# THE ROMANTEXT FORMAT: A FLEXIBLE AND STANDARD METHOD FOR REPRESENTING ROMAN NUMERAL ANALYSES

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## ABSTRACT

Roman numeral analysis has been central to the Western musician's toolkit since its emergence in the early nineteenth century: it is an extremely popular method for recording subjective analytical decisions about the chords and keys implied by a passage of music. Disagreements about these judgments have led to extensive theoretical debates and ongoing controversies. Such debates are exacerbated by the absence of a public corpus of expert Roman numeral analyses, and by the more fundamental lack of an agreed-upon, computer-readable syntax in which those analyses might be expressed. This paper specifies such a standard, along with an associated code library in `music21`, and a preliminary set of example corpora. To frame the project, we review some of the motivations for doing harmonic analysis, some reasons why it resists automation, and some prospective uses for our tools.

## 1. INTRODUCTION AND MOTIVATION

Roman numeral analysis represents tertian chords by their triad type (major, minor, diminished, augmented), their position relative to the tonic (specified by the scale degree of their root), their bass note or inversion, and the presence of sevenths or other added or altered notes. The practice emerged in the early nineteenth century, with Gottfried Weber's *Versuch einer geordneten Theorie der Tonsetzkunst* [19] drawing on Rameau's earlier concept of the fundamental bass. Weber's method was so immediately popular that he complained other theorists were stealing his methods, and it has remained common to the present day. It is useful to contrast Roman numerals with alternatives, notably:

- Absolute labels for chords such as 'C', as often found in lead sheets;
- Function-theoretic labels such as 'T[onic]';
- Inversional symbols accompanying bass notes as used in figured-bass notation.


Absolute chord labels are performer-oriented in the sense that they specify which notes should be played, but do not provide any information about their function or meaning: thus one and the same symbol can represent a tonic, dominant, or subdominant chord. Accordingly, these labels obscure a good deal of musical structure: a dominant-functioned G major chord (i.e. G major in the local key of C) is considerably more likely to descend by perfect fifth than a subdominant-functioned G major (i.e. G major in the key of D major). This sort of contextual information is readily available to both trained and untrained listeners, who are typically more sensitive to relative scale degrees than absolute pitches.

Roman numerals include contextual information at the cost of increased subjectivity: by labelling chords relative to a local tonic, they require the analyst to make a potentially difficult decision about what the tonic is. However, these decisions can be undone: given a Roman numeral and a key, one can algorithmically derive an absolute chord label. Thus Roman numerals can be used even in contexts where absolute labels are needed (for instance, exploring the frequency of "open" chords in guitar-based music). This makes it a good choice for the construction of analytical corpora, as one can translate from Roman numerals to absolute labels but not vice versa.

Function theoretical labels go one step further toward abstraction: here chords are identified not by their note content but by their perceived harmonic role. (Usually, the three Riemannian functions T, S, D are employed, though other writers have suggested additional harmonic categories.) Thus in C major, a term like "D[ominant]" could mean B-D-F, G-B-D-[F], or some other chord entirely; just as "S[ubdominant]" could mean either D-F-A-[C] or F-A-C. Because many distinct harmonies map to a single functional term, these labels cannot be translated into Roman numerals or absolute chord labels. However, function labels can often be recovered from Roman numerals: in ordinary musical contexts, vii and V are Dominants, while ii and IV are Subdominants [17]. Once again the asymmetry gives us reason to prefer Roman numerals for analytical corpora.

The inversional symbols of figured-bass notation are in many ways analogous to absolute chord labels, but with an important difference: they are often used to label "non-harmonic" sonorities containing dissonances that do not belong to the underlying harmony. For this reason, many recent theorists have favored them, [5, 10] be-

lieving that Roman numerals impose too strong a distinction between the harmonic and non-harmonic realm. (Ironically, Riemann himself made the converse complaint against figured-bass notation, believing that it did not draw a sharp enough distinction between harmonic and non-harmonic [13]). When we restrict our attention to tertian sonorities, however, figured-bass symbols are largely equivalent to absolute chord labels, telling performers what notes to play but not what they mean.

Each of these methods has its benefits and shortcomings; we have chosen Roman numerals for their widespread popularity, their translatability to the other formats, and their proven utility.

### 1.1 Motivation for Roman Numeral Analysis Corpora

Roman numeral analysis involves several different layers of subjective judgment:

- which notes are harmonic / non-harmonic;
- what complete harmony, if any, an incomplete or otherwise ambiguous chord might represent; and
- the underlying keys and when they change.

Thus Roman numeral analysis is not an automatic process, and humans may legitimately disagree about the best analysis of a given passage [14, 15, 18]. Instrumental textures present a particular challenge because it is not always clear where harmonies change, and even a single, monophonic passage such as an Alberti bass can imply multiple voices. Even in rhythmically simpler genres, such as the Bach chorales, there are significant challenges to automatic Roman numeral parsing.

One of us has written a rule-based Roman numeral analyzer that reproduces human analyses of the Bach chorales with roughly 82% accuracy (DT forthcoming work; code available on request). That figure represents something like the state of the art, and while 82% accuracy is sufficient for some applications, it falls far short of what is needed in serious analytical and pedagogical contexts. Furthermore, extending the method to instrumental textures poses a range of considerable challenges.

Such challenges motivate the construction of human-made corpora, which can serve as the "ground truth" for evaluating computational analyses. Human-made corpora can also allow us to study the degree of alignment among expert analysts, as well as providing important first-order information about harmonic practices in different historical eras. Finally, the combination of automatic analyses with machine-readable scores facilitates a host of analytical projects including the automatic identification of non-harmonic tones.

## 2. THE .RNTXT SPECIFICATION STANDARD

We now outline our proposed standard. Previous work to define standards and create corpora include [1, 3, 4, 7, 8, 11, 12, 16]. Our goal is to create a format that is not just parsable by a computer, but also easy for human beings to read and write. Previous work tends to neglect this latter consideration, and thus limits corpus creation to dedicated coders and researchers prepared to learn formats divergent from textbook models. The Clercq-Temperley and DCMLab's tabular representation are user-friendly exceptions; we provide converters as part of the `music21` code to connect with those format (as discussed below in Section 3.1) [2]. Additionally, [4] reports that TAVERN has plans for a forthcoming `music21` converter which would further extend the connections and interoperability between these corpora. We provide extensive online examples (cf. Section 3.2) below and include one extract in the text as Figure 1.

```
Composer: J. S. Bach
Piece: Chorale BWV269
Analyst: Dmitri Tymoczko
Proofreader: David Castro

Time Signature: 3/4

Form: chorale
m0 b3 G: I
m1 b2 IV6 b3 V6
m2 I b2 V b3 vi
m3 IV b2.5 viio6 b3 I
m4 V || b3 I
m5 V6 b2 vi6/5 b3 viio6
m6 I6 b2 ii6/5 b3 V b3.5 V7
m7 I || b3 I
m8 I b2 ii b2.5 viio6 b3 I6
m9 I6 b2.5 V4/3 b3 I
m10 V || b3 vi
Note: consecutive first inversion triads
m11 vi b2 iii6 b3 ii6
m11var1 vi b2 I6/4 b3 ii6
m12 I6 b3 V7
m13 I b2 I6 b3 V7/IV
m14 IV || b3 I
m15 V6 b1.5 V6/5 b2 I b3 viio6
m16 I6 b2 I b3 V b3.5 V7
m17 vi b2 IV b3 I
m17var1 vi b2 IV b2.5 viio6/4 b3.5 I
m18 V || b3 I
m19 V6 b3 IV6
m20 vi b2 ii6/5 b3 V b3.5 V7
m21 I
```

**Figure 1**. An example of the new standard as used to represent an analysis of the Bach chorale BWV269.

### 2.1 Metadata

Documents may begin with the following optional lines:

- Composer: e.g. 'Mozart'
- Piece: Name and/or catalogue number, e.g. 'K550'

- Analyst: The name of the original analyst / originator of this document, e.g. 'Jo Blogs'.
- Proofreader: The name(s) of the anyone involved in checking and correcting this work, e.g. 'Jo Vlogs'.

After the metadata, may include movement and time signature information on separate lines.

**Movement.** Use Arabic numbering to label the movement of a multi-movement piece.

```
Movement: 1
```

Each movement is typically contained in its own file.

**Time Signature.** Specify time signatures on a separate line in the form of a simple string, such as:

```
Time Signature: 6/8
```

Changes of time signature are notated with a new specification immediately preceding the change. If no time signature is specified 4/4 is assumed.

**Key Signature.** The format supports the (optional) specification of the notated key signature as a number of sharps (or negative number for flats) in the key signature. So the specification:

```
Key Signature: -1
```

stands for a key signature of one flat (F major or d minor).

**Minor Sixth / Minor Seventh.** Specifies how scale degrees 6 and 7 are to be interpreted in minor mode. Supported values are 'quality' (major chords are on flattened degrees, minor or diminished on raised degrees), 'cautionary' (default: same as quality, but # and b can used to leave off ambiguity), 'sharp' (raised degrees are standard; lowered degrees require b), and 'flat' (lowered degrees are standard). See github.com/MarkGotham/When-in-Rome for a tabular comparison of these options.

### 2.2 General syntax of Chords

After the metadata, the document proceeds to itemize each chord with one line per measure. Each line of analysis starts with the symbol 'm' followed immediately by a measure number with no space; it then proceeds with pairs of beat numbers (preceded by 'b') and their corresponding Roman numerals. For instance, the line:

```
m5 b1 IV6 b2 V
```

indicates that in measure 5, a $IV^6$ chord falls on beat 1, followed by a V chord on beat 2.

**Chord Inversions.** The format supports all standard representations of triad and seventh inversions, as itemized in Section 2.3. Slashes are optional for separating subscript from superscript numbers, so $I^6_4$ may be `I6/4` or `I64`.

**Missing beats.** If no beat is specified at the start of a line, beat 1 is assumed. For any further beats that are missing, the existing chord remains in effect. So the line:

```
m14 IV6 b2 V b4 V2
```

indicates that measure 14 starts with $IV^6$ chord on beat 1, followed by a V chord on beat 2 which remains in effect across beat 3, and becomes $V^2$ on beat 4.

**No chord.** 'NC' indicates a passage with no chord – where one chord terminates prior to the onset of the next.

**Measure numbers.** Each line begins with a measure number and each movement should be numbered separately. This means that every movement will start with measure 1, except in the case of an initial anacrustic measure which is numbered 0. (The `music21` parser interprets the length of the anacrusis based on the first notated beat: thus in 4/4, `m0 b4 C: V` indicates a quarter-note pickup, while `m0 b4.5 C: V` indicates an eighth-note pickup.) Thus measure 1 is always the first full measure. For multiple alternative measure numbers, such as first / second time repeats or endings, use lower-case Latin script, so '216a', '217a', '218a' for the first, and '216b', '217b', '218b' for the second. See 'Repeats' in Section 2.5 below for details of how to handle measures that repeat the harmonic context of other measures.

**Beats.** Beat numbering follows the conventions for the given meter, so 4/4 has 4 beats in total, while 6/8 and 2/2 have two. Thus a succession of eighth notes will be assigned different beat positions depending on that context, for instance:

- in 4/4: 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5.
- in 2/2: 1, 1.25, 1.5, 1.75, 2, 2.25, 2.5, 2.75.
- in 6/8: 1, 1.33, 1.66, 2, 2.33, 2.66 (or 2.67).

The X.33 and X.66 format is also used for the second and third units in a triplet division of a duple meter. For further division of ternary beats, analysts can either use more precision or multiple decimal points, so that '1.833' and '1.66.5' indicate the point halfway through the second eighth of the first beat of a 6/8 measure.

**Keys.** Indicate key changes with the name of the key in the correct (upper or lower) case, followed by a colon. `C:` indicates the key of C major; while `c:` is c minor. Sharps are notated with '#' and flats with either 'b' or '-'. Key changes occur between beat and chord, so

```
m112 IV6 b4 C: ii
```

indicates a key change to C major on beat 4 of measure 112. A single chord can be notated as a pivot chord belonging to two keys like so:

```
m112 IV6 b4 vi C: ii
```

Here, one and the same (D minor) chord is recorded both as 'ii' in the new key of C major and 'vi' in the old key (F major). (Note the lack of a beat between the Roman numerals in the two keys.) There is no need to change keys for modally-inflected chords:

```
m112 IV6 b3 iv6
```

indicates a major triad $\hat{6}$-$\hat{1}$-$\hat{4}$ followed by the minor triad $\flat\hat{6}$-$\hat{1}$-$\hat{4}$ with the same root.

A key with a semicolon preceding the colon, such as `C;:` indicates that the new key should also be indicated with a change of key signature in any generated score.

In cases of key ambiguity, a secondary key may be preceded by a question mark and an open parentheses such as `?(Bb:` which indicates that the analyst believes that B-flat major is also a valid key but that the prevailing key (such as g-minor) is the one to which subsequent Roman numerals will refer. These optional keys can be concluded by reversing the direction of the parenthesis as in `?)Bb:`.

**Chromatic Alteration.** For altered chords, simply use the appropriate triadic symbol: lowercase with the suffix

'o' for diminished, lowercase for minor, uppercase for major, uppercase with the suffix '+' for augmented. Roots can be raised or lowered with a preceding '#' and 'b'(e.g. `iv`). Thus `bIII+` indicates an augmented triad on a lowered scale-degree 3, or Eb-G-B in C major.

**Altered, added, and omitted tones.** These may be indicated by an operation and chord step in brackets. Thus `V4/3[b5]` indicates a $V^4_3$ chord with whose bass is lowered. Note the potentially confusing (but standard) combination of figured-bass and root-functional symbols: in `V4/3[b5]` the '43' refers to intervals above the bass, while [b5] refers to an interval above the root. The symbol 'no' can be used to specify chord tones that are to be removed. Each alteration should appear in its own set of brackets. Thus, as a non-sensical demonstration of multiple possible features, `V65[no5][add#6][b3]` indicates Bb-E#-F-G in C major.

**Minor mode.** In minor, scale degrees 6 and 7 are variable depending on whether the melodic or natural minor collection is used. For the purpose of legibility the expectation is that common chords conform to one of the standard minor scales. Thus `a: VII` refers to G-B-D while `a: viio` refers to G#-B-D. Similarly, `a: VI` is F-A-C while `a: vio` is F#-A-C. Augmented chords are treated as altered major chords (i.e. based on natural-minor scale degrees), while diminished chords are treated as altered minor triads (raised degrees). These interpretations can be changed through the 'Sixth minor' and 'Seventh minor' metadata tag described above.

**Applied Chords.** 'Applied', or 'secondary', chords are notated using '/'. For instance, `V/V` indicates the dominant chord of the dominant key of the prevailing tonic, so D major (V of G major) in the key of C major. Applied chords are typically used for local tonicisations (including the purely diatonic V/III in minor), reserving 'full' key changes like `C:` for longer modulations. Chained applied chords such as `V7/V/V` are allowed.

**Augmented and Neapolitan sixth chords.** These are sufficiently canonical to be afforded their own abbreviation. Thus 'Ger*' is shorthand for `#ivo*[b3]` where * labels the appropriate inversion (7, 6/5, 4/3, or 2), 'It*' for `#ivo*[b3]` (with possible inversions being 5/3 or blank, 6/3 or 6, or 6/4), and 'Fr*' for `II*[bV]`. For the Neapolitan, 'N' and 'N6' are both accepted abbreviations for `bII6`. Use `bII` for the Neapolitan in root position.

**Cadential 6/4.** For computational simplicity, the parser expects any of `I64`, `I6/4` or `Cad64` for the cadential 6/4 chord (`V64` is not treated as equivalent here since its meaning depends on context).

### 2.3 Chord Symbol Summary

The following list summarises the possible symbols available for use in describing chords.

- Sharps and flats: b = flat, # = sharp, bb = double-flat, ## = double sharp, etc.
- Major Triads: I, II, III, IV, V, VI, VII (upper case)
- Minor Triads: i, ii, iii, iv, v, vi, vii (lower case)
- Triad suffixes: add '+' to major for an augmented triad; 'o' to minor for a diminished triad (note, this is the letter 'o' not the numeral '0'); '/o' indicates a half-diminished seventh chord.
- Abbreviations: 'It', 'Ger', 'Fr', 'N', 'Cad'.
- Triad inversions: no symbol or '5/3' for root position; '6' or '6/3' for first inversion; '6/4' for second inversion (with or without the optional '/').
- Seventh inversions: '7' for root position, '6/5' for first inversion, '4/3' for second inversion and '2' for third inversion. '9', '11', and '13' are also supported in root position.
- Altered/added/omitted notes: use square brackets and Arabic numerals, e.g. '[no5]' for no fifth.

Together, these elements are sufficient to describe any standard tonal chord. Roman numerals may involve more or less complicated combinations of these symbols. Formally, the triad type is the only required element, so 'I' and 'V' (and their minor-mode equivalents) are the simplest possible syntatical entries. A maximally-complex chord description involves all of the available elements, which will be parsed in the following order:

1. Triad type (with quality indicated by case);
2. Triad suffix for diminished / augmented;
3. Accidental for raising/lowering the root (sometimes computed, in minor, from triad type);
4. Accidental for modifying a seventh and/or inversion that follows;
5. Seventh, ninth, etc. and/or inversion;
6. Accidental for modifying an ...
7. Altered/added/omitted note;
8. Relative key (in the case of applied chords)

Steps 6 and 7 also may be repeated.

See Section 3.1 for details of how the code processes this, and github.com/MarkGotham/When-in-Rome for full reference lists of all possible Roman numerals along with the pitches they entail in C major and a minor.

### 2.4 Form, Phrase, and Pedals

**Pedal points.** With pedal points, analysts face a choice between integrating the pedal into the Roman numerals – for instance, `I IV6/4 I` and `V I6/4 V` each has the same tones in the bass throughout – or to indicate that the pedal has harmonically separated from the passage and should no longer be represented in this way [9, p.113]. This format supports both notations. To notate a pedal separately, use a line of the kind:

`Pedal: G m14 b3 m19 b1`

Here a G pedal begins in measure 14 beat 3 and lasts until (but not through) measure 19 beat 1.

**Large-scale formal labels.** Formal sections can be identified using the prefix `Form:`. Examples include the major sections of Sonata Form ('Exposition', 'Second Theme', 'Development', 'Recapitulation' and 'Recapitulation Second Theme'); numbered variations in variations form ('Variation N'); and the large-scale divisions of a Rondo ('Rondo A', 'Rondo B'). These should be positioned on a separate line before the measure in which the section begins.

**Phrase boundary.** Phrase boundaries can be identified with '||'. This provides data useful for many lines of enquiry. From the strictly harmonic perspective, this can help to contextualise unusual progressions. For instance, in

```
m33 V || b2 IV
```

the oddity of an apparent V-IV progression is contextualised by the fact that it occurs across a phrase break: the music stops on V before resuming on IV.

### 2.5 Repeated Progressions and Variants

**Repeats.** For different passages with the same harmonies, the format supports the following abbreviation:

```
m3-4 = m1-2
```

This indicates that measure 3 is the same as measure 1 and measure 4 is the same as measure 2. This shorthand works for exact repeats of chords progressions, with the same chords, in the same order, in the same part of the measure. For near variants, judicious copy-and-paste is required, taking care to make the necessary changes. One of the authors (DT) has written a simple python program to renumber measures and shift chords into a new key, available on request.

**Variant readings.** For multiple readings of the same passages, use the 'var' tag. For instance,

```
m1 viio6
m1var1 ii
```

indicates that the chord in measure 1 is ambiguous: it may be viio6 or ii. Multiple variants may be indicated with var1, var2.

**Notes.** The 'Note' tag affords an opportunity to record any other noteworthy elements, such as a pattern not evident from the Roman numerals alone. Include notes on separate line, before the moment of interest. This subsidiary feature is for the analyst's reference only and not processed as part of the harmonic analysis.

## 3. CODE AND CORPUS

Apart from the .rntxt standard specification, this paper also presents a code library in `music21` for handling Roman numeral analyses, as well as a set of initial corpora.

### 3.1 Code

The code focusses on translation routines for the .rntxt representation defined above, the related Clercq-Temperley standard defined by Trevor de Clercq and David Temperley for rock harmony ('.tdc' extension), and the DCMLab's

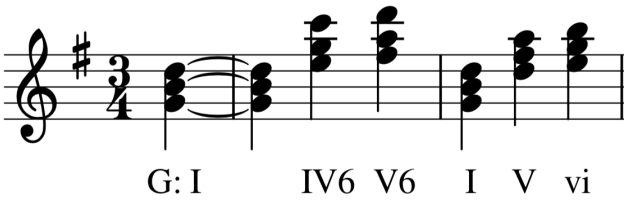


**Figure 2**. An example of `music21`'s default musical-notation rendering, with chords in close position and the numeral itself included as a 'lyric'. This example is from the start of BWV269, corresponding to Figure 1.

tabular representation format ('.tsv' extension). [1]

Like the .rntxt representation format, the code also provides a neutral conduit for processing Roman numeral analyses in various ways: converting between representation formats, rendering the analyses in musical notation, and engaging in computational analysis using the wider `music21` code base. Again, that neutrality means supporting any in-principle approach to Roman numeral analysis as long as the representation meets the syntactical criteria of the format.

Exceptions are raised in the case of divergence from the syntax, and the parsers are fully integrated into `music21`, so both `corpus.parse()` and `converter.parse()` read directly from the file types listed (.rntxt, .tdc, and .tsv). Files with other extensions can be parsed by passing in a format parameter: `.parse('file.txt', format='romantext')`.

All features of RomanText described in this paper are supported by the most recent release of music21 (v.5.7), except [addX] tones and settings for alternative parsing of vi/VI and vii/VII included in v.6.0alpha, and variant readings which are not currently supported.

From these RomanText analyses, the code creates a `music21` Score with a single Part object containing all the RomanNumeral objects within the relevant measures. Figure 2 shows an example of how `music21` renders Roman numerals: unless specified otherwise, the tonic is placed in octave 4 (the octave above middle C inclusive), the root (or imagined root if in inversion) is placed above that tonic, and the real bass of each chord is placed in the octave above that pitch. Where the corresponding score exists in an encoded format, this analysis part can be inserted as an additional 'part' in order to view the relationship between score and analysis in musical notation. Future work may see an option for matching the analysis up with the original piece in order to render chords in their original spacing.

The `RomanNumeral()` class extends the `Chord` class, inheriting mutually useful variables like `.root`,

[1] For more information on the deClercq-Temperley format, see the scholarly reports in [3] and [16]. For the DCML lab's standard, see [12] and the code base at `github.com/DCMLab/ABC/` For music21's provision, see the code base at: `github.com/cuthbertLab/music21/tree/master/music21/romanText` or for documentation: `web.mit.edu/music21/doc/moduleReference/moduleRoman.html` for the code and Chapter 23 of the User's Guide: `web.mit.edu/music21/doc/usersGuide/`

and introducing new read/write attributes. Thus anything one can do to or with a `Chord` is also possible with a `RomanNumeral`. A Roman numeral pairs a `.figure` (such as `I6`) with a `.key` (such as `C`), but the class supports a range of additional attributes, some settable, others read-only.

Additional methods support the creation of RomanNumeral object ab initio, such as the `.romanNumeralFromChord()` method which processes any chord (which in turn can be made from a list of pitches) into a `RomanNumeral` object when paired with a specific key.

As discussed in Section 2, the RomanText format supports additional elements that are more textual than harmonic: 'large scale formal labels', 'pedals', and 'notes'. music21 processes these as text with a dedicated subclass of TextExpression.

### 3.2 Corpus

Finally, we present a set of example corpora approximately representing the start, middle and end of common-practice tonality as follows (with the total analyses in brackets):

1. Monteverdi madrigals, Books 3–5 (48 works);
2. Bach chorales (a sample, 20 analyses);
3. Preludes from the first book of Bach's Well Tempered Clavier (complete, 24 preludes);
4. Beethoven string quartets, converted from the DCMLab's ABC corpus and with manual error-correction (complete, 16 quartets, 70 movements);
5. 19th-century French and German songs from the 'Scores of Scores' corpus [6], (sample, 50 songs).

See github.com/MarkGotham/When-in-Rome for directions to these corpora: the first two are included in the latest version of music21; more will be added after error checking. We offer them in order to illustrate how the format works in a range of repertoire contexts, and to provide an initial dataset for experimenting with the format. An additional corpus of approximately 1,000 scores, ranging from Dufay to Brahms, will be released within a year.

As we have been at pains to point out, the .rntxt format accommodates any kind of Roman numeral analysis, as long it is adopts the basic syntax as outlined above. That said, any particular corpus will have to make 'policy' decisions about its approach, if it is to be consistent. In these corpora, we have elected to prefer:

1. harmony changes on metrically strong positions and at regular intervals;
2. to analyse similar material in similar ways;
3. to identify as 'harmonic' notes that do not belong to any common species of non-harmonic tone (e.g. notes that are both leapt-to and leapt-from); and
4. harmonic analyses that are more consistent with standard harmonic theory.

No.1 and No.2 are intuitive enough, though No.2's reliance on 'similar' leaves ample room for ambiguity; furthermore there are cases where harmonic considerations lead to different analyses of parallel passages. Rule No. 3 requires harmonic analyses to conform to the precepts of traditional contrapuntal theory, which is mostly appropriate for our chosen repertoires (though some allowances need to be made in the case of Monteverdi).

No.4 is arguably more interesting. The preference may appear circular, but it is not: standard harmonic theory asserts that the majority of tonal chord progressions can be understood as conforming to a small number of harmonic and contrapuntal patterns; it does not assert that all passages are unambiguous, nor that composers tried to avoid analytical ambiguity when composing. Thus analysts commonly rely on their harmonic expectations when identifying chords. For instance, given a D-F dyad between I and $I^6$ in a common-practice C major context, preference No.4 helps lead us to identify the most promising candidates for completion as ii, $V^4_3$, and $viio^6$ and to choose either of the latter two, since the progressions I $viio^6$ I6 and I $V^4_3$ $I^6$ are significantly more common than I ii $I^6$. (The former is more common in Bach; the latter in Beethoven, so detailed stylistic information is needed in this case.) The sense of 'commonness', furthermore, can be justified by looking only at those cases where a complete triad intervenes between I and $I^6$. In this way, we use our sense of what happens in the non-ambiguous cases to guide our interpretation of the ambiguous ones.

A more thorough-going discussion of the philosophical options available to Roman numeral analysts will be published by author DT soon.

## 4. SUMMARY AND OUTLOOK

This paper presents a specification for Roman numeral analysis, code for working with those analyses, and a set of example corpora. The format thus supports a range of data-driven approaches to harmonic analysis, as well as other applications including pedagogical (e.g. visualisation and the selection of pertinent teaching examples) to compositional (setting harmonic constraints for stochastic composition). We hope that these offerings will contribute positively to ISMIR's 20th anniversary call for 'reusable' material to 'build up consistent knowledge across the community.'

## 5. ACKNOWLEDGEMENTS

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## 6. REFERENCES


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