



Encoding Matters

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sciences humaines du Canada



Introduction



In previous studies of computational musicology, we have observed that modifying the workflow for obtaining digital scores may also affect the result of the studies

- Using a different version of the same music notation software
- Importing/Exporting the same file in a different music notation software
- Translating the digital score from one symbolic format to another

The best practices learned from this experience contributed to the development of a methodology for creating symbolic music corpora (Cumming et al., 2018)

Encoding Matters

Encoding
discrepancies
in existing data



Encoding Matters



Investigate the **discrepancies** between symbolic music files that (intend to) represent the same music score document, which are studied in two different contexts

- A person encodes a music score document using a music notation software (Transcription)
- A symbolic music format is translated into a different symbolic music format (Translation)

Encodings



Selected work

Beethoven, Op.18 No.1 - I. Allegro con brio

Encodings

- *Finale encoding*
 - Source: the Gutenberg project
 - Encoder: Geof Pawlicki
- *MuseScore encoding*
 - Source: musescore.org
 - Encoder: Gavin Ailes
- *Sibelius encoding*
 - Source: tes.com
 - Encoder: submitted by user *dunhallin*

Translations



Each of the previous encodings has been exported as a **MusicXML** file using the latest stable version of the music notation software, afterwards, these files are translated into **two** other symbolic music formats

Translations

- MusicXML ----> Music Encoding Initiative (MEI)
 - Parser: Verovio v2.0.0 (<https://www.verovio.org/>)
- MusicXML ----> Humdrum(**kern)
 - Parser: humlib (<https://github.com/craigsapp/humlib> - commit *b71f716*)

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Translations

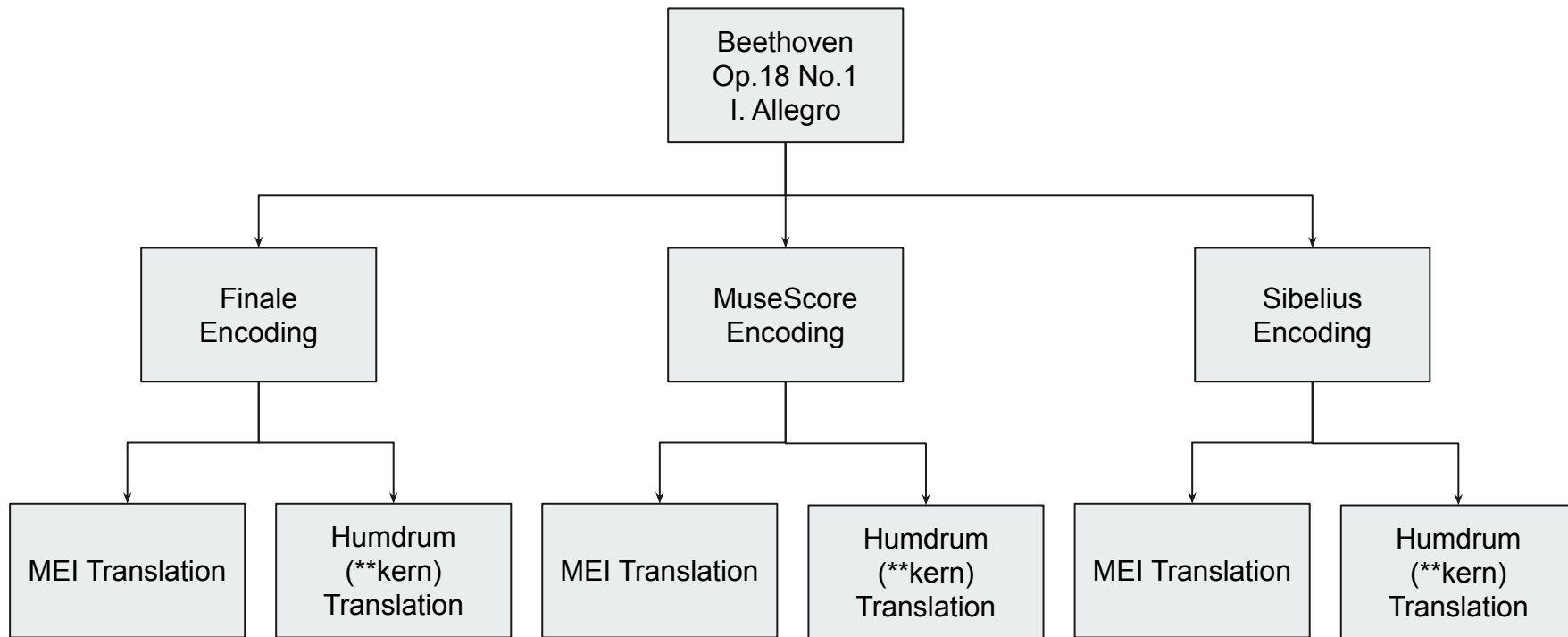


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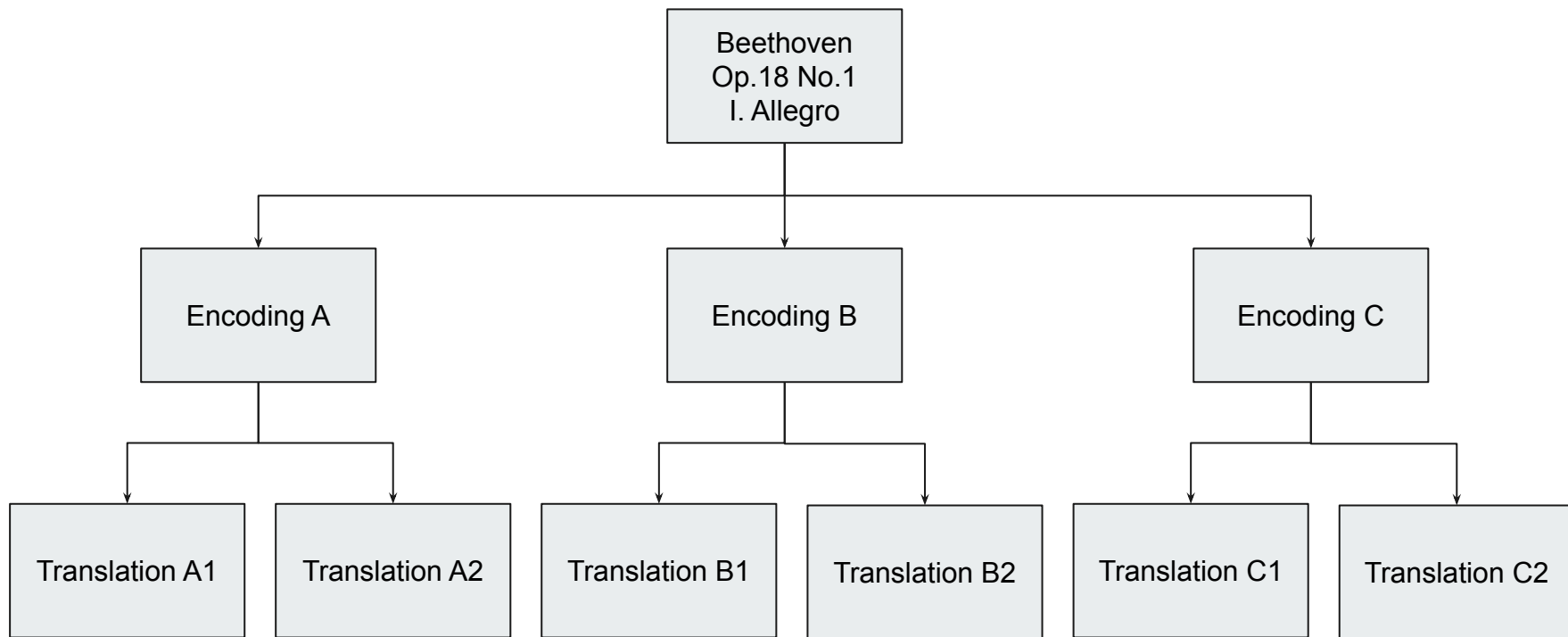
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Encodings and Translations



Encodings and Translations (anonymized)



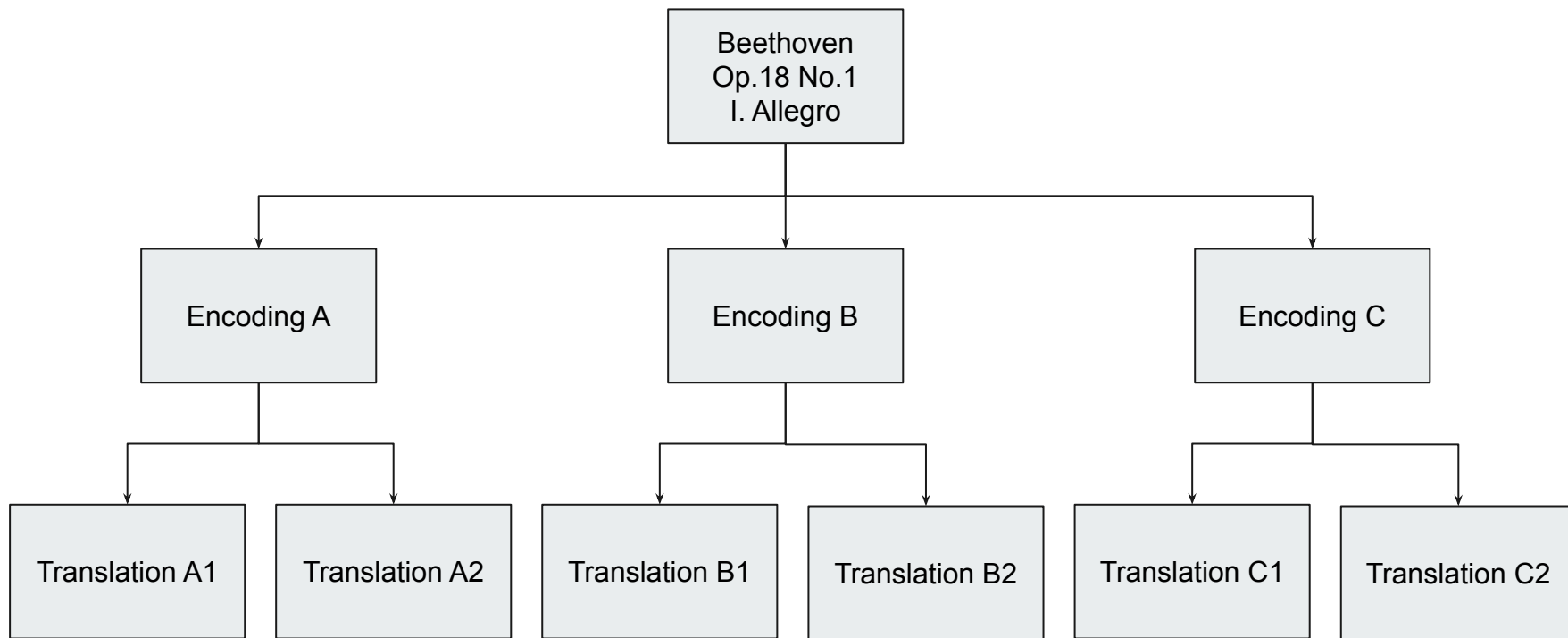
Method



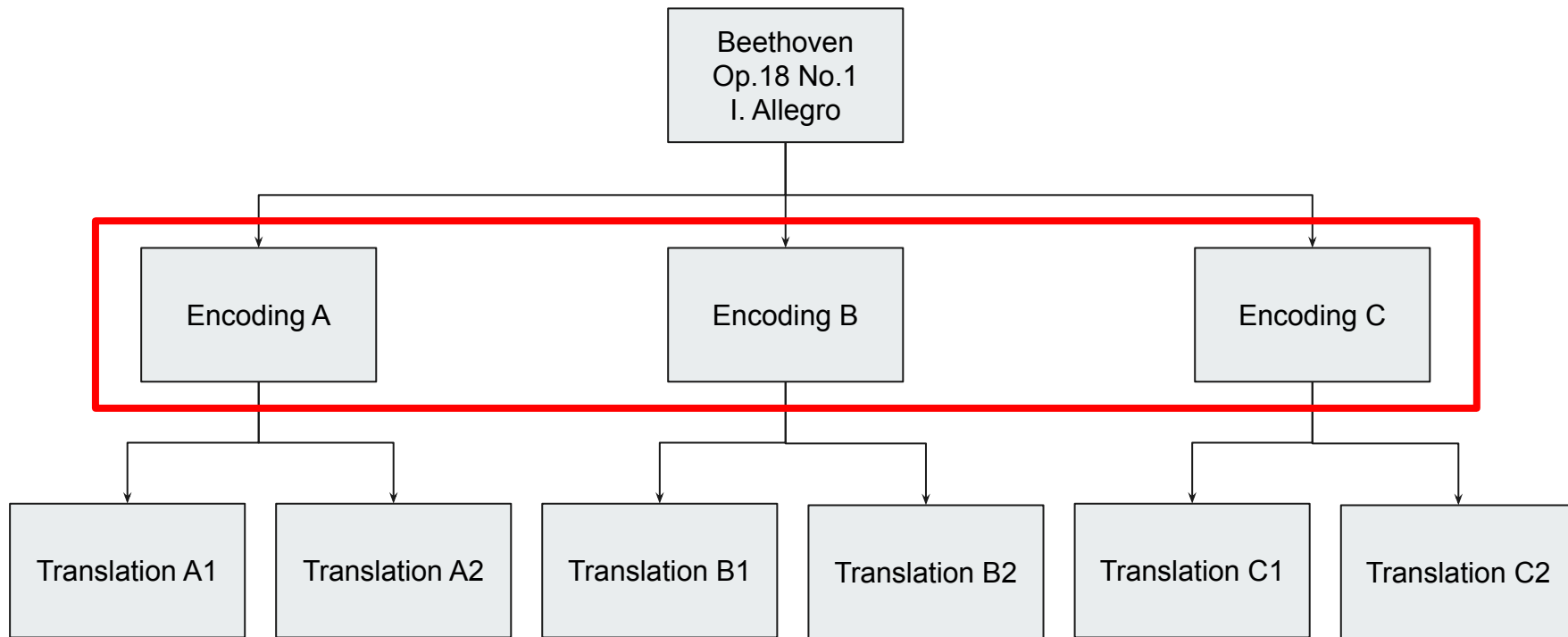
Studying discrepancies in two different contexts

- **A person encodes a music score document using a music notation software (Transcription)**
- A symbolic music format is translated into a different symbolic music format (Translation)

Encodings and Translations (anonymized)



Encodings and Translations



What is *equivalent*?



Having the same **note/rest attacks**, starting at the same **offset**

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The image shows a musical score for Violin I and Violin II, measures 1-2 of Beethoven Op. 18 No. 1, I. Allegro. The score is written in 3/4 time with a key signature of one flat (B-flat). The Violin I part starts with a quarter note G4, followed by a quarter note A4, a quarter note Bb4, and a quarter note C5, all beamed together. The Violin II part starts with a quarter note F4, followed by a quarter note G4, a quarter note A4, and a quarter note Bb4, all beamed together. The two parts are in unison for the first two measures. The score ends with a double bar line.

Beethoven Op.18 No.1 - I. Allegro, measures 1-2

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The image shows a musical score for Violin I and Violin II, measures 1-2 of Beethoven Op. 18 No. 1, I. Allegro. The score is written in 3/4 time with a key signature of one flat (B-flat). The Violin I part starts with a quarter rest, followed by a quarter note G4, a quarter note A4, a quarter note B4, and a quarter note C5. The Violin II part starts with a quarter note G4, a quarter note A4, a quarter note B4, and a quarter note C5. Both parts have a slur over the first four notes. The score ends with a double bar line.

Beethoven Op.18 No.1 - I. Allegro, measures 1-2

What is *equivalent*?

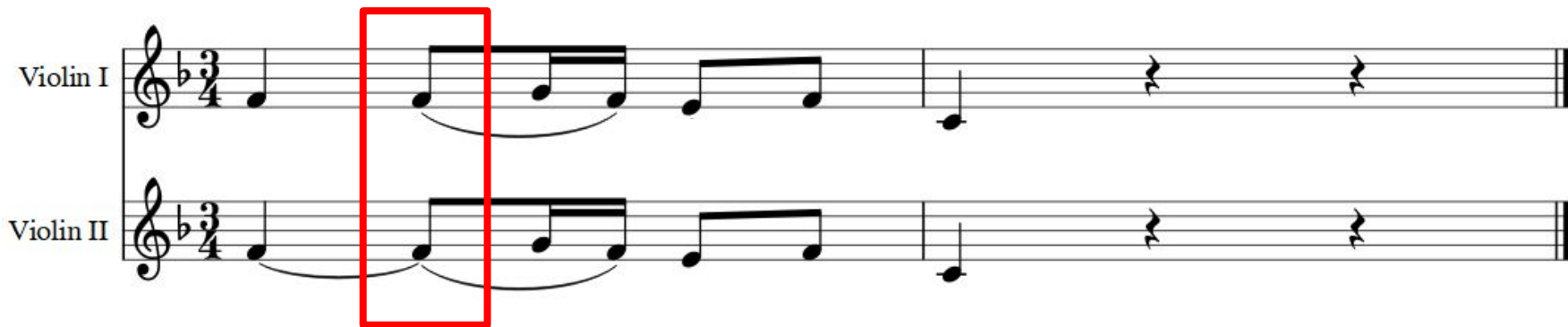
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Beethoven Op.18 No.1 - I. Allegro, measures 1-2

What is *equivalent*?

Having the same **note/rest attacks**, starting at the same **offset**



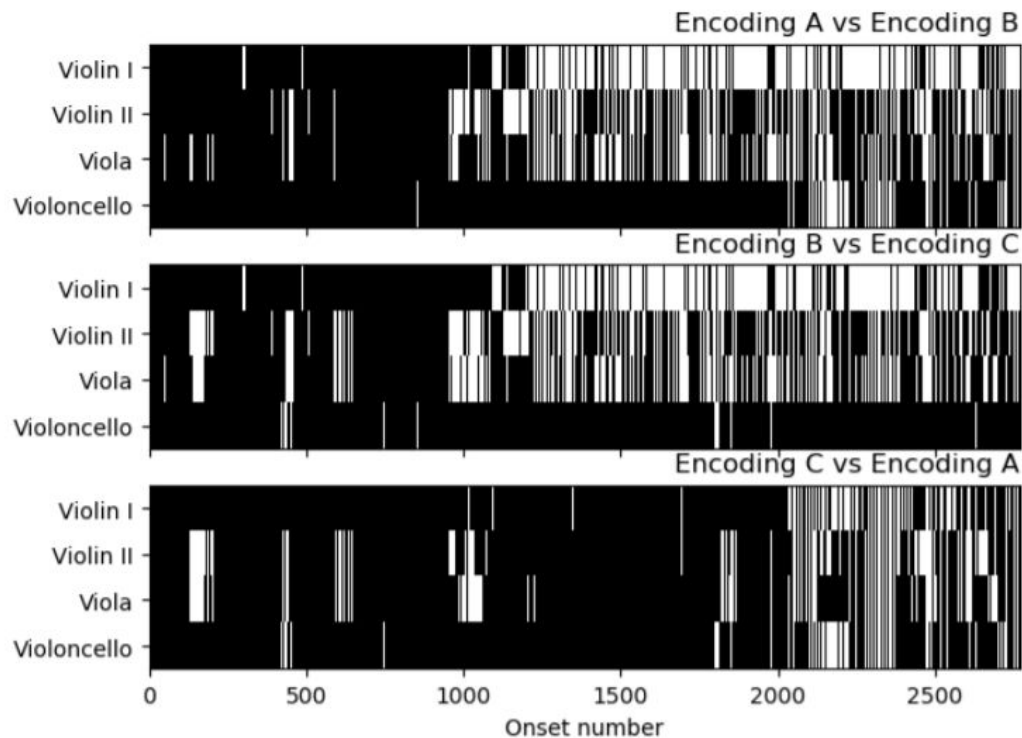
The image shows a musical score for Violin I and Violin II, measures 1-2. The key signature is one flat (B-flat) and the time signature is 3/4. The first two notes of each staff are highlighted with a red box, illustrating the concept of equivalent note/rest attacks starting at the same offset.

Violin I

Violin II

Beethoven Op.18 No.1 - I. Allegro, measures 1-2

Comparison of Encodings



Discrepancies



Introduced by *Music Notation Software*

Introduced by *Human Encoders*

Discrepancies (Music Notation Software)

41

Violin II

pp

The image shows a single staff of music for Violin II, measures 41-45. The staff begins with a treble clef and a key signature of one flat (B-flat). The melody starts on a half note G4 (two flats), followed by a quarter note A4 (one flat), a quarter note B4 (natural), and a quarter note C5 (natural), all beamed together. A slur covers the next three measures: a half note B4 (natural), a half note A4 (one flat), and a half note G4 (two flats). This is followed by a quarter note F4 (two flats), a quarter note E4 (one flat), and a quarter note D4 (natural), all beamed together. A final slur covers the last two measures: a half note C4 (two flats) and a half note B3 (one flat). The dynamic marking *pp* is written below the first measure. The piece concludes with a double bar line.

Encoding B, measures 41-45

Discrepancies (Music Notation Software)

Unclosed tie (imported in a different music notation software)



Encoding B, measures 41-45

Discrepancies (Music Notation Software)



Encoding B, measures 168-170

Discrepancies (Music Notation Software)



Encoding B, measures 168-170

Discrepancies (Music Notation Software)



Encoding B, measures 168-170

Discrepancies (Music Notation Software)

Overrun measure

Violin I



The image shows a single staff of music for Violin I in G major (one sharp). The notation consists of a series of eighth notes, some beamed together. A dynamic marking of *sf* (sforzando) is placed below the staff. A small purple icon with the number '32' is positioned above the staff in the middle of the line.

Encoding B, measures 168-170

Discrepancies (Music Notation Software)

Overrun measure (imported in a different music notation software)

Violin I



The image shows a single staff of music for Violin I in 3/4 time, with a key signature of one flat (B-flat). The notation consists of a series of eighth and sixteenth notes, some beamed together. A dynamic marking of *sf* (sforzando) is placed under the first measure. The notation ends with a double bar line and repeat dots, indicating the end of the excerpt.

Encoding B, measures 168-170

Discrepancies

The image shows a musical score for two violins, Violin I and Violin II, in 3/4 time with a key signature of one flat (B-flat). The score consists of two measures. In the first measure, both violins play a sequence of notes: a quarter note G4, followed by a pair of eighth notes F4 and E4, then a quarter note D4, and finally a quarter note C4. The notes F4, E4, and D4 are beamed together. In the second measure, both violins play a quarter note C4, followed by a quarter rest, and then another quarter note C4. The notes and rests are aligned vertically between the two staves, indicating they play the same notes simultaneously.

Encoding C, measures 1-2

Discrepancies (Human Encoders)

Slurs instead of ties

The image displays a musical score for two violins, Violin I and Violin II, in 3/4 time with a key signature of one flat (B-flat). The score consists of two staves. The first staff is labeled 'Violin I' and the second 'Violin II'. Both staves show a sequence of notes: a quarter note, followed by a pair of eighth notes, then another pair of eighth notes, and finally a quarter note. In the Violin I staff, a slur is placed over the first pair of eighth notes, and another slur is placed over the second pair of eighth notes. In the Violin II staff, a tie is placed over the first pair of eighth notes, and another tie is placed over the second pair of eighth notes. The labels 'slur' and 'tie' are positioned below their respective markings. The rest of the notes in both staves are identical.

Encoding C, measures 1-2

Discrepancies (Human Encoders)

Repeated notes, trills, and grace notes

Encoding A

Violin I

Violin II

Viola

Violoncello

Encoding B

Violin I

Violin II

Viola

Violoncello

Encodings A and B, measures 30-31

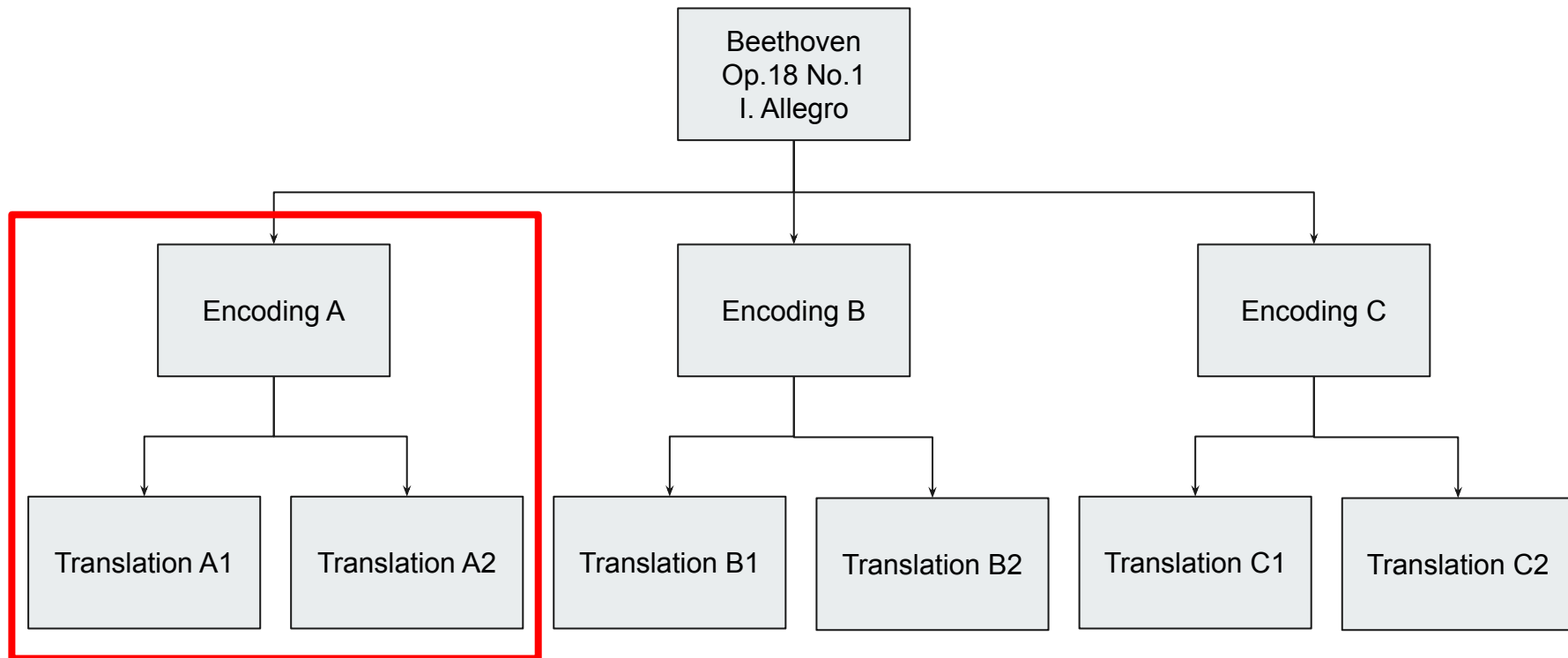
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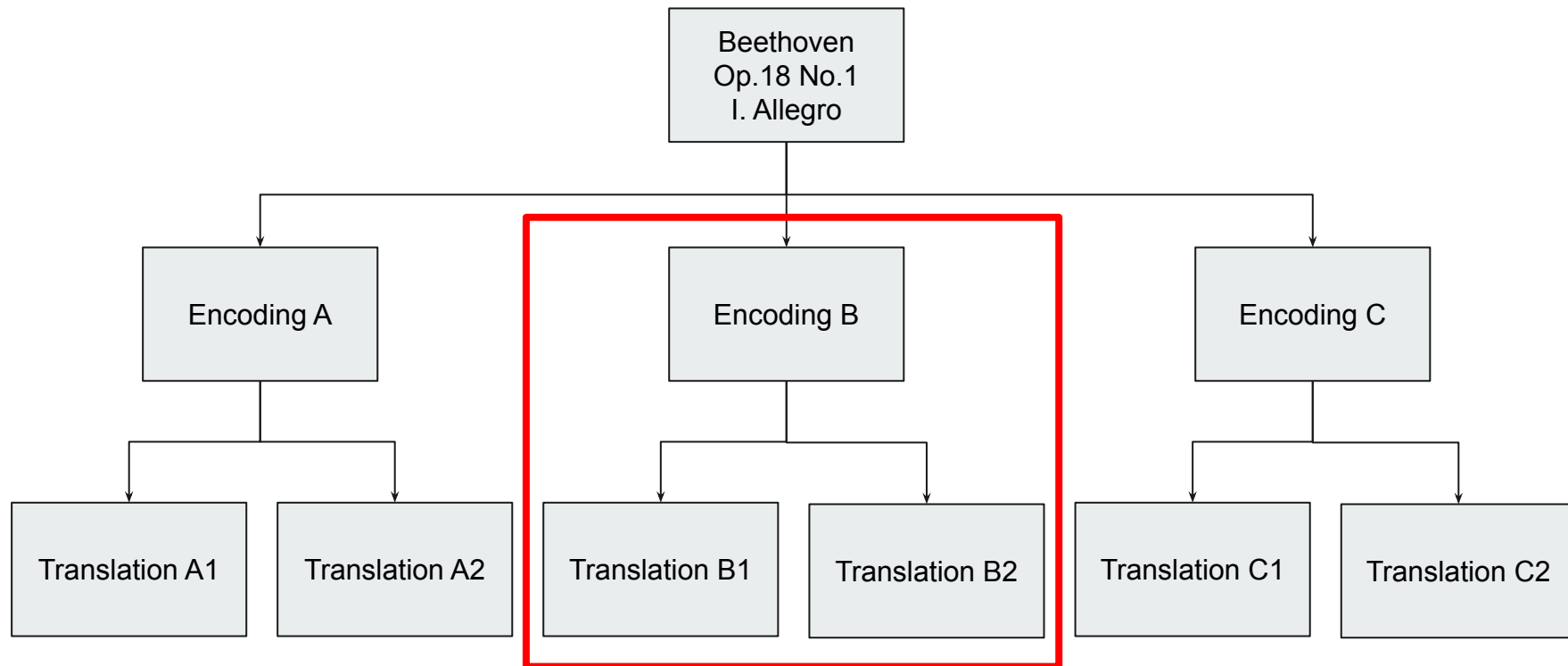
Studying discrepancies in two different contexts

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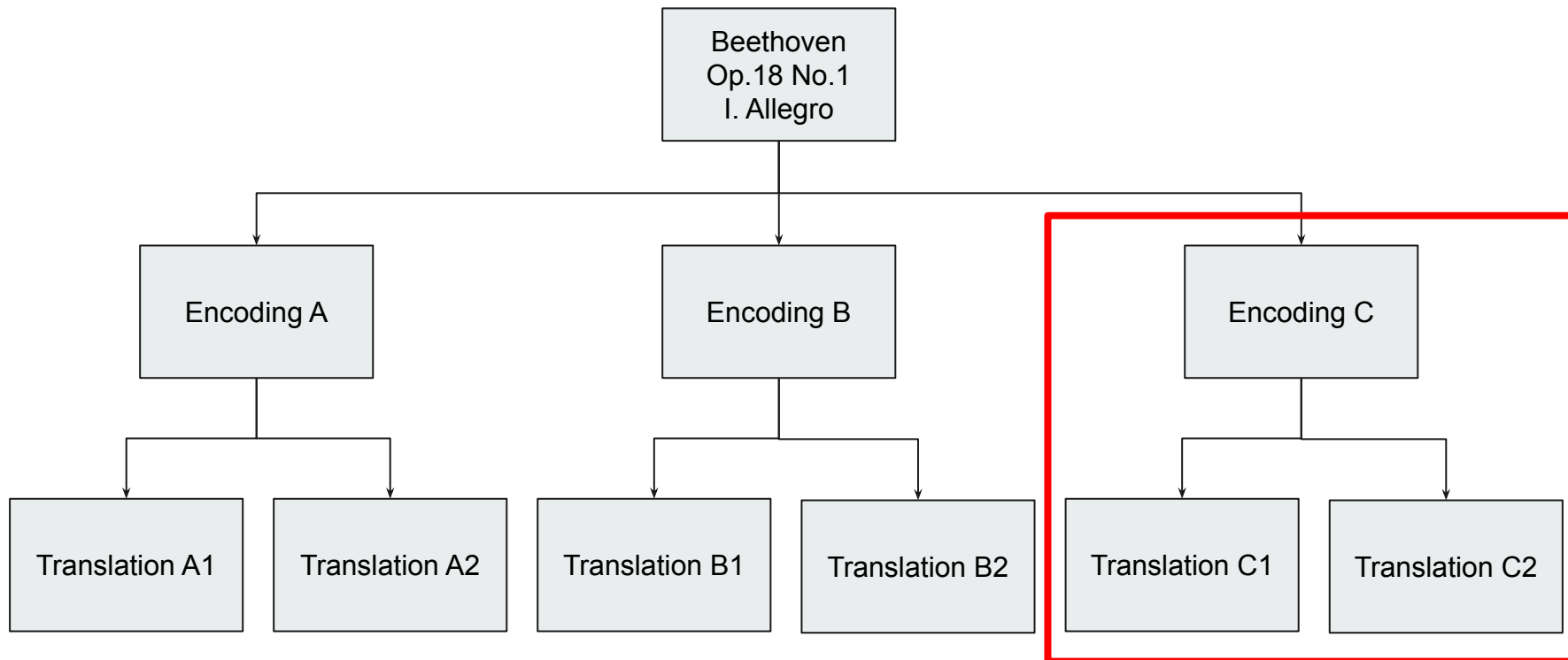
Encodings and Translations



Encodings and Translations



Encodings and Translations



What is *equivalent* (in a translation)?



Having the same note/rest **events**, starting at the same offset and **preserving the same attributes** (duration, articulation, and ornaments)


What is *equivalent* (in a translation)?

Having the same note/rest events, starting at the same offset and preserving the same attributes (duration, articulation, and ornaments)

Original



Translation



The image displays two staves of musical notation, labeled 'Original' and 'Translation'. Both staves are in treble clef, B-flat major, and 3/4 time. The original notation shows a sequence of notes: a quarter note on G4, a quarter note on A4, a quarter note on B4, a quarter note on C5, a quarter note on B4, a quarter note on A4, a quarter note on G4, a quarter rest, a quarter rest, and a quarter rest. The translated notation is identical to the original, showing the same sequence of notes and rests. The notes are connected by a slur, and the rests are marked with a squiggle.

Beethoven Op.18 No.1 - I. Allegro, measures 1-2

What is *equivalent* (in a translation)?

Having the same note/rest events, starting at the same offset and preserving the same attributes (duration, articulation, and ornaments)

The image displays two staves of musical notation, labeled 'Original' and 'Translation', in 3/4 time with a key signature of one flat. A red rectangular box highlights the first two measures of both staves. In the 'Original' staff, the first measure contains a dotted quarter note, and the second measure contains an eighth note followed by a sixteenth note. In the 'Translation' staff, the first measure contains a quarter note, and the second measure contains a quarter note followed by an eighth note. The red box indicates that the note and rest events are equivalent in terms of their starting and ending times, even though the phrasing and note values differ.

Beethoven Op.18 No.1 - I. Allegro, measures 1-2

What is *equivalent* (in a translation)?

Having the same note/rest events, starting at the same offset and preserving the same attributes (duration, articulation, and ornaments)

The image displays two staves of musical notation, labeled 'Original' and 'Translation', in 3/4 time. The original notation shows a sequence of notes: a quarter note, a half note, a quarter note, and a quarter note, all beamed together. This is followed by a quarter rest, a quarter note, and another quarter rest. The translation notation is identical to the original. A red rectangular box highlights the first measure of the second staff, which contains the beamed eighth notes, demonstrating that the translation preserves the note events, their starting offsets, and their attributes (duration, articulation, and ornaments).

Beethoven Op.18 No.1 - I. Allegro, measures 1-2

What is *equivalent* (in a translation)?

Having the same note/rest events, starting at the same offset and preserving the same attributes (duration, articulation, and ornaments)

Original

Translation

Beethoven Op.18 No.1 - I. Allegro, measures 1-2

Discrepancies (Translation)

Synchronized: note/rest events in the original score that **were found** in the translation

- Identical: note/rest events that have preserved their properties
- Different: note/rest events that have **not** preserved their properties

Non-sync: note/rest events in the original score that **were not found** in the translation, at least not in the offset of the original

Encoding vs. Translation	Synchronized Identical / Different	Non-sync
A vs. A1	95.2% / 4.8%	0.0%
A vs. A2	6.1% / 48.5%	45.4%
B vs. B1	95.1% / 4.9%	0.0%
B vs. B2	18.6% / 5.3%	76.1%
C vs. C1	94.4% / 5.6%	0.0%
C vs. C2	26.1% / 2.3%	71.6%

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Conclusions



Investigate the **discrepancies** between symbolic music files that (intend to) represent the same music score document

We hope that the better understanding of these discrepancies may help to

- Compare symbolic music files to find discrepancies
- Evaluate the quality of symbolic music corpora out there
- Mitigate *known* patterns of discrepancies automatically

Thank you



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Future work



Search for some of these patterns in large corpora to find their relevance in the existing corpora

Write routines to attempt to auto-correct these discrepancies when they are unambiguous (e.g., if a tie starts in XML-based formats, it must conclude)