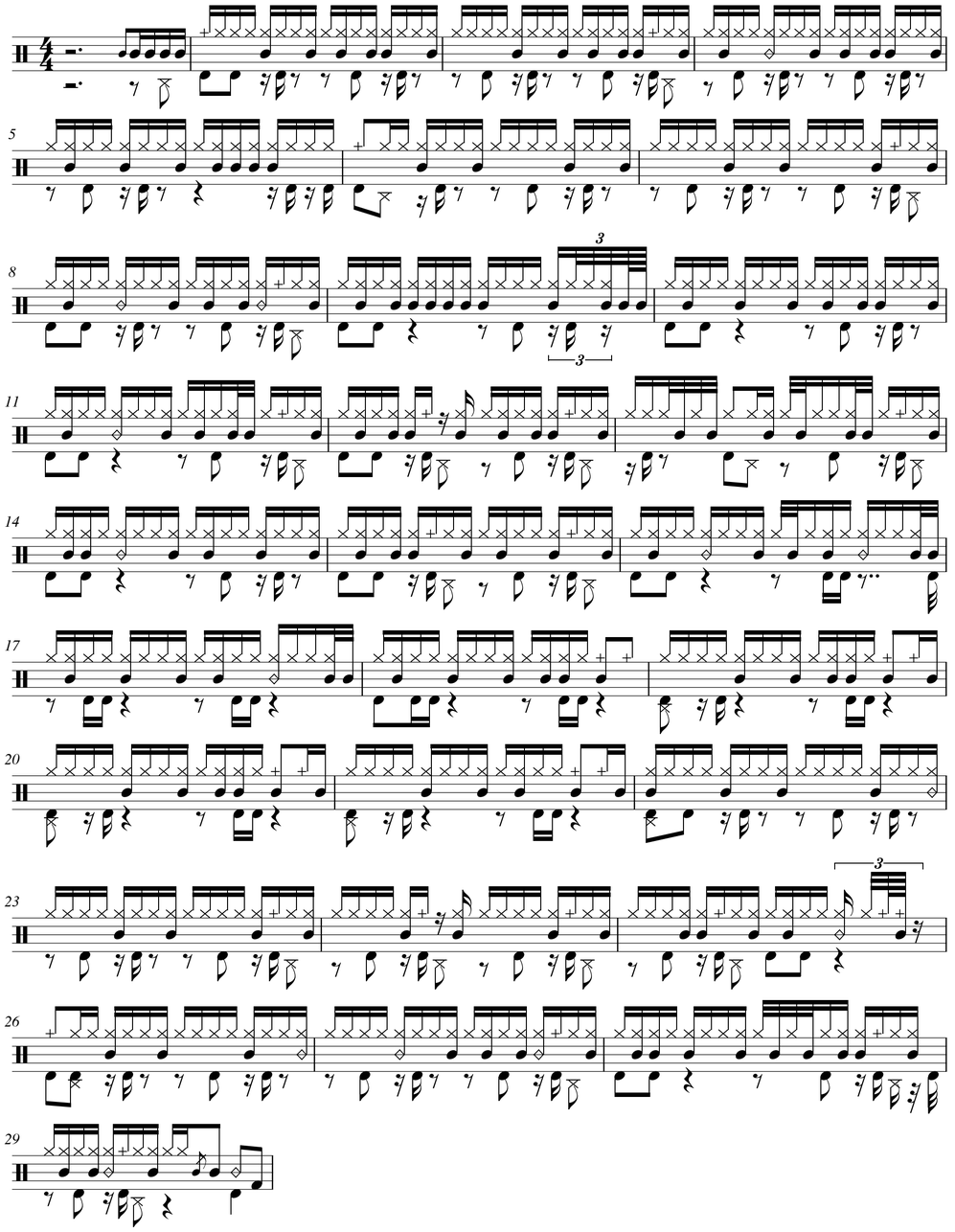
with Martin Digard (INALCO), Lydia Rodrigez-de la Nava (PhD)

automated transcription of GMD MIDI files into drum notation

- **quantitative parsing** approach
  - every score file (XML) is produced from a MIDI file with a generic *rhythm tree grammar* (4/4 measure)
    defining the time positions expressible in score
  - MIDI tokenization with constraints specific to drumming
    when several MIDI events are aligned to the same time position
    e.g. hands ≤ 2, feet ≤ 2
  - processing errors from MIDI sensors

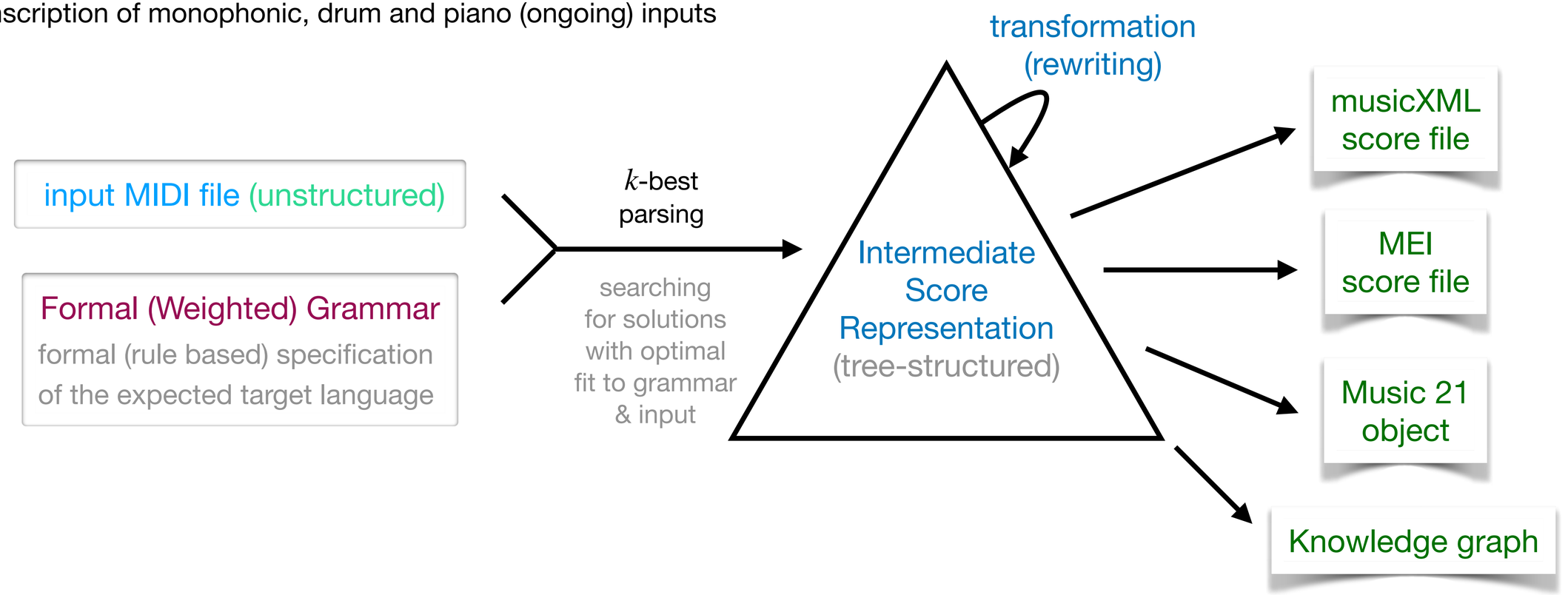
- polyphonic transcription case-study, simpler than piano

- using system **qparse** for music transcription



Music transcription workflow (qparse)

system for the transcription of monophonic, drum and piano (ongoing) inputs



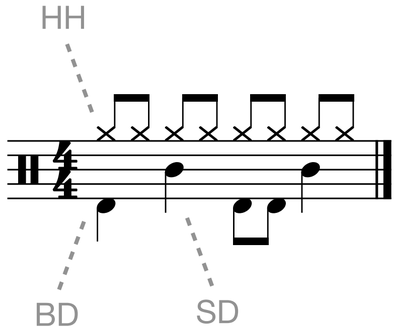
https://gitlab.inria.fr/qparse/qparselib 75 Kloc C++

https://qparse.gitlabpages.inria.fr

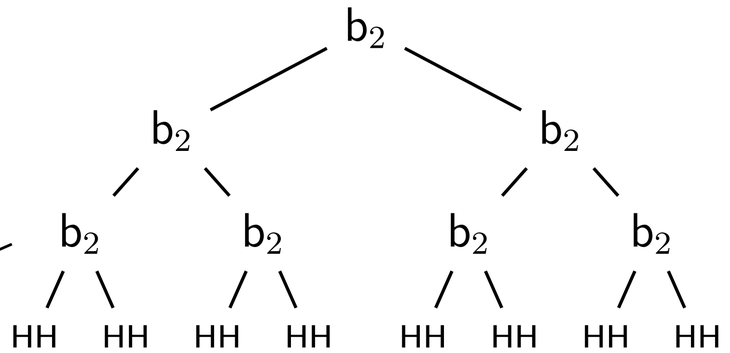
- Command lines tools (monophonic, drum, piano)
- Python binding - Lydia Rodrigez-de la Nava
- several output formats (Philippe Rigaux, Clément Buon, …)
- Online port, real-time - Leyla Villaroel
- Other subtasks: pitch-spelling, key estimation, beat/tempo tracking…

Tree-structured Intermediate Score Representation

trees define time positions in score
by hierarchical divisions of time intervals



voice 1

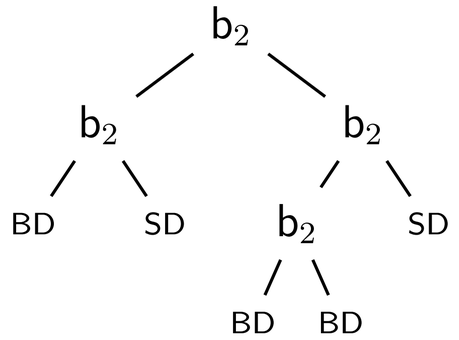


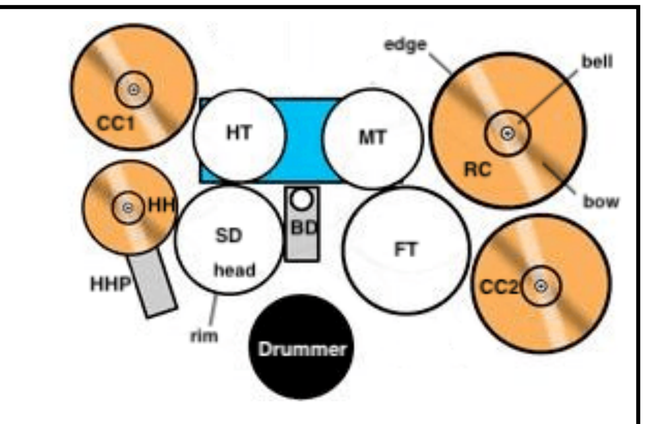
1 measure

4 beats

2 16th notes per beat

voice 2



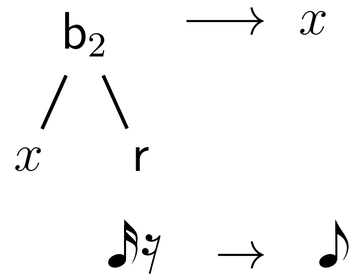


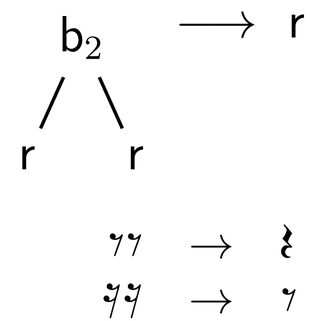
Transforming the Score Representation

rewriting = post-processing in drum transcription workflow

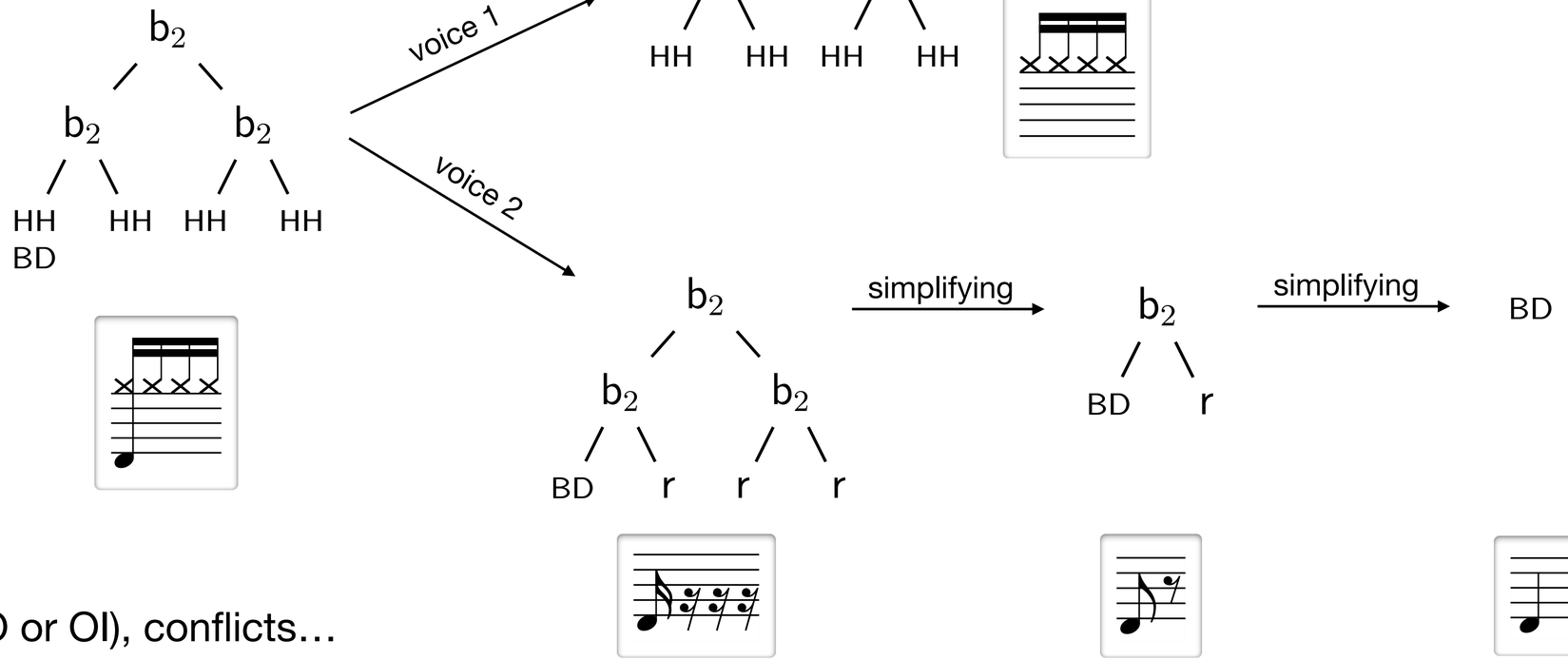
based on simplification rules

applicable at any position of the tree



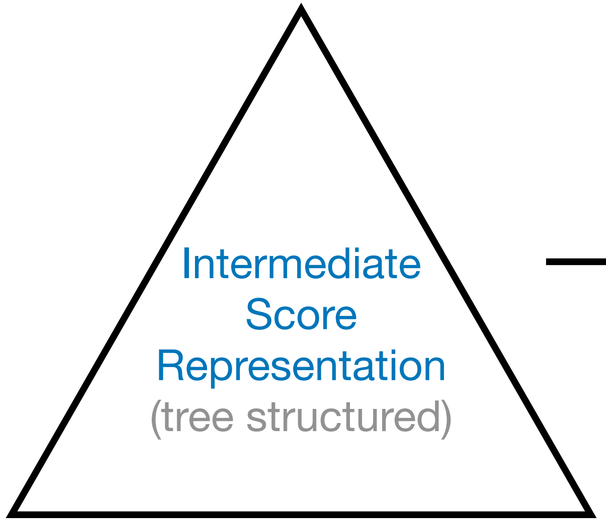


voice separation & simplification



problems: rewrite strategies (*e.g.* IO or OI), conflicts…

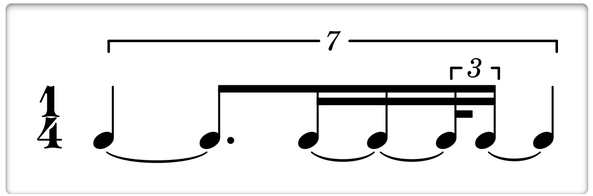
Information Extraction (1)

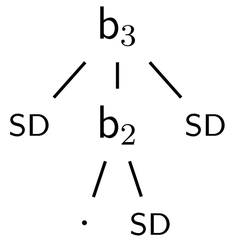


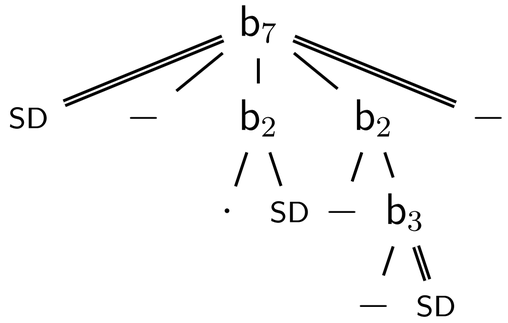
metric of complexity

evaluation of score readability or difficulty
based on tree *size*, *depth*, *branching degrees*…

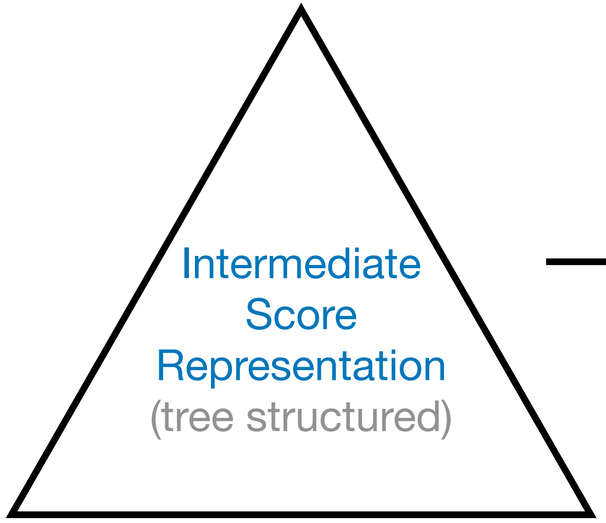
two notations
for a *sicilienne*







Information Extraction (1)



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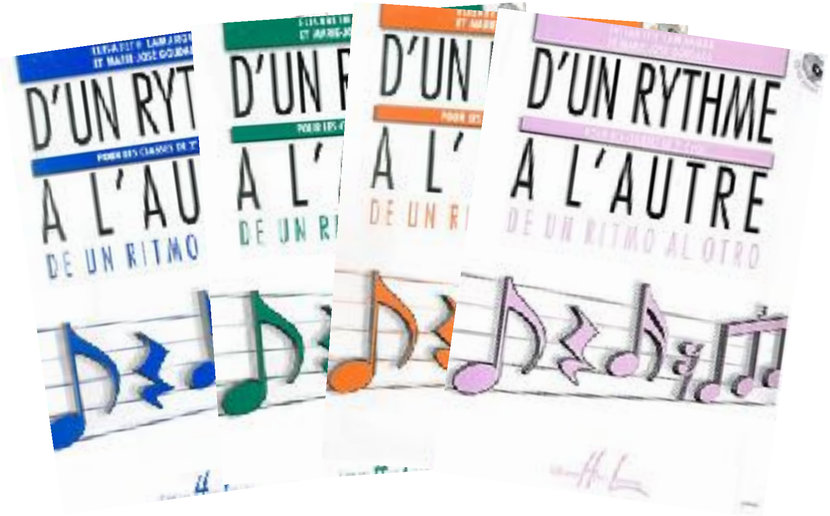
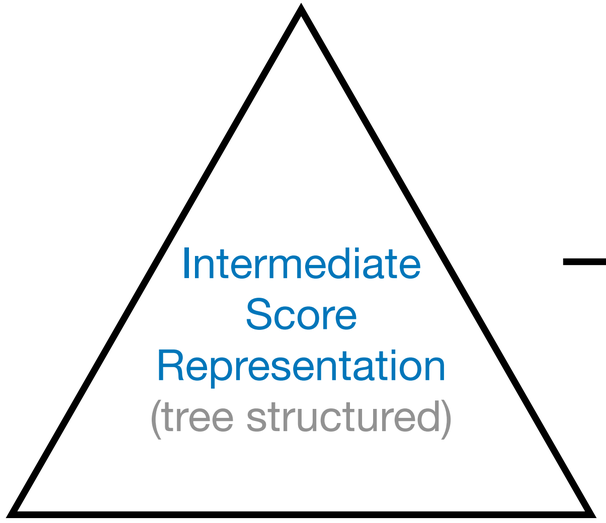


Information Extraction (2)



musicological descriptors

(tonality, irregular rhythms,
nb accidentals, intervals…)

Jean-Paul Despax, dir. Rémi Goasdoué (EDA, U. Paris-Cité CNRS)
PhD on Education Sciences : *Musical ear training*

- digitization (MusicXML) of a large corpus of musical dictations from CNSM 1957-1989
  > 350 exercices
  > 1250 student papers

- extraction of descriptors with Music21
  (collaboration, w. Augustin Bouquillard)

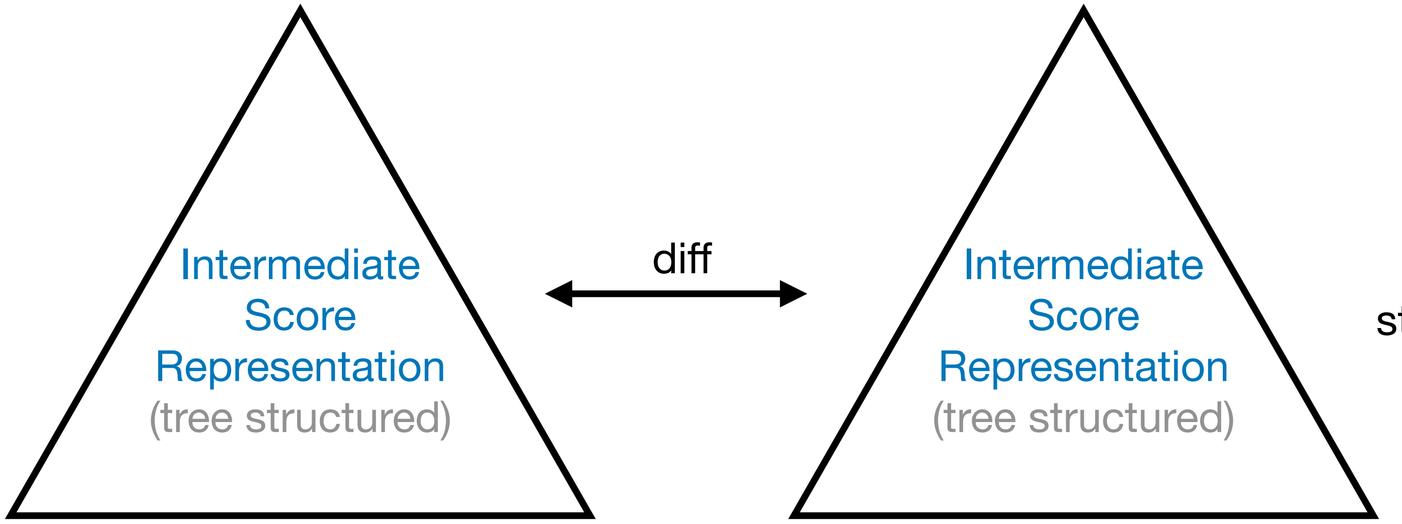
- clusterization

- cross-analysis exercices / papers
  correlation instrument / errors

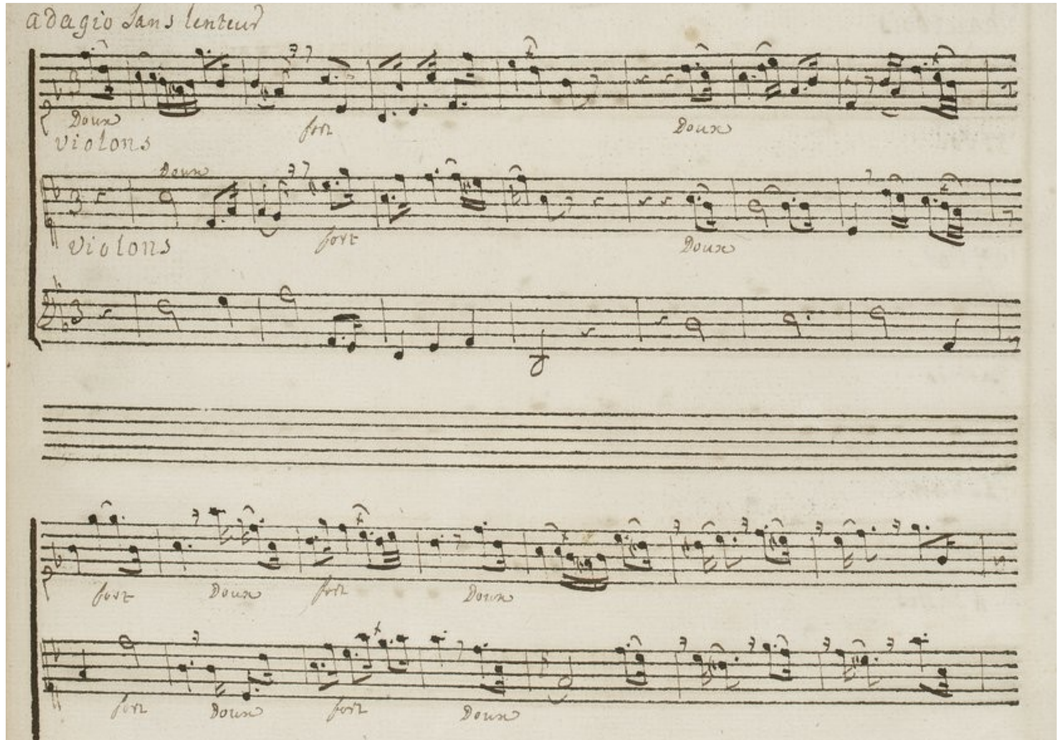
Similarity Metrics (1)

score-diff tool
w. Francesco Foscarin

case study on
Rameau ouvertures
Optical Music Recognition
(OMR)
and correction by
IReMus lab.



evaluation combining
string and tree edit-distances



Les Surprises de l'amour
Jean-Philippe Rameau
Ouverture, adagio

BnF © *Gallica*

Similarity Metrics (1)

score-diff tool
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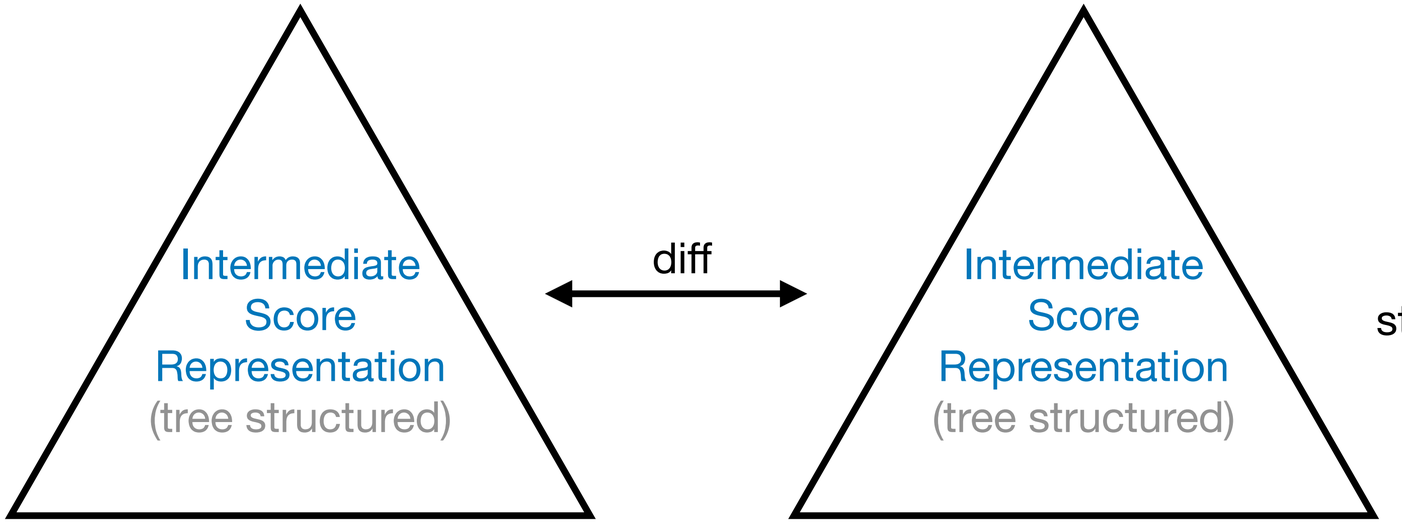
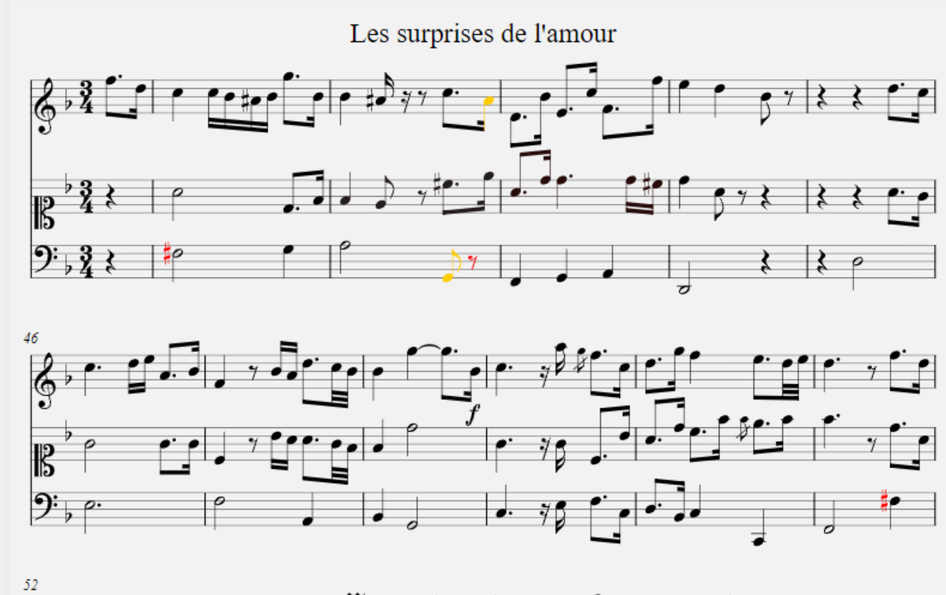
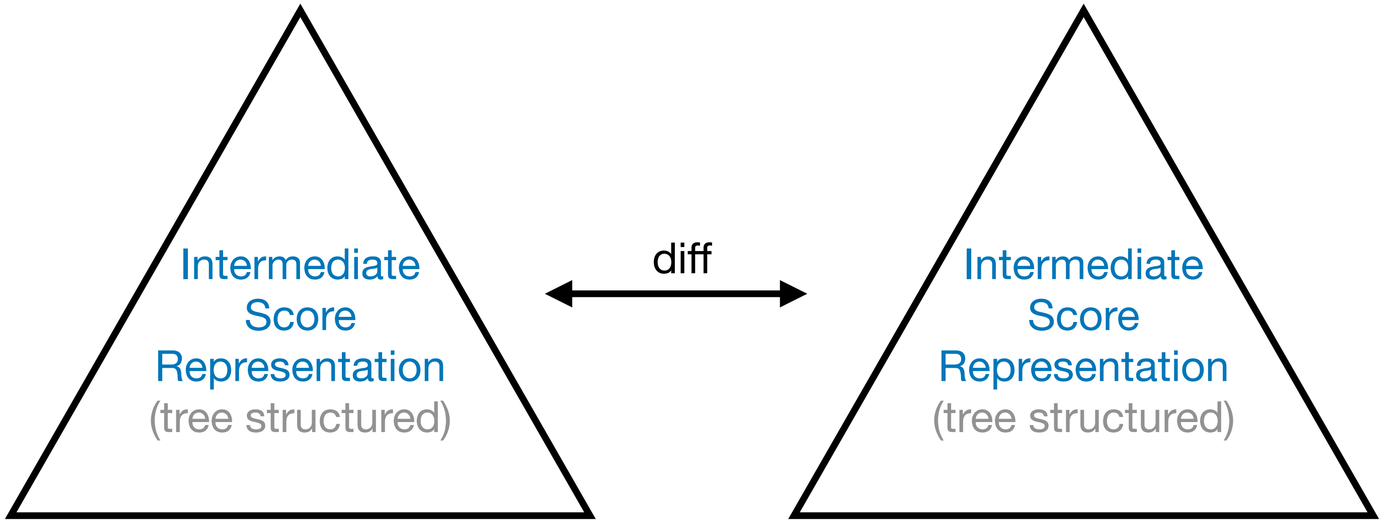


evaluation combining
string and tree edit-distances

OMRized version



Manual correction (ground truth)



ANR Collabscore

CNAM, IRISA, IReMus, BnF, Fondation Royaumont

project on score collection digitization (OMR) and collaborative (crowd) correction

- demonstrator by Fondation Royaumont, for public dissemination
  Debussy *Fantaisie for piano and orchestra* (1889-1990)
- several revisions by Debussy:
  annotations and autographes of the composer
- printed edition with annotations by Alfred Cortot (for the creation in 1919)
- objective of demonstrator:
  - OMRization of editions + annotations
  - visualisation of differences between the revisions

Summary

- Abstract model of music scores
  tree-structured
- Techniques and Tools to
  build, transform, export, analyse scores
- Applications
  - Transcription (monophonic, drum, piano)
  - IE: complexity measure, descriptors
  - Computation of similarity metrics and diff list

Collaborations

- Musicologists
  IReMus (SU,CNRS, Paris), Algomus (Cristal, Lille)
- Education sciences
  EDA
  analysis, IE
- Librarians
  BnF (Gallica), Royaumont foundation
  digitization, public dissemination
- Company
  Metronaut
  automatic accompaniment app

Thank you!