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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

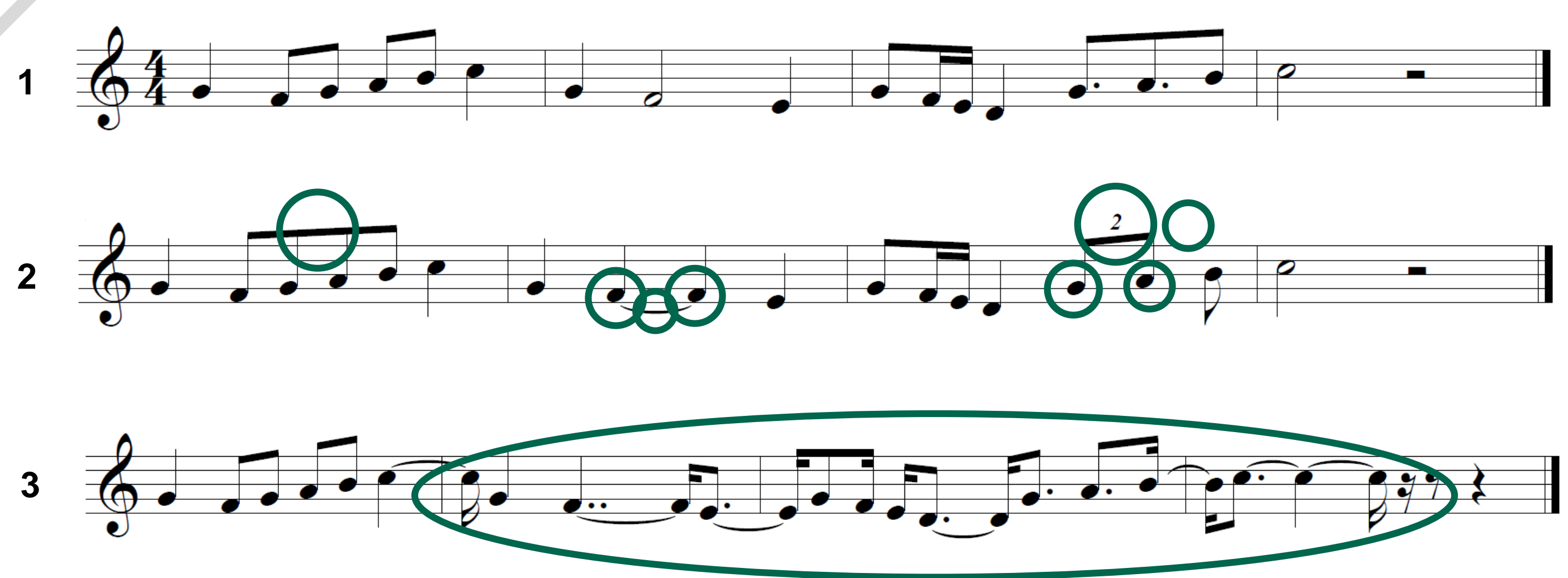
Two comparison on two different objectives:

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:

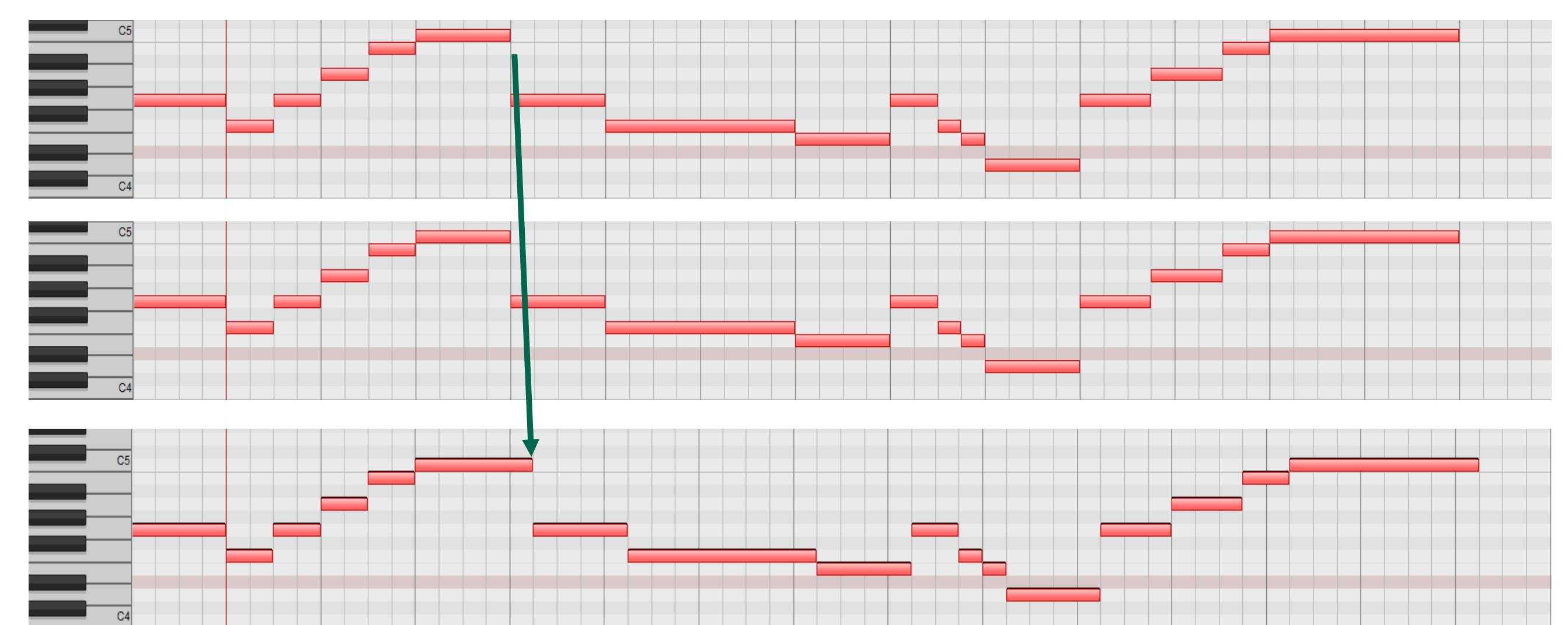
- a list of the modifications to transform one score into the other,
- a value Δ , that evaluate the difference between the two scores.

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

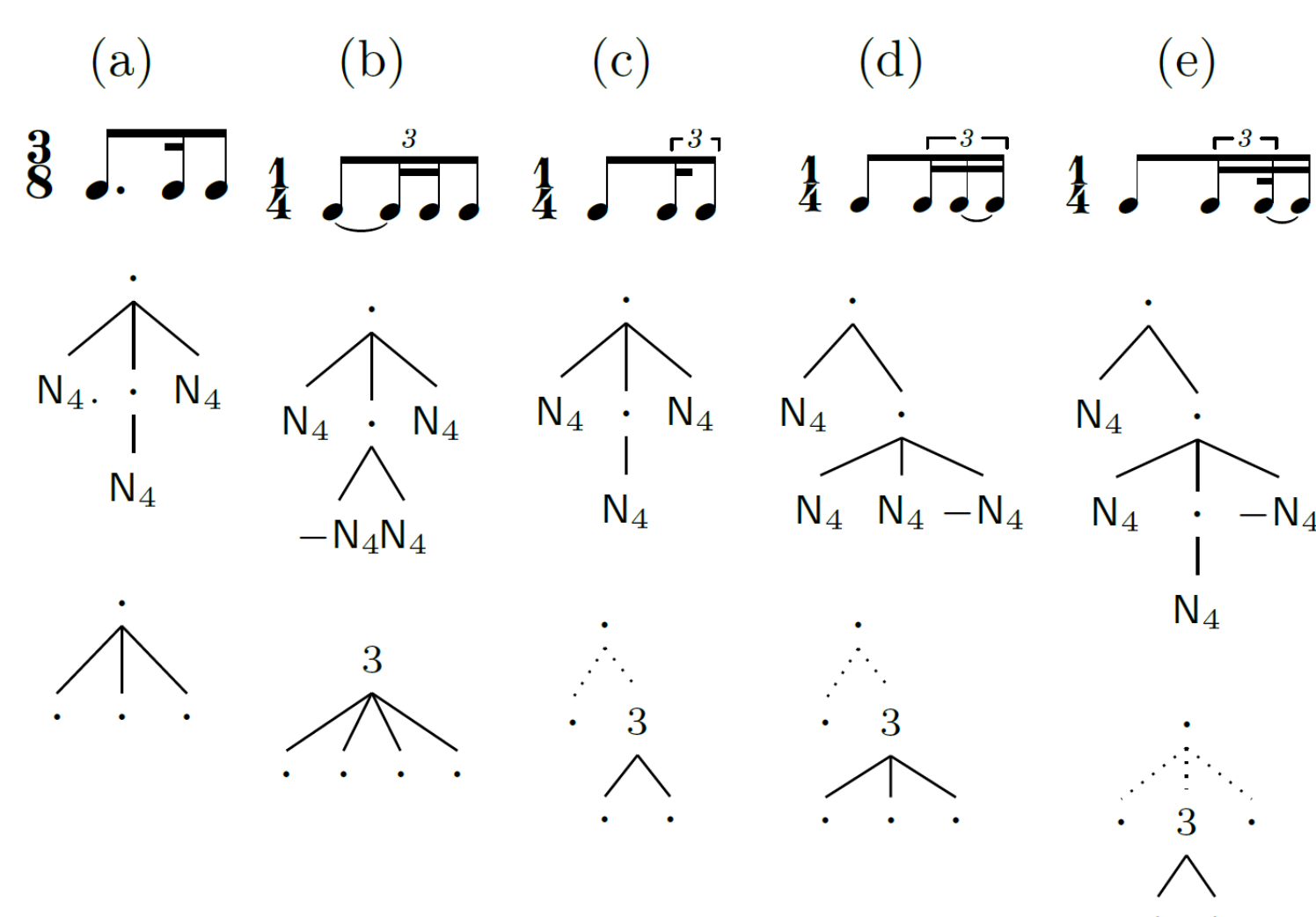


- 1 → 2 : $\Delta_{SEM} = 0$, no differences
- 1 → 3 : $\Delta_{SEM} = 1$, just one note with longer duration

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 α, β, γ are user-defined cost/weight values.

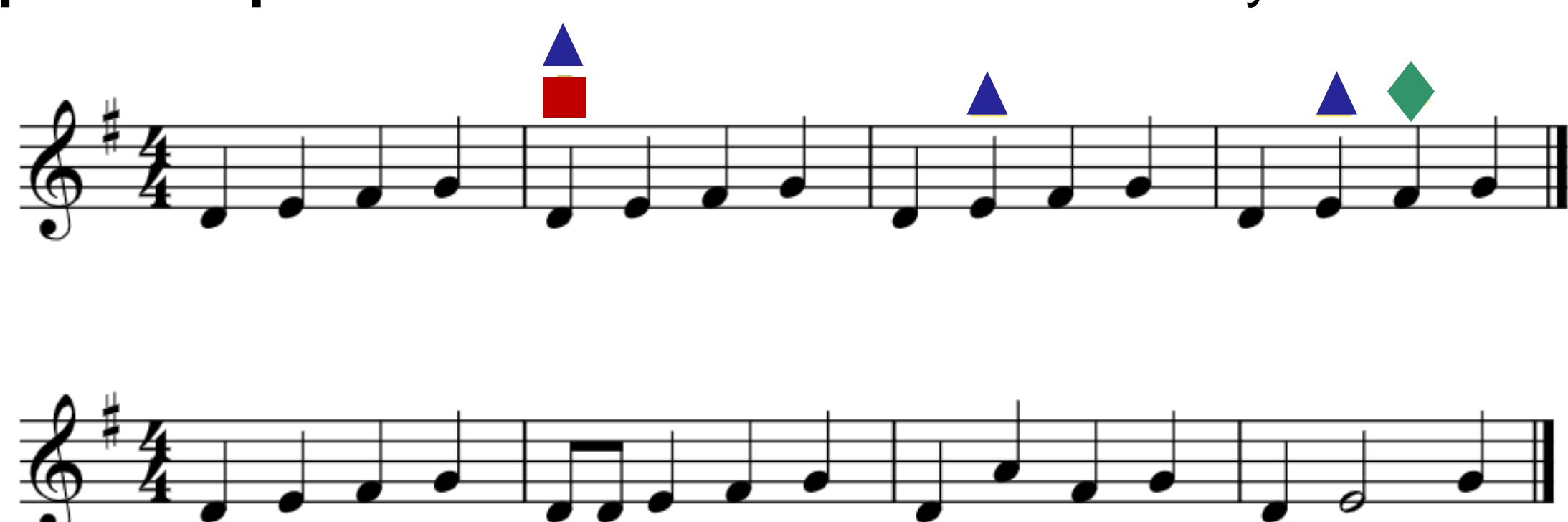
Implementation

Partial implementation in the digital music library NEUMA (neuma.huma-num.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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