Automated Transcription of Electronic Drumkits

Martin Digard

inalco
Institut national des langues et civilisations orientales

Florent Jacquemard

Inria informatiques mathématiques
le cnam

Lydia Rodriguez-de la Nava

Inria informatiques mathématiques
le cnam

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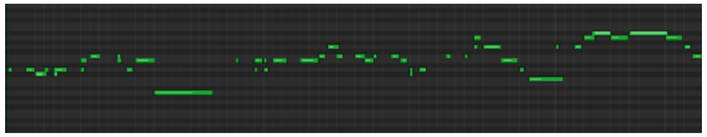
Objective & Outline

source
MIDI drumkit

symbolic representation
of performance
piano roll (MIDI file)

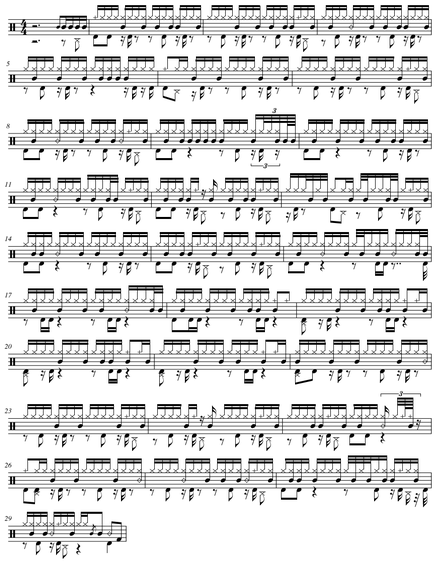
- only NOTE-ON Events
- pitches = Drum Elements
- unquantized onsets & durations



symbolic MIR

- rhythm quantization
- voice separation
- score engraving

target representation
music score (XML file)



Outline

1. Elements of Drum notation

2. Parsing Drums MIDI Recording
   - Prior Weighted Tree Grammar
   - Vertical Alignments

3. Score Engraving
   - Building an Intermediate Score Representation
   - Term Rewriting

4. Experiments and Results
   with Google Groove MIDI dataset

Drum Notation

- for teaching
  Drum notation emerged with drum schools

- for the preservation of improvisations

- no standard
  2 schools (few differences):
  - Europe (Agostini)
  - US (“Universal”)

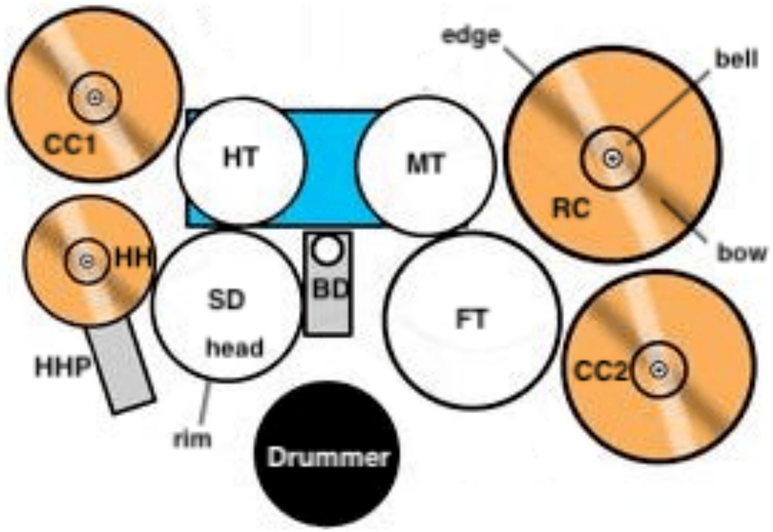
- readability is a crucial issue
  the number of elements in drumkits can overload the notation

Drumkit Elements

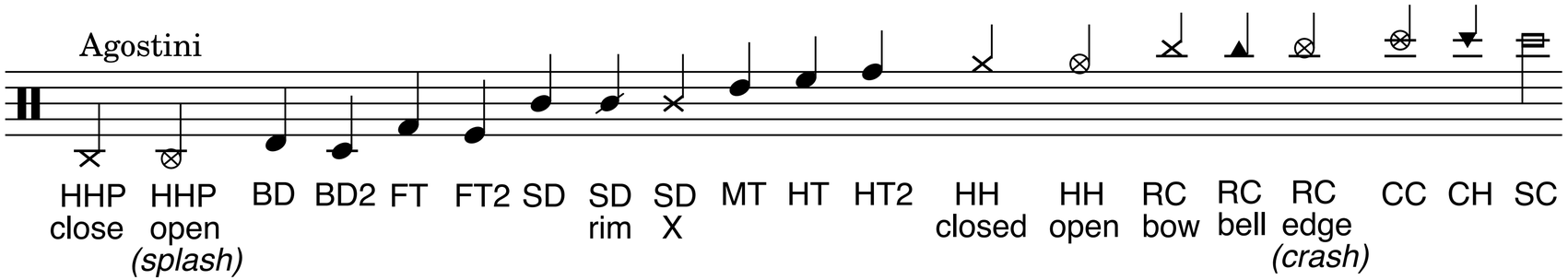
Principles:

- 1 pitch = 1 drum kit element
  height = position in space

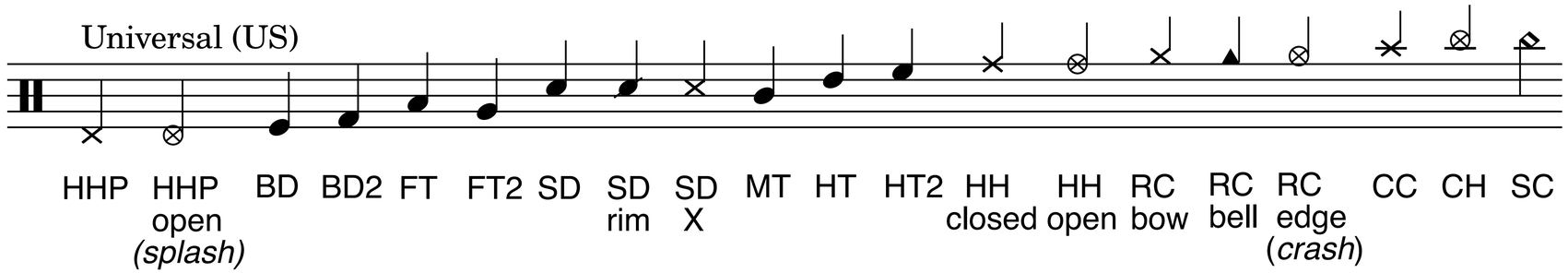
- note head = mode



European notation



US notation



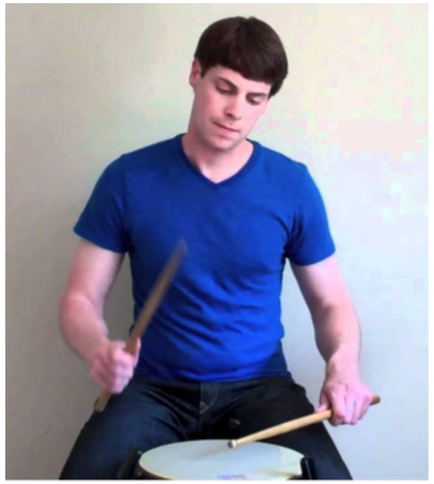
Dynamics, Ornaments

accent
marcato
ghost note
SD flam
FT flam
flam between HT and SD
drag *(not used)*
16th-note roll
32nd-note roll

corresponding to velocity

2 strikes

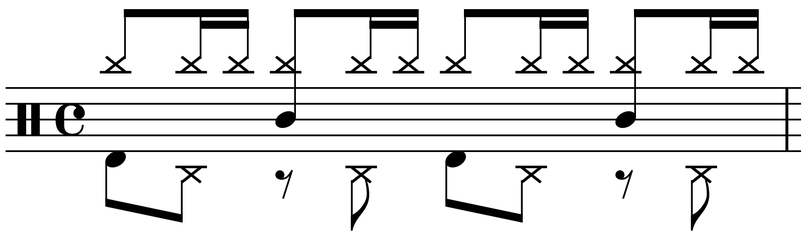
denoted explicitly (in extenso)



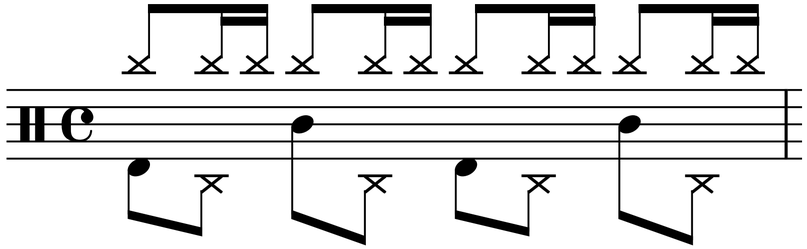
Voices

- 1 staff
- but several voices
  (for readability)
- voices denoted with stem direction

voice separation is performed according to a schema fixed for the whole score

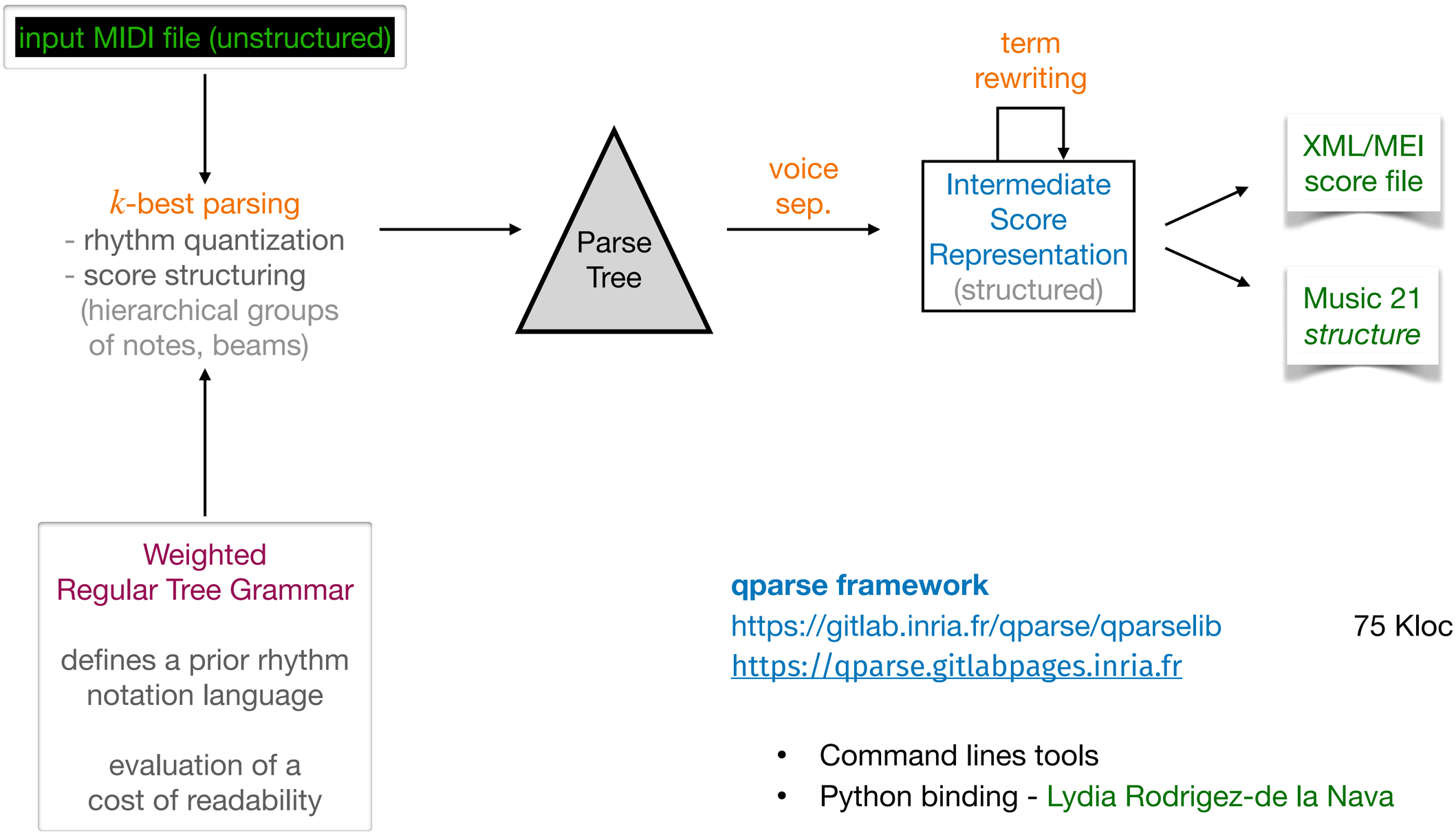


- top voice:
  hand-played notes
- bottom voice:
  feet-played notes



- top voice:
  repeated rhythmic patterns (RC)
- bottom voice:
  other (sporadic) elements

Transcription Workflow



qparse framework

https://gitlab.inria.fr/qparse/qparselib

https://qparse.gitlabpages.inria.fr

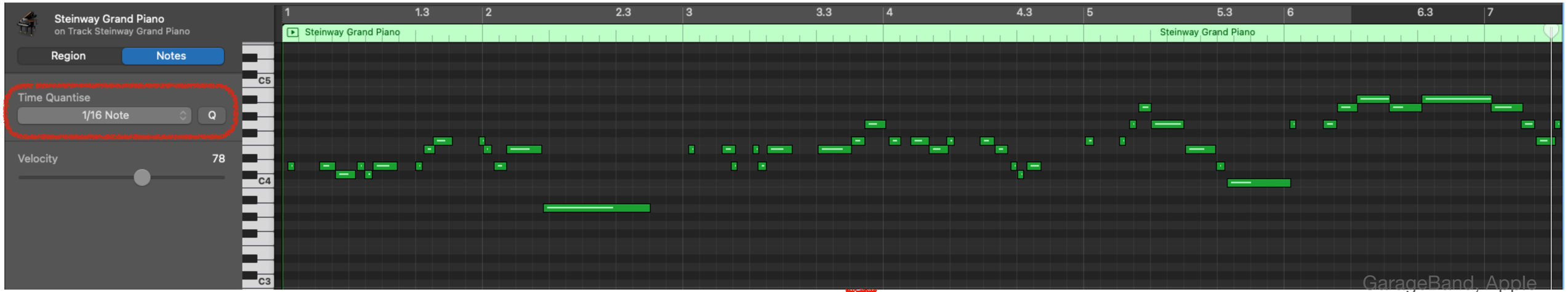
75 Kloc C++

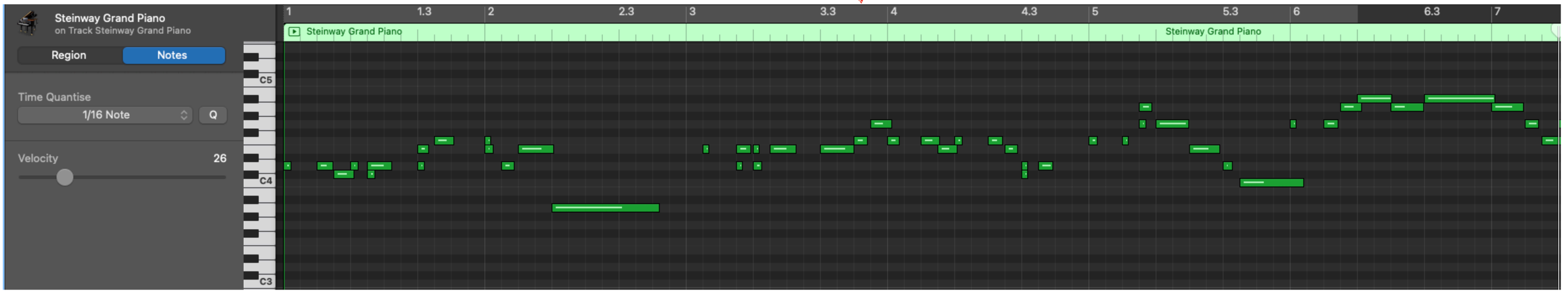
- Command lines tools
- Python binding - Lydia Rodrigez-de la Nava

Rhythm Quantization “on Grid”

Rhythm quantization with grids, *e.g.* MIDI files import

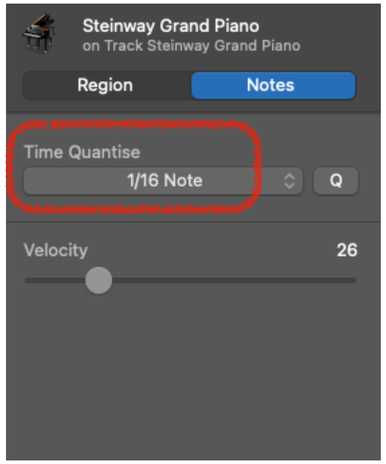
- in score editors (Finale, Sibelius, Dorico, Musescore…),
- or in DAWs (Ableton Live, Logic…)



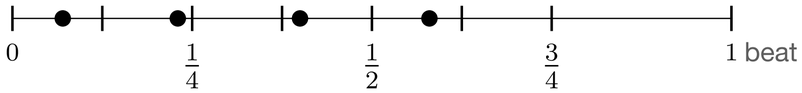


Grid based Approaches to Rhythm Quantization

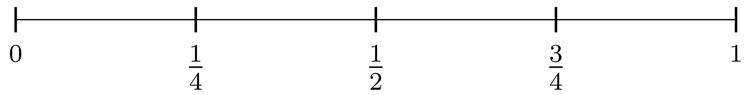
Alignment of every input time point (onset) to the closest position in a *grid* = sequence of equidistant time position.



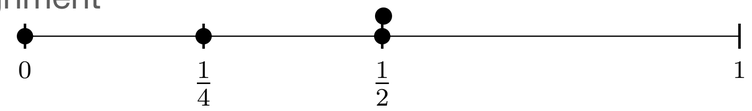
input

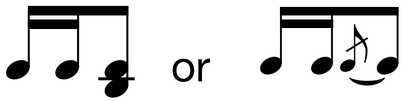


grid 16th note

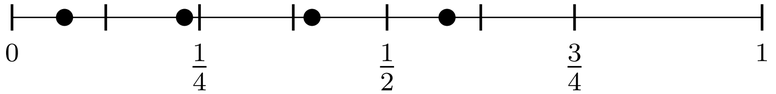


alignment

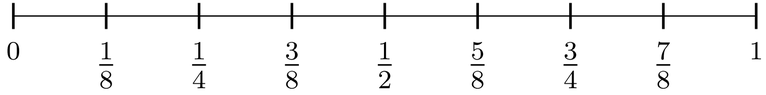


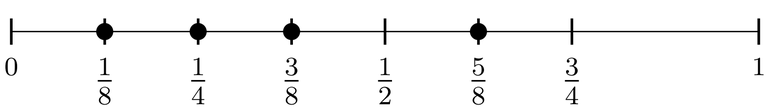


poor fit, good readability



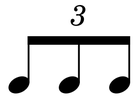
grid 32th note





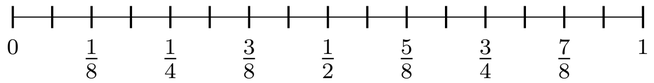
good fit, bad readability

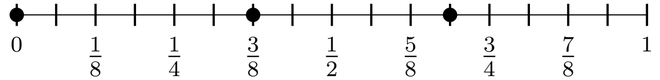
case of triplet



input

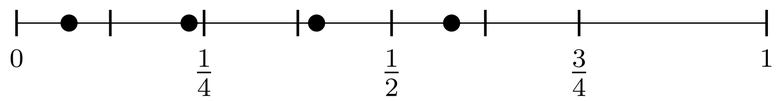
grid 64th note



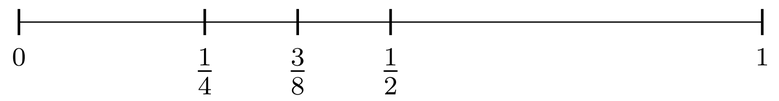


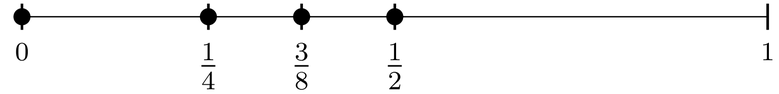
good fit, bad readability

Hierarchical (irregular) Grids

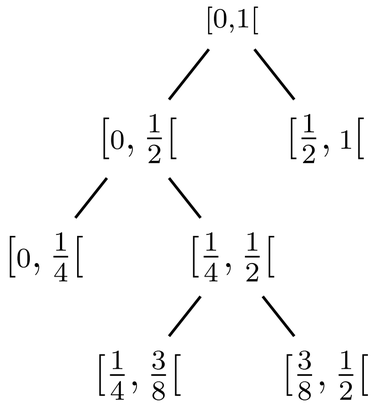


hierarchical grid





close to intuition



regular grids

- search of a best quantization is possible by a brute-force enumeration: 8th note grid, 16th, 32th, 64th…
- result not always optimal
- problems with tuplets (so called “*irrationals*” 3, 5, 7…)

hierarchical grids = trees

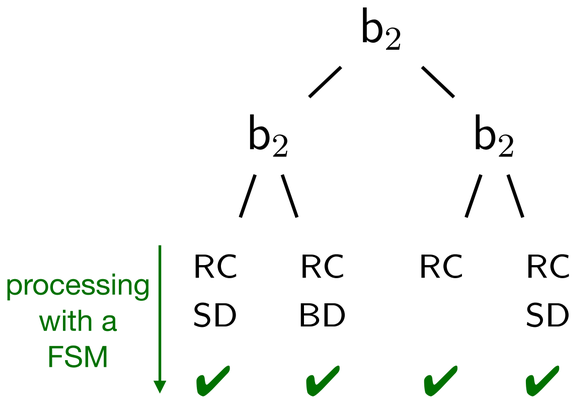
- more “natural” results
- brute force enumeration impossible

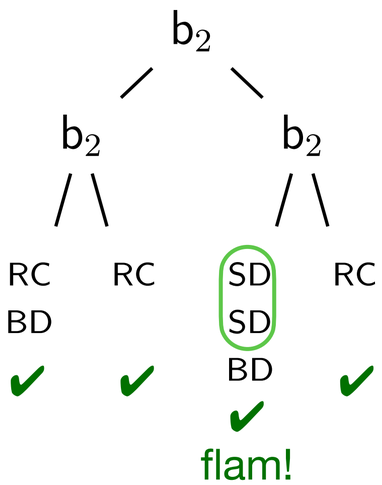
- prior specification of the language of acceptable hierarchical grids with quantitative formal language models: Weighted Tree Grammars

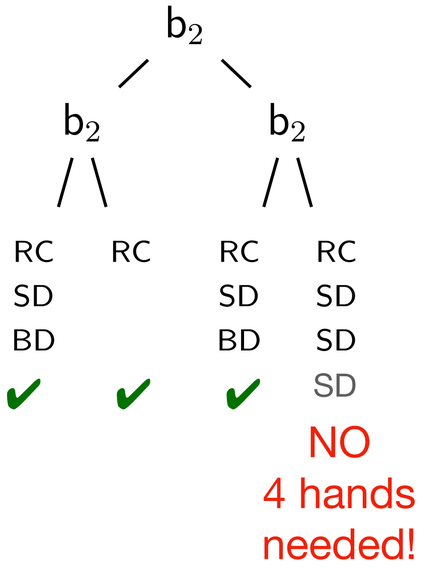
- Dynamic Programming parsing algorithm to extract 1-best tree, optimal *wrt*
  - weight wrt grammar (readability)
  - distance to input (accuracy)

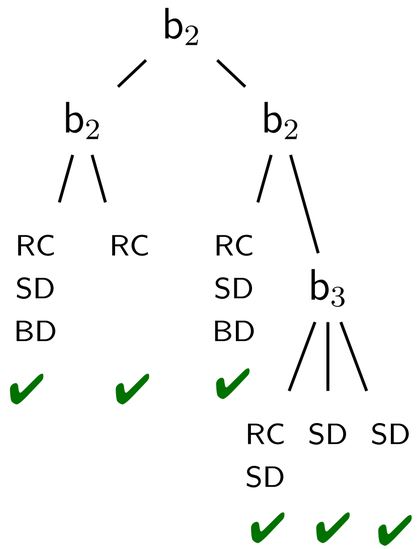
Parse Trees & Vertical Alignments

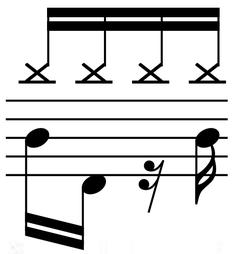
Several events might be aligned at the same position of a hierarchical grid (= leaf of parse tree). They are considered simultaneous.

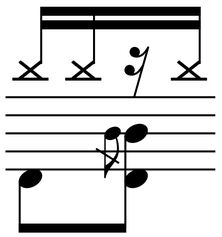




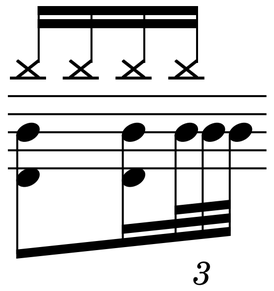


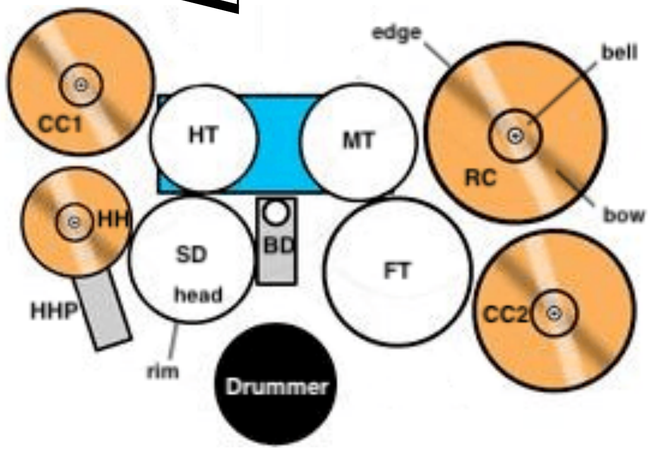






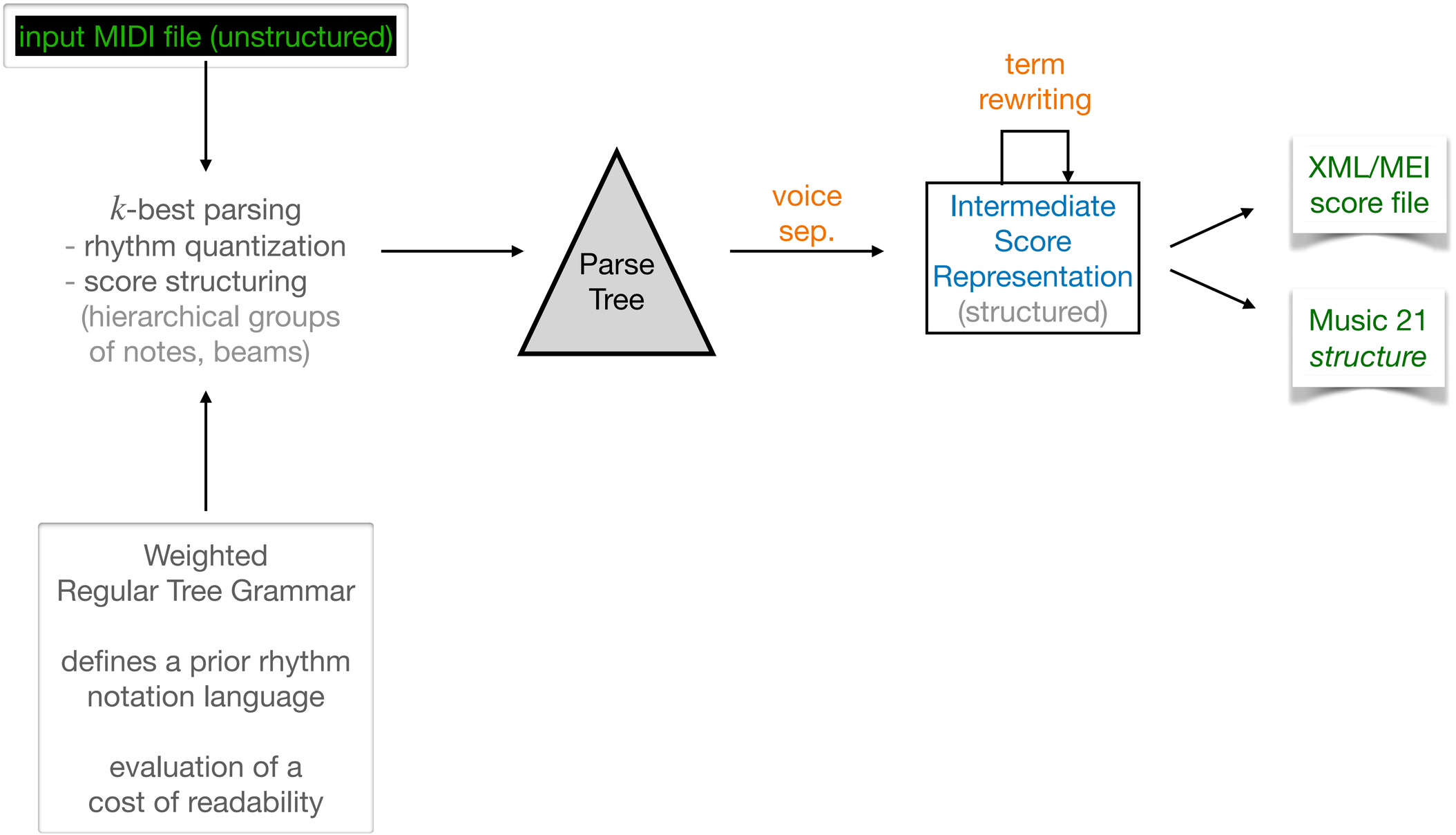
alignment rejected





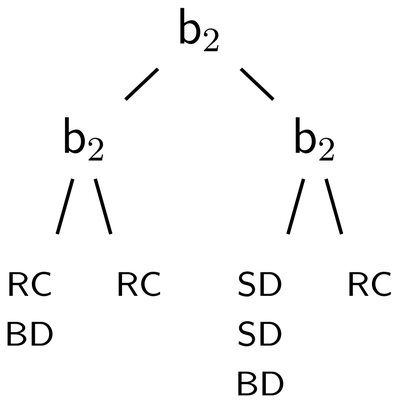
The FSM also detect (and fix) some MIDI captation errors.
e.g. confusion between rim-shot and cross-stick

Transcription Workflow



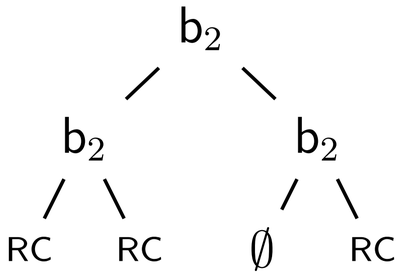
Post-processing the intermediate score representation

parse tree

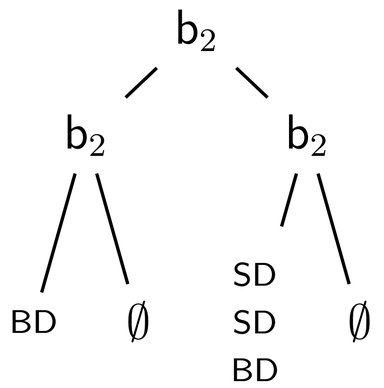


voice separation
(projection)

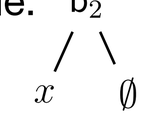
high voice

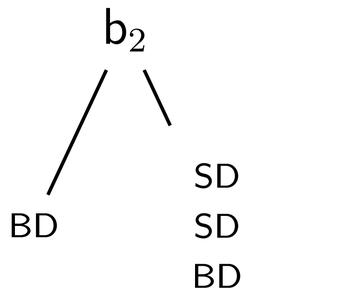


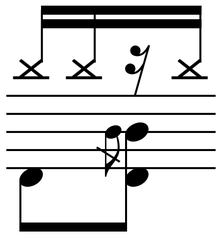
low voice



simplifying
with rewrite rule: $b_2 \longrightarrow x$







Theoretical issues:

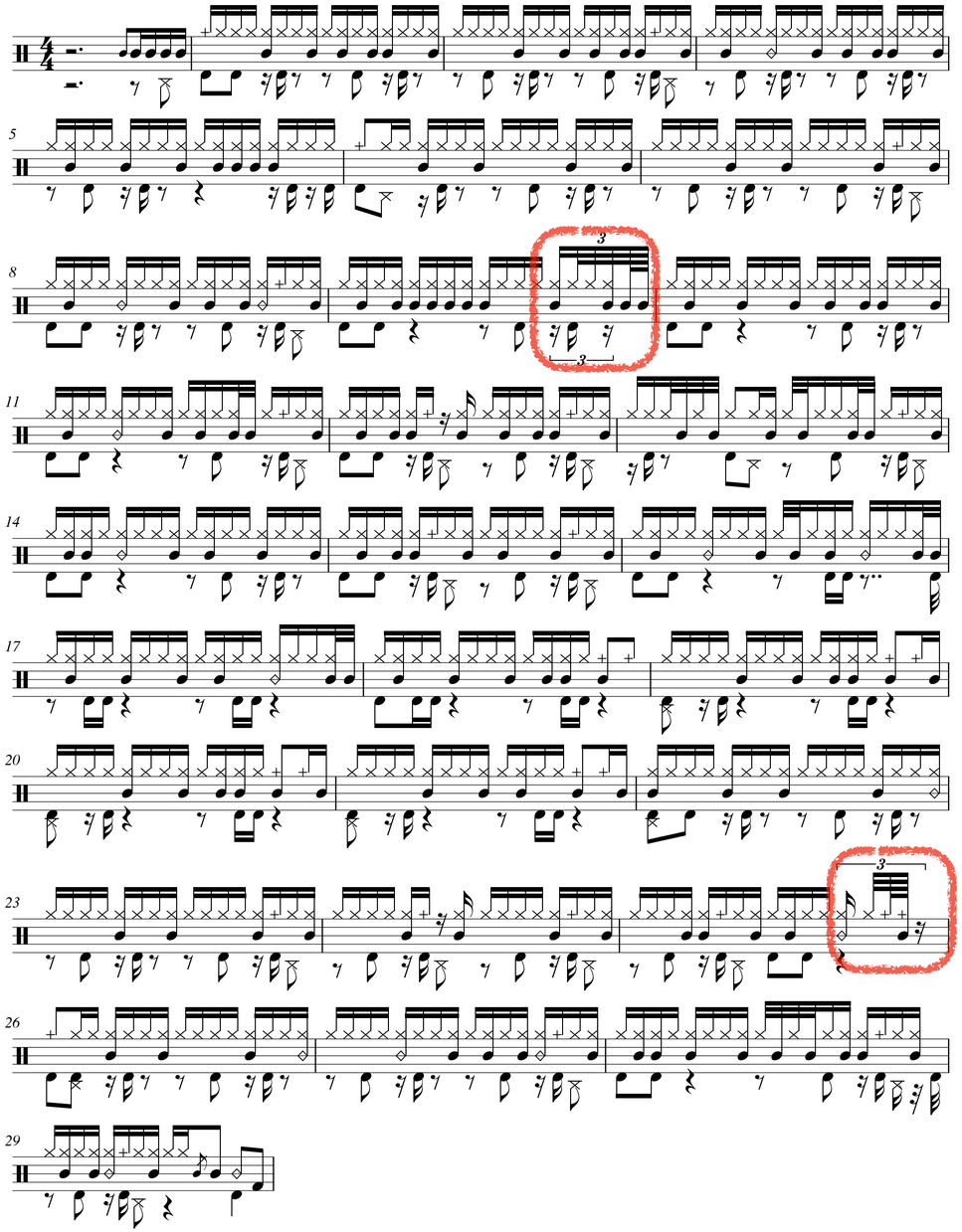
- rewrite strategies (*e.g.* IO or OI),
- conflicts (overlapping rules)…

with **Groove MIDI Dataset**

- by Google Magenta
  https://magenta.tensorflow.org/datasets/groove
- 13.6 hours, 1150 MIDI files ~ 22000 measures
  recorded by professional drummers on a electronic drum kit
- audio (wav) files synthesized from (and aligned to) MIDI files
  for evaluation of audio-to-MIDI drum transcription
- no score files!
  i.e. no ground truth for evaluation

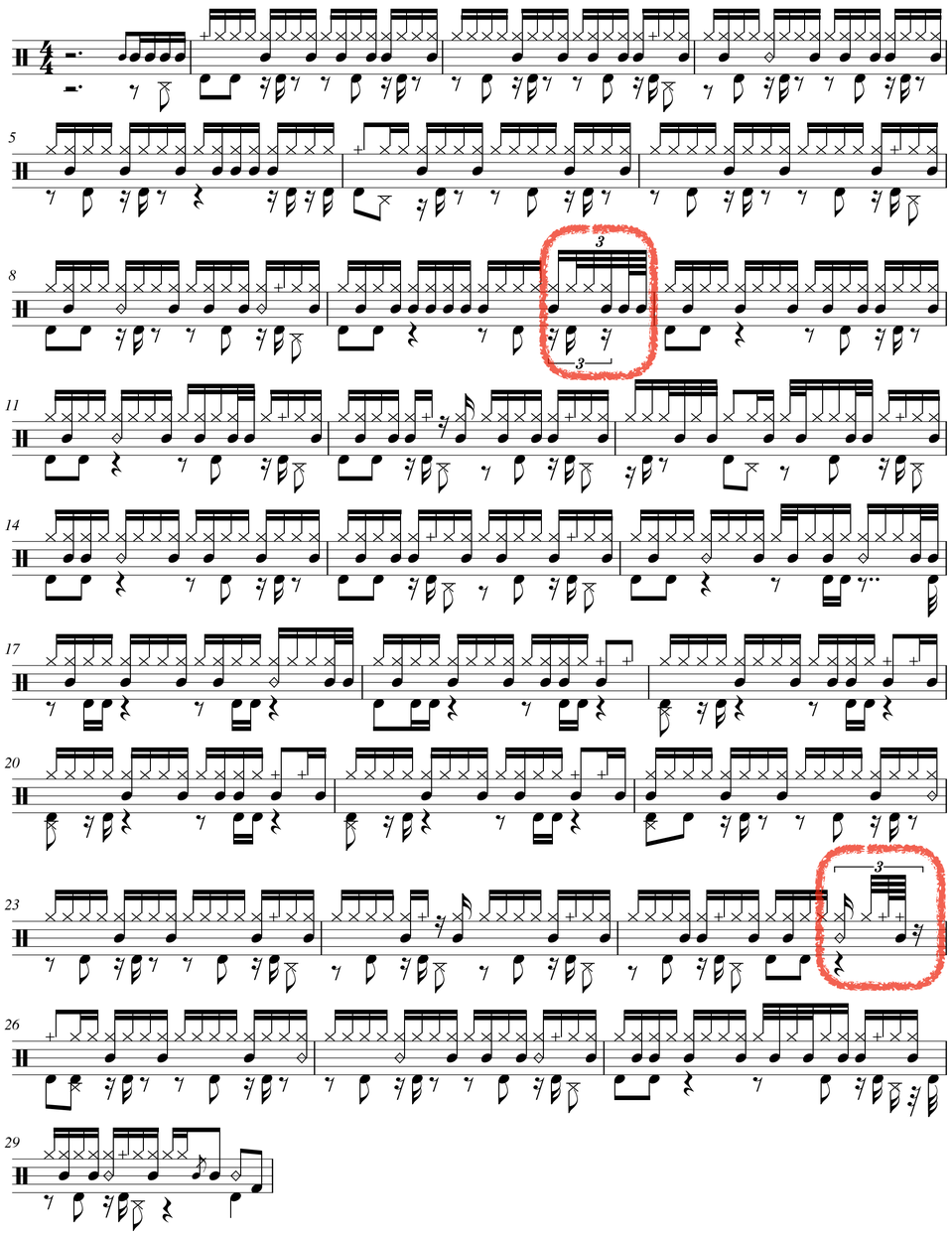
Results

- 25 score transcriptions to XML/MEI as proof of concept
  https://gitlab.inria.fr/transcription/gmdscores
- score length: 24 to 261 4/4 bars, tempo is known
  transcription time ~ 2s per score
- all score files (XML) produced from the MIDI files
  with the same generic tree grammar (4/4 measure)
- FSM for specific drumming constraints (hands ≤ 2, feet ≤ 2)
- processing of flams
- processing of errors from MIDI sensors

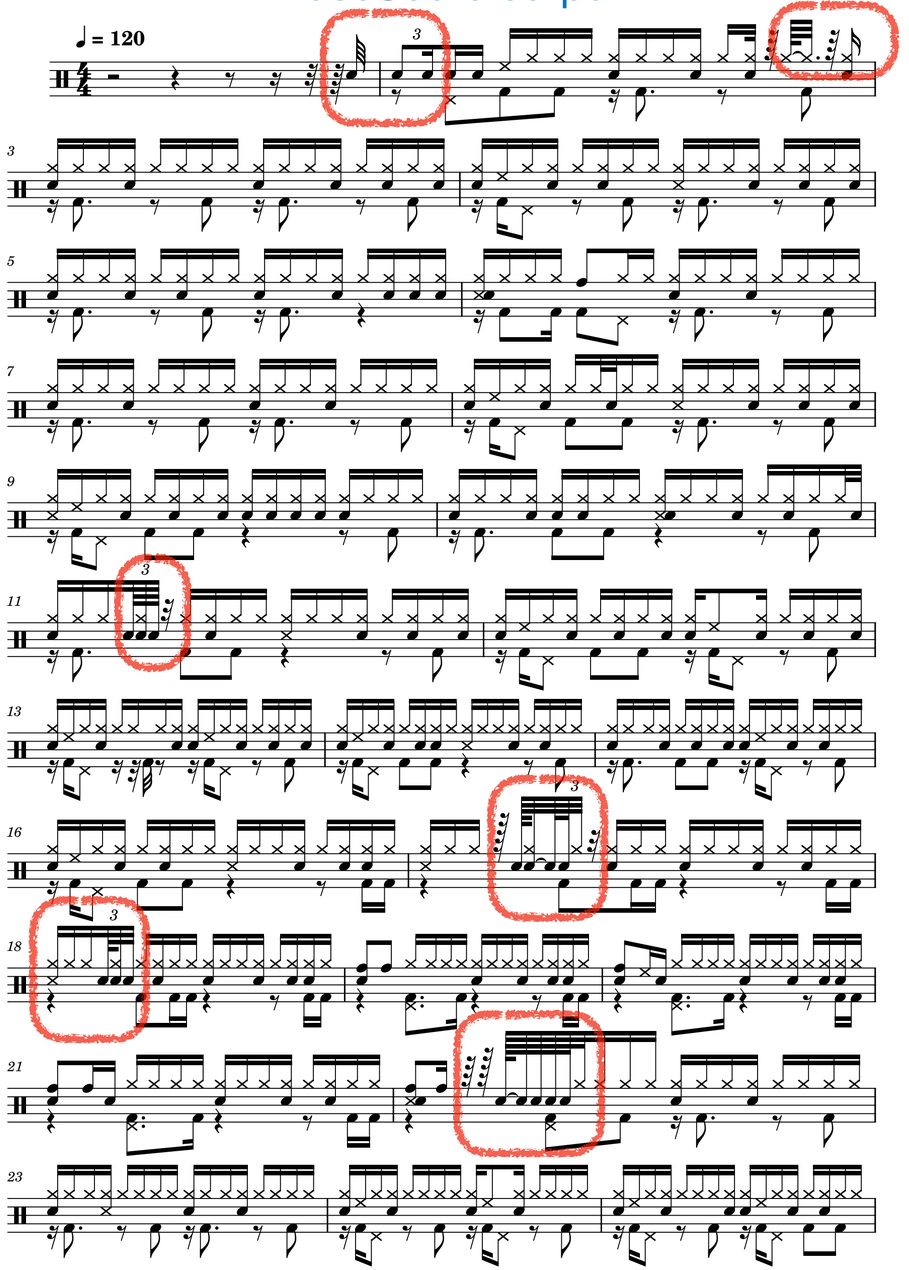


Experiments (comparison with MusScore)

qparse output

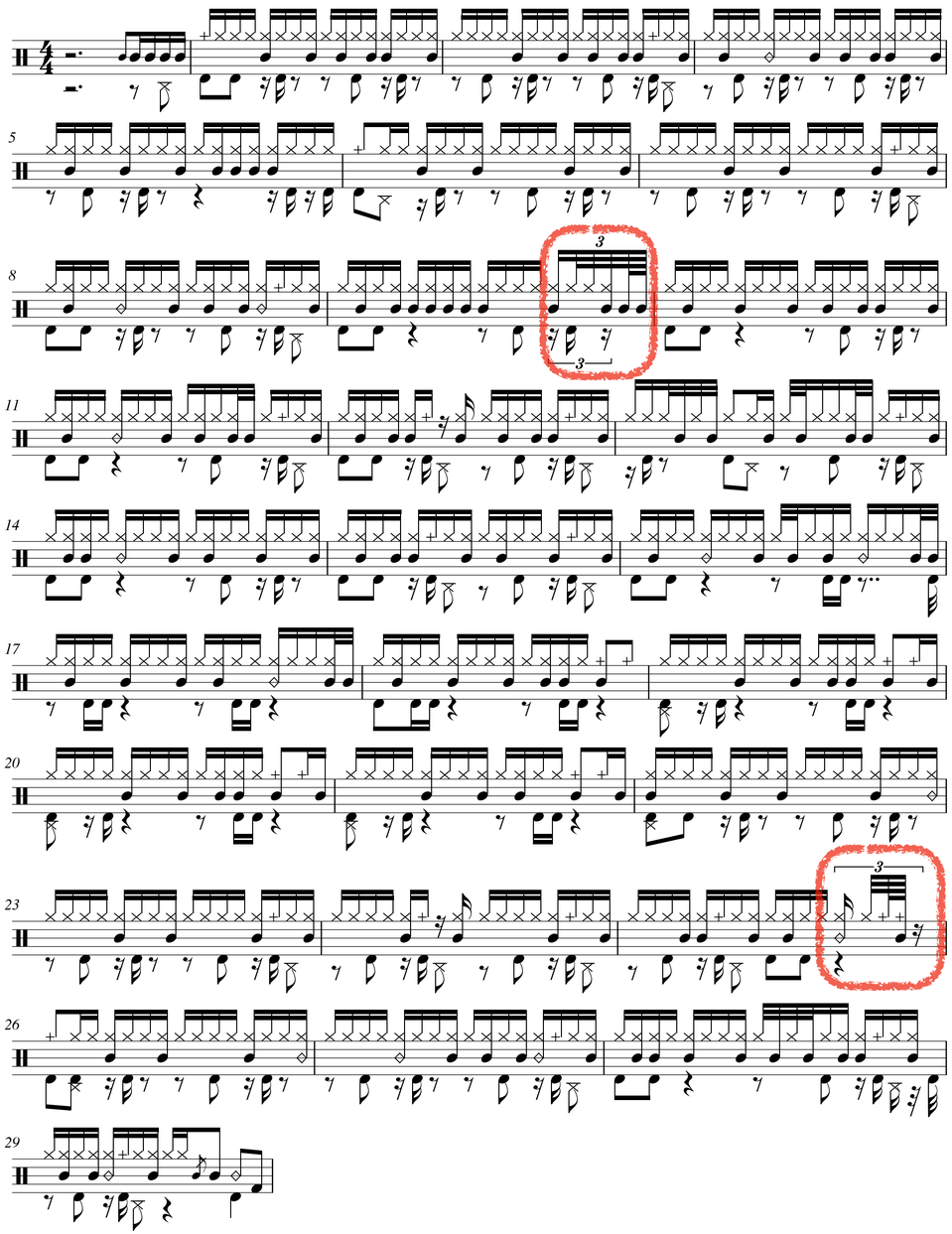


MuseScore output

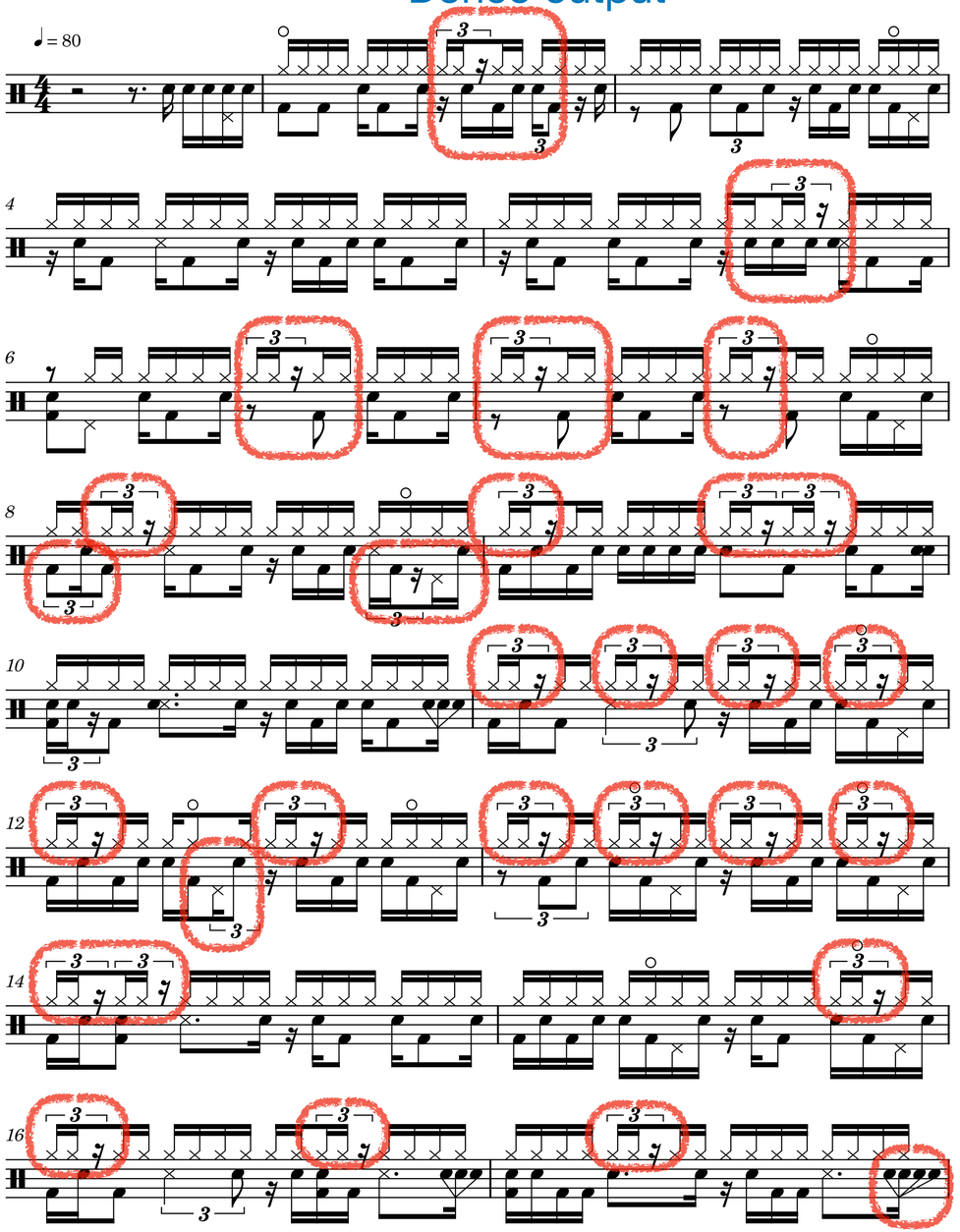


Experiments (comparison with Steinberg's Dorico)

qparse output



Dorico output



swing issue?

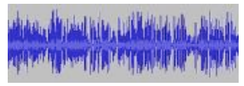
Perspectives: Piano & Guitar transcription

Transcription procedure for MIDI drumkit input, based on
- prior quantitative language models (weighted tree grammars)
- techniques of parsing by Dynamic Programing
- post-processing with Term Rewriting

Future plans:

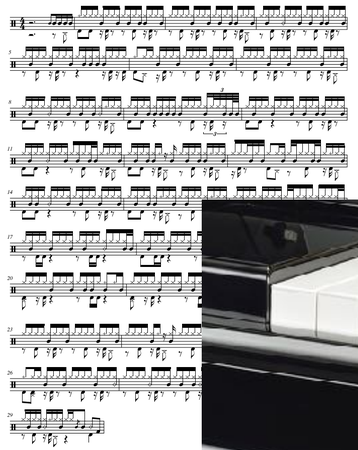
- Complete transcription of Google's **Groove MIDI Dataset** with manual corrections by a drummer
  → dataset of drum scores

- Backend of **Audio2MIDI** drum transcription
  C.-W. Wu et al. *A review of automatic drum transcription*. IEEE/ACM TASLP, 26(9), 2018.



audio MIR

symbolic MIR



- **Guitar & Piano** MIDI2score transcription
  voice separation
  several piano datasets (aligned audio/MIDI/scores)
  based on recording from Yamaha Piano Competition