

## Evaluating musical score difference: a two-level comparison

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# EVALUATING MUSICAL SCORE DIFFERENCE

## A TWO-LEVEL COMPARISON

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**Goal:** Have a *diff* tool for music scores, similar to the Unix *diff* utility

### Why:

- Collaborative score editing
- Music transcription evaluation
- OMR evaluation

### Issues:

- the line structure of a XML file does not reflect the its musical structure → not meaningful to apply a text *diff* to XML scores.
- What exactly we evaluate? Graphical content or musical content?

### Our Approach

**Two comparison** on two different objectives:

1. **Syntactic level:** the graphical content of the score (beamings, tuplets, dots, ties, etc.).
2. **Semantic level:** the musical content of the score (notes duration and pitch).

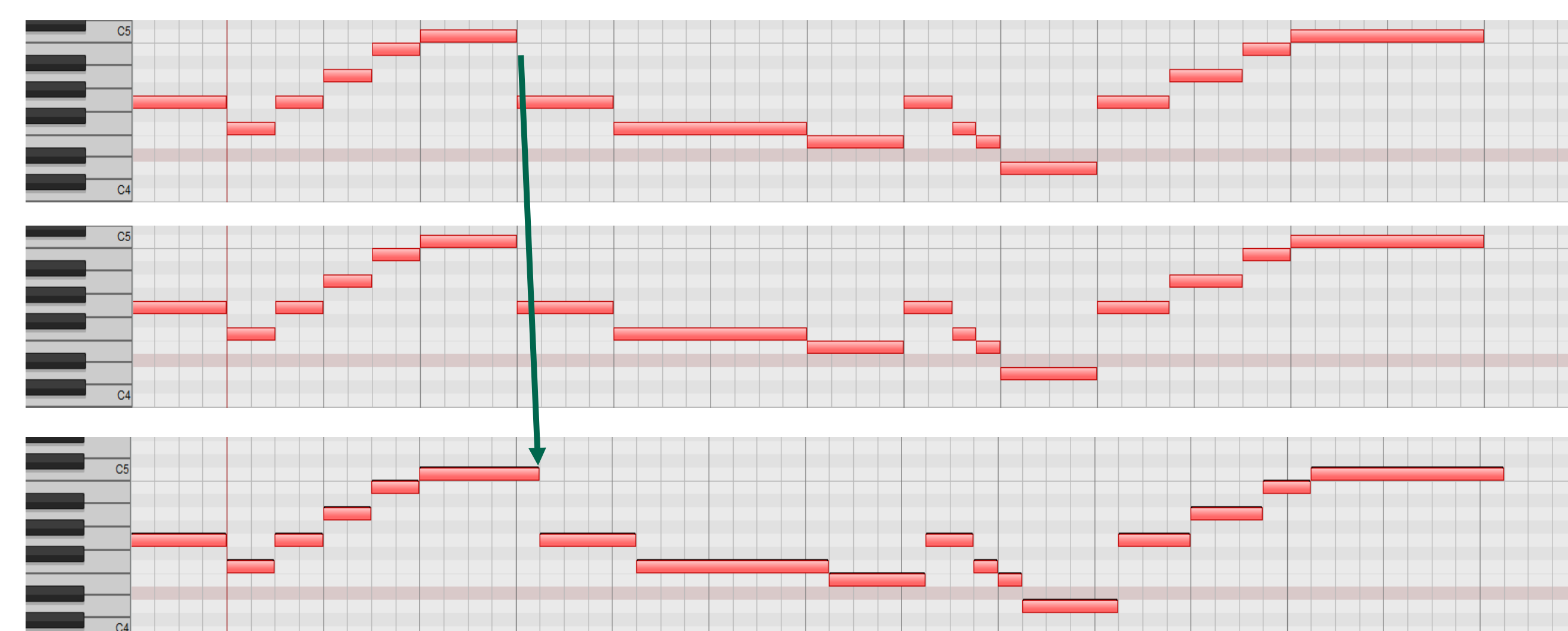
For both cases the output is:

- a list of the modifications to transform one score into the other,
- a value  $\Delta$ , that evaluate the difference between the two scores.

#### Graphical Content Comparison

- 1 → 2 :  $\Delta_{SYN} = 8$ , small differences in beamings, noteheads, ties and tuplets
- 1 → 3 :  $\Delta_{SYN} = 32$ , all the score is different because of the longer C in the first bar

#### Music Content Comparison

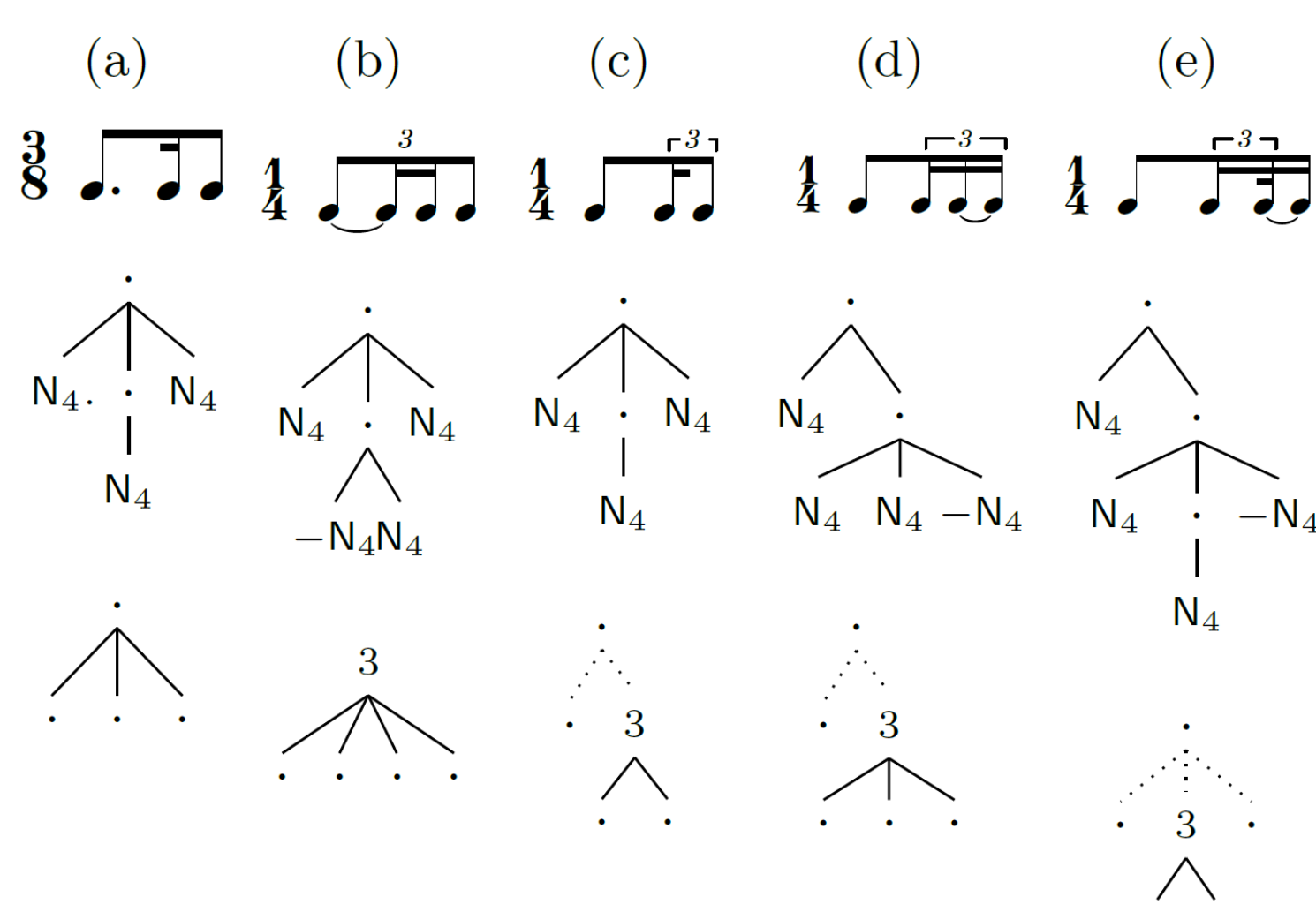


- 1 → 2 :  $\Delta_{SEM} = 0$ , no differences
- 1 → 3 :  $\Delta_{SEM} = 1$ , just one note with longer duration

## 1 Syntactic difference

We model the graphical score with **notation trees** [5]:

- Beaming Tree
- Tuplet Tree



- Find Least Common Substring (LCS) between trees hash for each voice.
- Equivalent to compute an edit distance with only insertion and deletion operations.

## 2 Semantic difference

We model the score content with timelines (similar to MIDI files).

From each timeline we:

1. build a sequence of couples <pitch, duration>.
2. Compute an edit distance with the usual operations (insert, delete and update) [4]

This difference is feature-based:

- pitch only,
- durations only,
- both features.

$$\Delta_{SEM} = \frac{\alpha \cdot \#UPD + \beta \cdot \#INS + \gamma \cdot \#DEL}{\#events}$$

where  $\alpha, \beta, \gamma$  are user-defined cost/weight values.

## Implementation

Partial implementation in the digital music library NEUMA ([neuma.humanum.fr/](http://neuma.humanum.fr/)).

Two REST API:

- Input: 2 midi files
- Input: 2 music-xml or MEI scores

A graphical representation with Verovio web library.

Example of the semantic difference computation and visualization (with Verovio) on two monophonic scores. The edit operations are notated by different figures: square (insert), triangle (update), rhombus (delete).

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