Harmalysis: A language for the annotation of roman numerals in symbolic music representations

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1 Abstract

High-quality annotations of harmonic analysis are scarce [1, 2, 3, 4]. Furthermore, the existing data usually follows different conventions for spelling scale degrees, inversions, and special chords (e.g., cadential six-four).

There have been efforts for standardizing the notation of harmonic analysis annotations [5], however, these have not been very successful because: 1) there are few software tools able to parse such notations 2) as a consequence, researchers have not adopted the suggested notations and it is more frequent to find a different notation with every new dataset.

We attempt to mitigate the limitations of existing notations through the definition of a new language for harmonic analysis, which we call *harmalysis*. This language 1) provides a notation that adjusts as much as possible to the way in which researchers have annotated roman numerals in existing datasets, 2) formalizes the resulting notation into a consistent and extensible context-free grammar, 3) uses the context-free grammar to generate tools that are able to parse and validate annotations in the syntax of the language.

We make the formal definition of the language, a context-free grammar described in the Extended Backus-Naur Form (EBNF), available as an open-source repository. Within the same repository, we make available tools for parsing annotations in the *harmalysis* language. The tools allow the users to extract high-level semantic information from their annotations (e.g., local key, root of the chord, inversion, added intervals, whether the chord is tonicizing another key or not, etc.) and to validate the correctness of a given annotation according to the grammar of the proposed language.

The language has been designed to be easily annotated through the addition of lyrics in music notation software or—when supported by the symbolic music format—in a dedicated data structure for indications of harmony (e.g., the `function` tag in MusicXML, the `harm` tag in MEI, and a `**harm` spine in Humdrum). This ensures that the users adopting the language find an immediate

application for it.

2 The *harmalysis* language

Recently, the interest for harmonic analysis and its standardization in machine-readable contexts has been revisited by academics [4] as well as developers of music notation software [6].

We follow a similar approach by presenting a new language of roman numeral analysis, which can be encoded within symbolic music representations. The new language, *harmalysis*, is based principally on Huron's `**harm` syntax [5], which was originally intended for accompanying music scores encoded in the Humdrum(**kern) representation. We extend this syntax by borrowing elements from the `RomanText` format [4], MuseScore's notation for roman numeral analysis [6], and conventions observed in existing datasets of roman numeral analysis [1, 2, 3]. As a result, the *harmalysis* language is a superset of the `**harm` syntax, which includes additional features and supports a wider range of customs of harmonic analysis.

2.1 Goals of the language

The main goal of the language is to provide a convention for the annotation of roman numeral analysis, which the human analysts can use while they encode music through music notation software (e.g., MuseScore) or text-based encodings (e.g., Lilypond). These annotations, intelligible by the automatic tools accompanying the language, can later be used in machine-readable contexts, such as music information retrieval (MIR) tasks, computational musicology, and music engraving.

As an additional goal, the language attempts to integrate all the conventions observed in harmonic analysis practices that can be assimilated. This integration, however, is restricted to maintaining a rigorous definition of the language, which should always be characterized by a formal grammar. One example of such integration is the use of numeric inversions (e.g., `V65`) as well as inversions denoted by letters (e.g., `V7b`). Each of these conventions has its strengths and weaknesses, which is why they have been—individually—adopted in the past, however, they have now been adopted within the same annotation language. This presents an additional benefit, namely, using the same language and tools to process (although with limitations) existing datasets that have used different conventions of harmonic analysis.

As most formal languages, *harmalysis* is driven by a number of principles, which guided the decisions made during its design.

2.2 Principles of the language

The *harmalysis* language attempts to be:

1. Similar-looking to a textbook analysis: The language should feel intuitive to annotators who are familiar with textbook conventions of roman numeral analysis.

2. Compact: The labels of the language are relatively short and adequate for human annotators. Although they may be too terse for some users.

3. Flexible, but consistent over flexible: The language attempts to facilitate the preferred convention of most annotators, however, the formal definition of the language implies that sometimes the annotators will have to adopt a different convention than the one they usually follow (e.g., case-sensitive scale degrees are mandatory).

4. Agnostic to the symbolic music format: The language is based on plain-text annotations, it does not enforce (but also does not oppose) other data-description languages (e.g., JSON or XML), and it is not tied to a specific symbolic music format.

5. Stand-alone at the level of individual labels: Each label in the language can encode enough information to disambiguate its precise meaning without relying on a configuration file, the musical context, or previous labels.

6. Application-driven: The language is meant to be accompanied by tools that facilitate the extraction of high-level information from its annotations, rather than facilitate the preservation of very specific, non-conventional harmonies. Nonetheless, a feature called *descriptive chords* is provided for encoding non-conventional harmonies.

7. Extensible: The grammar of the language will always remain open-source and open to revisions and improvements.

3 Conclusion

In this paper, we introduced the *harmalysis* language for the annotation of roman numeral analysis in symbolic music representations. The language incorporates most of the features of the `**harm` syntax [5] as well as other conventions for the annotation of harmonic analysis [4], which are formalized in an open-source context-free grammar. Given the formal definition of the language and the tools that we make available with it, we consider that the *harmalysis* language is a valuable resource for researchers encoding or utilizing harmonic analysis datasets. The latest grammar of the language and its accompanying software can be found in the following website: `https://github.com/napulen/harmalysis`.

4 Statement[1]

The authors are interested in facilitating the systematic annotation of ground-truth data for the analysis of tonal music, particularly, in the context of music information retrieval (MIR) and machine learning. Should this proposal be accepted, the presentation will consist of a demonstration of the capabilities of the language, followed by a few example queries. No additional requirements other than the connection from a personal laptop to a projector would be necessary.

References

[1] Johanna Devaney et al. "Theme And Variation Encodings with Roman Numerals (TAVERN): A New Data Set for Symbolic Music Analysis." In: *Proceedings of the 16th International Society for Music Information Retrieval Conference*. Málaga, Spain: ISMIR, 2015, pp. 728–734. DOI: 10.5281/zenodo.1417497. URL: https://doi.org/10.5281/zenodo.1417497.

[2] Néstor Nápoles López. "Automatic harmonic analysis of classical string quartets from symbolic score". Masters Thesis. Universitat Pompeu Fabra, 2017. DOI: 10.5281/zenodo.1095617. URL: https://doi.org/10.5281/zenodo.1095617.

[3] Markus Neuwirth et al. "The Annotated Beethoven Corpus (ABC): A Dataset of Harmonic Analyses of All Beethoven String Quartets". In: *Frontiers in Digital Humanities* 5 (2018). ISSN: 2297-2668. DOI: 10.3389/fdigh.2018.00016. URL: https://www.frontiersin.org/articles/10.3389/fdigh.2018.00016/full (visited on 12/18/2019).

[4] Mark Gotham, Dmitri Tymoczko, and Michael Cuthbert. "The RomanText Format: A Flexible and Standard Method for Representing Roman Numerial Analyses". In: *Proceedings of the 20th International Society for Music Information Retrieval Conference*. Delft, The Netherlands: ISMIR, Nov. 2019, pp. 123–129. DOI: 10.5281/zenodo.3527756. URL: https://doi.org/10.5281/zenodo.3527756.

[5] David Huron. *Representation: **harm — humdrum-tools 1 documentation*. URL: https://www.humdrum.org/rep/harm/ (visited on 12/18/2019).

[6] *Roman Numeral Analysis (RNA)*. Musescore.org. URL: https://musescore.org/en/handbook/3/roman-numeral-analysis-rna (visited on 12/18/2019).

[1] As requested in the call for proposals.