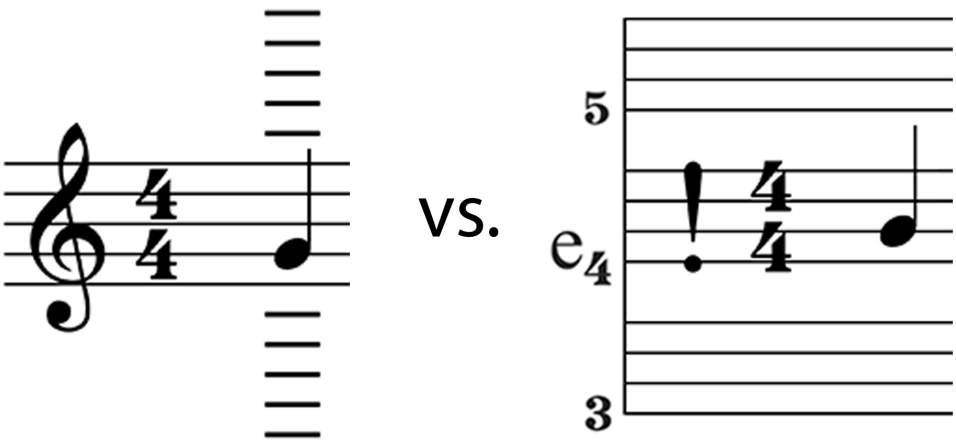

symmetrical

acaNotation

The **method** of
"symmetrical" music notation (aNs)
-
not just for guitar

A music-philosophical consideration for music didacts and educators

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(transl. from German [Rev. 2.2.5] to English [Rev. 1.4.1], date 2023-11-18)

A big annoyance in connection with learning music notes is that the classical notation system is "asymmetrical", which means: in different octaves, notes with the same name sit on different lines or spaces in the system. This involves a lot of learning effort.

With a few changes, however, the classical notation system can be transformed into a symmetrical one that is very easy to learn.

Meaning and purpose of **acaNotation**

- convert the asymmetrical classical notation system into a symmetrical one
- bringing the application of the classical notation system to all existing musical instruments and singing voices without taking into account the different clefs (treble, bass, alto, tenor, etc.)

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Abstract

In the *asymmetrical* classical notation system[1], the five-line representation as well as the use of ledger lines[2] and different clefs[3] (treble, bass, tenor, alto, etc.) are used for the different pitches[4], which are in a total range of 7+ octaves. Having five lines and four spaces that in every octave are filled with different tones (tone names) involves a lot of learning effort for music students.

Asymmetrical in the non-mathematical sense here means: irregular, uneven, inhomogeneous, incongruent. The only question is: "Asymmetrical with respect to what?"

[1] classical notation system, classical music system = klassisches Notensystem
[2] ledger line = Hilfslinie
[3] clef = Notenschlüssel
[4] pitch = Tonhöhe

In the entire classical notation system, which extends over 7+ octaves, there are many note positions that are spatially identical but have different names for the seven **natural tones**[5] c, d, e, f, g, a and b. In other words: there are notes with the same natural name that are in different positions on staffs[6] and ledger lines. Music students who want to learn how to read music must learn the many different positions of notes in the classical staff system.

In the **symmetrical acaNotation (aNs)** presented here, however, the 7 natural tones are always in the same positions across all octaves. The 7 NATURAL TONES and their positions only have to be learned once, which are then numerically assigned to NATURAL TONES', NATURAL TONES'', NATURAL TONES''', etc. by applying a simple octave index (0 - 7) in the range of all pitches depicted. This means that the ledger lines, which many music students find very complicated, as well as the various clefs can be dispensed with. By reducing the notation system to 7 notes with fixed positions on the lines and spaces of a staff, the **aNs** system becomes "symmetrical" across all octaves.

The **acaNotation** system is therefore **octave-symmetrical** on the staff[7].

The term *symmetry* here is not to be understood mathematically and geometrically, because there is no way to physically draw a mirror axis[8] into the system. In the present notational context, symmetry has a more metaphorical meaning, namely when, in a "mirroring of two octaves", on both sides of the mirror or symmetry axis, each natural note x of one octave with the same note name exists as a natural note x' of the other octave. This mirror process with the natural notes x'', x''' etc. is repeated over all octaves.

aNs can be easily applied to all musical instruments and singing voices. The user of this octave-symmetrical notation system is only required in one respect: They must know in which octave (0 .. 7+) or in which octave range their instrument is played or their voice is sung.

For the technical implementation of **acaNotation**, the classsical notation system was changed a little: instead of five, there are only 4 lines in a staff and therefore 3 spaces instead of four. The *individual* ledger lines that exist in the classical sense are no longer applicable. They are replaced by **groups**

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[5] natural tone = Stammton

[6] staff/stave = Notenzeile -> staff line = Notenlinie

[7] **Octave symmetry** should not be confused with **note symmetry**. Neither the notes in the classical staff system nor those in **aNs** are arranged symmetrically within themselves. However, the notes of both systems are linear: you know where they start and where they end.

[8] mirror axis = Spiegelachse

of ledger lines (auxiliary lines) that give the user the impression of being coherent and easily manageable staffs. According to Adam Riese, exactly 7 tones (the natural tones) can be accommodated in this range of 4 + 3 note positions. The notes, symmetrically organized in this way, repeat from octave to octave without changing position - this approach is what ensures notational success.

V. Notation Software

The *Capella* software from WHC was used to create the notations in this document. Capella is available in German and English. Capella can do everything you need, is very easy to use and is available for relatively little money.

1 Preface

Also the other two **acaMusic** paradigms, called **acaChords** and **acaLead**, were about making life easier for guitarists in the future - based on the representation methods that have so far been established in the music-technical area.

In the **acaChords** paradigm[9], absolute chords were replaced by generic relative step numbers. This eliminated the annoying transposition problem when changing between keys.

In the **acaLead** paradigm[10], by replacing the classical position concept[11] in guitar sheet music with the linearly scaled *Fret Index*, playing notes on the higher, non-distinct[12] frets of the fingerboard became an easy matter.

Since both paradigms mentioned can in principle be used immediately by every guitarist, in addition to their theoretical structure they have immediate practical relevance.

This practical relevance is currently not given in the paradigm of **symmetrical acaNotation (aNs)** presented here. At the current stage, **aNs** is still an exclusively theoretical concept, just a concept idea that is initially presented to the world of musicians who read music and subjected to a critical discussion among music didactists and educators with expertise in music notation. Although all of the music illustrations contained in this document were graphically created without any problems using the *Capella* notation software, the sound references required for listening are still missing (the music illustrations cannot yet be reproduced acoustically). Special software implementations are required for this. Depending on the final assessment of the peer readers and notation lobbyists, the **aNs** idea may one day come into circulation as a finished product - as a new notation software.

Like the other two **acaMusic** paradigms mentioned above, the **symmetrical acaNotation** also pursues the goal of a clearly noticeable simplification of application in order to make life easier for musicians reading music. The classical notation, which consists of five staff lines and four spaces and uses ledger lines, is asymmetrical (there is no regular repetition of the notes across the octaves) and is therefore difficult to learn[13]. Due to the variety of representations associated with it (there are many different clefs for different instruments and their different octave positions), classical notation

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[9] See the document: "acaChords Notation - Die Methode". (This document is currently only available in German.)
[10] See the document: "acaLead Notation - Die Methode". (This document is currently only available in German.)
[11] position concept = Lage-Begriff
[12] uneindeutig, nicht eindeutig (ambiguous)
[13] There is an analogy to learning a language. Acquiring a (new) language is easier the fewer irregular verbs there are.

in its entirety can only be learned with a great deal of effort. The **symmetrical aNs notation**, on the other hand, only consists of four staff lines and three spaces. It does not require any different clefs or any ledger lines (in the classical sense). These differences to classical notation make it very easy and clear in all applications that occur in musical practice.

2 The acaNotation system in comparison with the classical notation system

The following illustration shows the **primary staff**[14] of the **aNs** system in comparison with the classical staff equipped with a treble clef. The staffs of both systems contain the seven natural tones c - d - e - f - g - a - b, but in the modified order e - f - g - a - b - c - d.

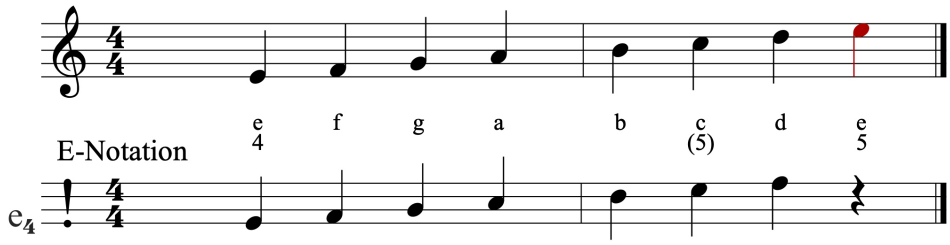

*Fig. 1 The **aNs** primary staff in E-Notation vs. the classical notation system*

e_4 = **tone octave index** (the tone on the bottom line of the staff is the natural note e in the fourth octave)

Because of the treble clef (the note on the belly line of the clef is by definition g_4), in the upper classical staff the first note in the illustration is the note e from the fourth octave (e_4). The next higher note e, the note e_5 one octave above, corresponds to the last note printed in red.

Since there are two notes with the natural note name e, which are in different positions within a staff (one note e is also on a line, the other one an octave higher in a space), the system is - related to the octaves involved - asymmetrical.

Note: By convention, octave changes always occur on the note c, for example "… a, b, c_4, d, e, f, g, a, b, c_5, d, e …". As a reminder of this, the note c in the second measure[15] of the illustration has been given the (5) identifier.

The clef of **acaNotation** is the exclamation mark (!). Its point is always on the lowest - system indexing - staff line. However, the bottom line can have different tone octave indices (see below).

[14] Primär(noten)zeile
[15] measure = Takt

In the **symmetrical acaNotation** system (4 staff lines, 3 spaces), the same seven natural tones were initially set in the illustration as in the classical staff system. However, the red note e_5, which repeats one octave higher, is missing because the **aNs** staff is completely filled with the 7 natural tones and can no longer accommodate any further notes - not even in the space[16] directly above the staff and below the first ledger line!

Just as in the classical staff the treble clef (there are also other clefs, see below) marks the note g_4, in **aNs** this marking is taken over by the point of the exclamation mark on the bottom line of the staff, here marked e_4. Because the tone on the bottom line was determined to be e by the tone index, in **acaNotation** terminology it is an **E-Notation**.

The use of E-Notation is ideal for learning simplicity because it means that the seven natural tones sit on the same lines as the natural tones in the classical treble clef staff. Anyone who knows the treble clef no longer needs to learn the E-Notation of **aNs**.

Attention: In addition to the octave change remark made above for the note c, it should also be mentioned that the note octave index e_4 is not intended to claim that a new octave begins on this staff line with the note e (new octaves begin as is well known with the note c, see above), but simply that the note e from the fourth octave sits on this staff line.

As the following illustration with the alternative C-Notation shows as an example, in principle six other natural tone notations are possible in **aNs**.

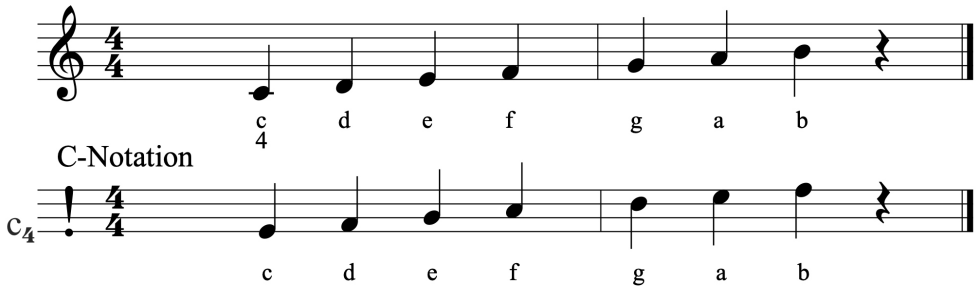

*Fig. 2 **aNs** primary staff in C-Notation*

Whether, in addition to the E-Notation that corresponds to the classical treble clef note distribution, the other realizable natural tone notations of **aNs** also make practical sense beyond their theoretical significance should not be further questioned at this point. It's just important to know that these notations are technically possible.

[16] Unfortunately there is no term like the german "Hilfszwischenraum" in English.

The advantage of the C-Notation over the E-Notation is nevertheless clear: since a new octave begins by convention with the note C, each staff arranged with the C-Notation stands for a new octave in the definitional sense of its beginning with the tone c. The disadvantage is: this "notation " must first be learned.

3 The primary and secondary staff(s) of acaNotation

From the introductory explanations above it was already clear that the pitches of the notes on an **aNs** staff are determined by the **numerical octave index** on the lowest line of the staff. If notes are to be written beyond the range of an octave, additional staffs are required in **aNs**, each of which has its own octave index:

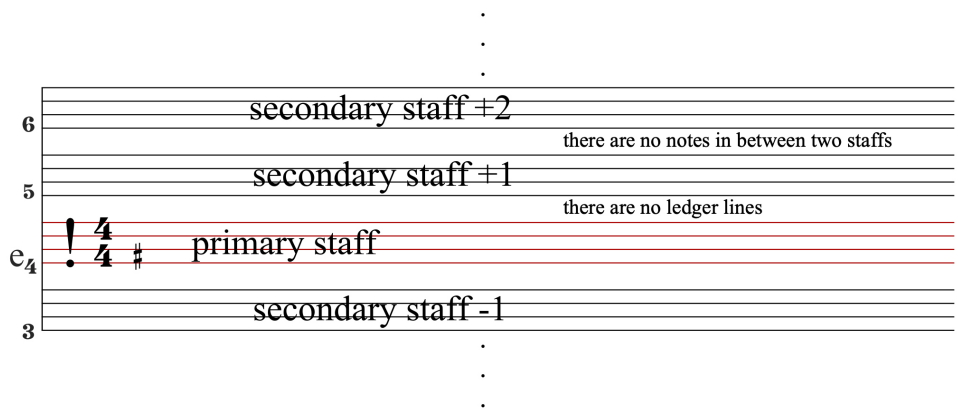

*Fig. 3 The primary and secondary staffs in **acaNotation***

For reasons of better visibility, the primary staff in the figure has been colored red.

An **aNs** system consists of a mandatory primary staff and further secondary staffs above or below it. Since each of these staffs - apart from the different octaves - contain the seven natural tones in the same positions (see above), the system is **symmetrical** over the entire tonal range.

The primary staff and secondary staff(s) are complete, self-contained entities whose boundaries (the top and bottom staff lines) cannot be exceeded.

There are no ledger lines (in the classical sense, more precisely see below) and, above all, no further spaces in between ledger lines that could corrupt the octave symmetry. There can also be no additional notes between two staffs, because allowing this option would also destroy the symmetry of the system. (First of all, more detailed below: The reason lies in the double membership of notes sitting on ledger lines and in spaces to two adjacent staffs. These notes, whose special task would also include connecting two staffs with one another [see below, for example, the transition between the treble and the bass clef] can belong to both the staff below them and

the one above them. So, are they one note or two? This question doesn't have a clear answer... and so it's best to take care of it that it no longer needs to be asked.)

As already mentioned, the primary staff is mandatory, secondary staffs are optional - they can excist if necessary, but do not have to.

The primary staff contains the tone octave index (here: e_4) as well as the additional information about the **aNs** clef (!), the time signature[17] (here: 4/4) and the global accidentals[18] to indicate the key[19] (here: the # on the F space, i.e. G major or E minor). On the primary staff, the octave index is basically absolute and consists of the octave numbers 0 to 7.

The secondary staffs only contain information about the octave on the system indexing line, but not about the tone. The tone index can only be set once, namely in the primary staff and is binding for all secondary staffs. The octave index of a secondary staff can be either *absolute* (0 .. 7) or *relative* (…-2, -1, 0, +1, +2 …) to the octave index of the primary staff.

Octave indices do not have to be linear; there can also be octave jumps. For example, for a couple of notes in the bass, the primary staff can have an octave index of 3, and the secondary staff directly above it can have an octave index of 6 for a trill in the higher note range. The octave index can also be changed at any point within a staff (see example below).

4 Secondary staffs are grouped ledger lines

Strictly speaking, in **aNs** there is only one "real" staff, that is the primary staff. Only it contains the clef (!), as already pointed out above, the time signature and the global accidentals (*#*, *b*) for the key identifiers. However, notes that do not fit into the primary staff due to their pitch do not - as in the asymmetrical classical notation - appear on individual ledger lines and in spaces that seamlessly follow the staff, but rather they appear - with a clear optical offset - on secondary staffs.

Functionally, a secondary staff is a group of consecutive ledger lines (consisting of 4 lines and 3 spaces) that appear to be staffs like the primary staff because they consist of the same number of lines and above have their own octave index. This is the simple but well-working trick for imposed octave symmetry in **aNs**.

You could also say figuratively that the primary staff is a *real* staff, while the secondary staffs are *virtual*.

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[17] time signature = Taktart
[18] accidental = Versetzungszeichen
[19] key = Tonart

5 An example: The natural notes on the guitar in classical and in acaNotation representation

To illustrate the difference between symmetrical and asymmetrical note representation in conjunction with classical ledger lines, the natural notes on the guitar up to the fourth fret should be considered:

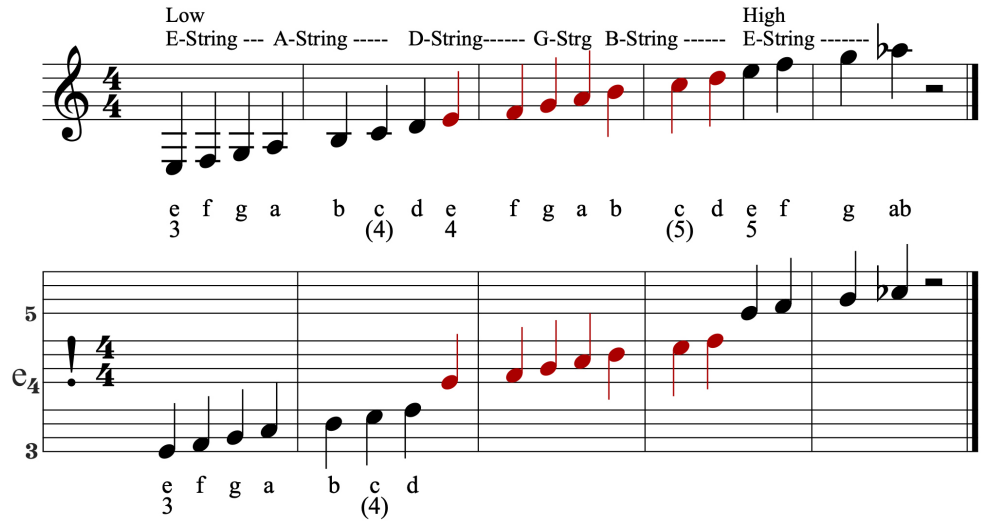


Fig. 4 The natural notes on the guitar using ledger lines

The asymmetry of the standard notation system is clearly visible in the illustration: The natural note e exists three times (e_3, e_4, e_5) in different positions. In the symmetrical **aNs** system, however, the natural note e - regardless of the octave - is always in the same place within a staff, namely on the lowest line[20].

Empty (blank) and incomplete measures on secondary staffs

What is striking for experienced music readers is that, compared to classical notation with more than one staff of music (e.g. the combination of treble and bass clef, see below), there are apparently "empty/blank" measures in **aNs** staffs, i.e. measures that do not even contain a measure-filling rest[21]. As a reminder: "In **aNs** there is only one real staff, that is the primary staff." All notes that sit on the virtual secondary staffs indirectly belong to the primary staff (comparable to the notes on ledger lines in

[20] At this point there will be musicians who protest that the effective range of notes on the guitar up to the fourth fret is not - as shown - from e_3 to ab_5, but from e_2 to ab_4, i.e. an octave lower. The counter to this is that the tones of the guitar are traditionally written one octave higher than they sound. This will be discussed in more detail later.

[21] rest = Pause

classical notation). Taking this into account, all measures in the illustration are completely filled.

In this context, the half-rest in the last measure of the illustration could of course also be located a little deeper in a space on the primary staff without the last measure on the secondary staff becoming incomplete.

Bar lines on secondary staffs

Bar lines on secondary staffs only have a visual function, not a technical one. In **aNs** systems - if they are very clear in songs with a small range - the bar lines extending from the primary staff to the secondary staff can also be omitted (see the note example *Morning has broken* below), comparable to the notes on ledger lines in classical notation that are not separated by bar lines. In extensive, complex notations, however, bar lines on secondary staffs serve as rhythmic orientation for the musician.

Blank areas on secondary staffs

Regarding the complete emptyness of secondary staff areas, this is also a personal preference in **acaNotation**: in individual user practice, the display of empty areas on secondary staffs could be dispensed with entirely. In this case, sections would only be displayed (e.g. measure-wise) if they are at least partially occupied by notes or rests. The result then could look like this:

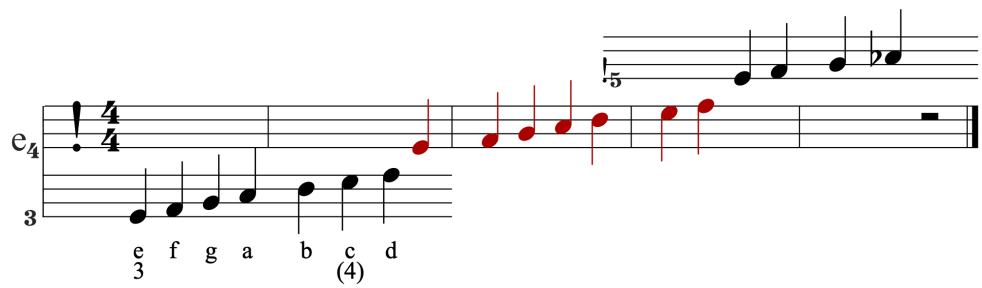


Fig. 5 Graphically shortened secondary staffs without bar lines and without empty areas

6 Different clefs in the classical notation system

Many musicians find the many different clefs in the classical notation system to be very strenuous. The basic rule is: every notation system requires a specific clef because it determines which pitches the staff lines and the spaces represent. Each clef has - recognizable by its optical shape on a specific staff line - a reference tone from which the pitches of the other notes

are derived. For example, the belly of the "G" treble clef in the classical staff encloses the second line from the bottom. Notes on this line therefore have the natural note name g.

In the wide range of tones - from very low to very high across 7+ octaves - the countless musical instruments and singing voices have specific tonal ranges in which they can be used. For each tone range, the challenge is to distribute the tones belonging to it as notes as well as possible across the limited number of staff lines (5 in the classical staff system) and spaces available. This can only be achieved if each tone range receives an individual clef that works well for it, through which - as already mentioned above - the reference tone for exactly this tone range is bindingly determined. For example, the reference tone used for many musical instruments and singing voices is that of the treble clef with the note g from the fourth octave (g_4). If, despite a well-chosen reference tone, not all of the tones in a range fit into the limited line system because the respective tone range is simply too large, then ledger lines must be used above and below the staff, which artificially expand the staff.

If a tone range becomes so large that the number of ledger lines becomes too large and confusing, then there is the trick of allowing staffs with different clefs to flow into one another. (A well-known example of this is the transition from the treble clef to the bass clef, see below.)

As useful as the different clefs may be for group-specific coverage of all tones in the classical 5-line system, they have a significant disadvantage: each clef defines the five lines, spaces and the countless ledger lines with individual natural note positions according to its style, and that in turn means: all notes of each clef must be learned independently of each other! This can take time and there is always a risk of confusion when reading the music.

The huge learning effort associated with the different clefs, which makes life difficult for many musicians who read music, is due to only one circumstance, namely the asymmetry of the classical notation system. That's a shame, because the classical notation system is actually quite well thought out.

The most common classical clefs are shown in the following figure:

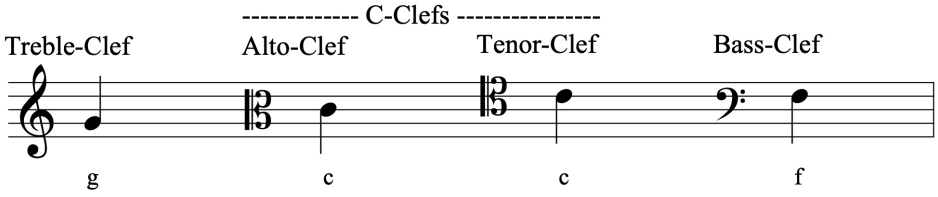


Fig. 6 Common classical clefs

From the group of C clefs (of which only two are mentioned in the figure above), there are three more clefs for those who like it completely. The five different reference positions for the note c in the 5-line system of the classical staff are as follows:

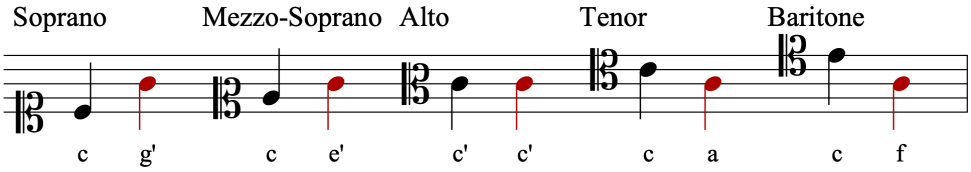


Fig. 7 The 5 different C clefs

This figure can be interpreted in two ways: at each of the five C clefs

- [see black notes] the reference natural note c is on another staff line, or
- [see red notes] a staff line has a different meaning

Note: the same position in the staff with different clefs means different tones.

By the way: the soprano clef is comparable to the C-notation of **aNs** (s.o. Fig. 2, p. 9).

In addition to the G treble clef, the F bass clef has a special meaning for many musicians who read music, as it follows the lower treble clef almost seamlessly in terms of tonal range. There is only one ledger line and two spaces between the two systems (see below).

To illustrate this, the original tone stock on the lowest four frets of the guitar should once again be used, but this time not by using ledger lines (see above Fig. 4, p. 8), but by using the bass clef instead:

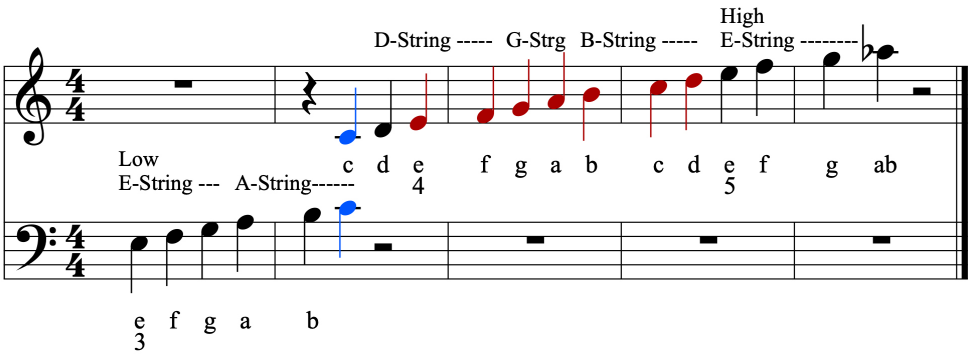


Fig. 8 The natural notes on the guitar using the bass clef

The bass clef is also on 5 lines. The colon marks the tone f; that's why this clef is also called the F clef.

The dual representation principle behind it is quickly understood: If you want to avoid using ledger lines as much as possible, you can do this elegantly by using different clefs. This practice of changing clefs is used very frequently - often even within a given staff.

The blue colored note c_4 can be notated in two ways, either by using a ledger line *below* the treble clef, or by using a ledger line *above* the bass clef. This ledger line cannot be dispensed with because it connects the treble and bass staff in terms of sound. From a numerical point of view, however - as already pointed out above - there is a problem concerning the double membership of notes sitting on ledger lines and in spaces. Should these notes be counted once or twice? In any case, ambiguity is not compatible with the semantics of “symmetry,” which is about clear belonging.

It is easy to see the same asymmetry as in the representation with ledger lines: the natural note e sits at three different positions in the staff, all of which have to be learned.

But you might think that there aren't that many positions that need to be learned …

Well, there are …

Showing the entire range of tones across all 7+ octaves with treble and bass clef, this is what it looks like - just for the natural note c as an example:

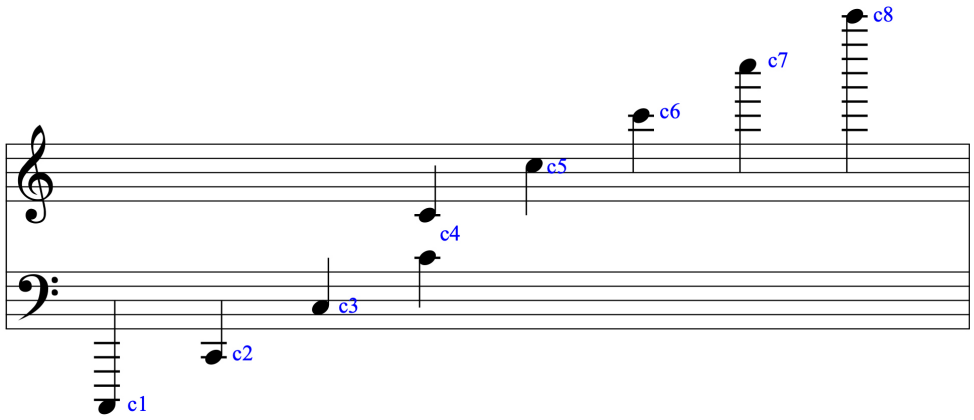


Fig. 9 The natural note c across 7 octaves in a classical representation

The 6 x 9 = 52 notes, which are missing in the illustration for reasons of clarity, have to be added in mind.

In **aNs**, the tone scenario, which seems very frightening in the classical notation system, is presented a little more clearly due to the octave symmetry inherent in the system:

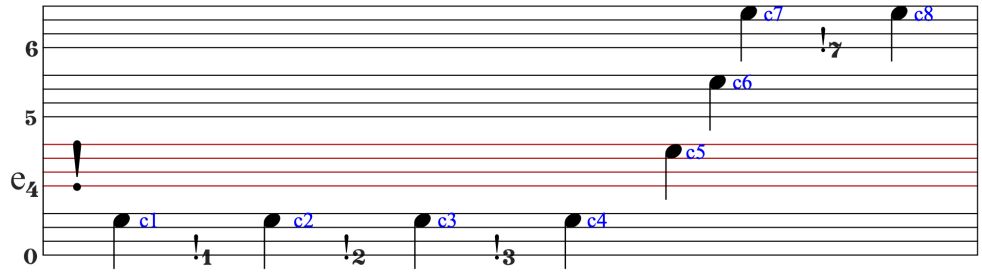


*Fig. 10 The natural note c across 7 octaves in **acaNotation** representation*

The note c always sits in the same position on a staff, regardless of the octave.

Although self-explanatory at second glance, the bottom staff is worth mentioning. As a secondary staff at the beginning with the octave index 0, the natural note c can be octaved to the note c_1 in this staff. The octave index is then increased by 1 three more times within the same staff without any problems. It couldn't be simpler - in the sense of easy to learn and use.

7 A historical side note on the creation of acaNotation

It was the illustration shown above of the transition from the treble to the bass clef (see Fig. 8, p. 15), that inspired me in 1974 (it was two years after I learned to play the guitar "properly" from sheet music as a 14-year-old) to draw attention to the problem of octave asymmetry in classical notation. It took me a while before I finally understood the reason for the asymmetry, and then I needed some time before I found a solution to the problem.

After some back and forth, it became clear to me that the asymmetry in classical notation can be traced back to two factors: first of all, the five-line system for the 7 natural tones of an octave contains one line and one space too many - four lines plus three Spaces (4 + 3 = 7) are correct for taking exactly one octave of notes.

I then had a hard time recognizing the meaning of ledger lines reaching into the asymmetry - ledger lines which at first glance only have advantages because they can expand the note range of staffs in a very simple way if necessary. But this impression gained at first glance is deceptive, because the ledger lines in the classical staff system corrupt the requirement from above that a staff may only contain exactly 7 natural tones. Due to the possibility of placing notes in the spaces directly above and below the staff (in the treble clef these are the notes d_4 and g_5), two additional tones are automatically added to the 7 natural tones, which are unwanted and not needed. But once you have them, you can't get rid of them anymore. I realized: It is not the ledger lines per se that are part of the asymmetry

problem, but rather it is a.) the transition between a ledger line to a staff (or vice versa) and b.) the transition directly from one staff to the next if they are separated by a space with note-meaning.

I concluded from this: the transitions between staffs and ledger lines must not be occupied by notes; they must be tone-free neutral zones if asymmetry is to be prevented. My most important conclusion from the previous findings was: with a new ledger line - both *above* a staff and *below* it - a new staff (theoretically) begins, which is complete after another three ledger lines. Then the game begins again - both upwards and downwards - until all octaves are covered.

In concluding my asymmetry considerations, this meant to me: music staffs must be complete, self-contained entities that repeat themselves unchanged octave by octave. But this also means that a staff can and must contain each natural note exactly once, and not two or even several times, as in the classical staff system. With 7 natural tones that an octave contains, this only works with four staff lines, not with five.

*

Back then, in the 1970s, when I was 16 years old, my knowledge of the advantages of an octave-symmetrical notation system was simply something I could be happy about, without any chance of practical implementation was given. Above all, a music teacher who did not understand (or did not want to understand) the didactic and pedagogical significance of a symmetrical notation system for music students took the wind out of my sails with "discouraging" words to pursue this idea further.

Today, some fifty years later, I am still convinced of the superiority of a symmetrical notation system over the asymmetrical classical one. Today, publishing projects have become much easier. With modern text and music notation programs, ideas can be quickly translated into visually appealing representations so that they can then be conveniently presented to other people for review via the Internet.

Another advantage of today's era over the past is the ability to promote acceptance of a new idea (paradigm) through easy-to-use computer software. In the past, music notes had to be painstakingly drawn by hand. Every writing mistake was a catastrophe because little by little the handwritten sheet of music became more and more illegible, and at the very end everything had to be copied out again. Hours and days went by without any productive output.

What a blessing it was for me when home computers suddenly came along, and with them (in 1993) the *Capella* music notation software. Suddenly every musical idea was put on paper (on the printer) in a very short time.

If there are any interested computer scientists who would like to program the **aNs** system as a software solution, I would be happy if they got in touch with me. However, I would prefer a Capella plugin.

8 The cognitive difference between 5-line and 4-line staffs

If a staff consists of too many lines, it becomes confusing and it becomes difficult to tell the notes apart comfortably. This effect of difficult readability can also be observed with many ledger lines.

The five lines in the classical staff system, too, are - from the perspective of the **evolutionary brain** - one line too many.

Experiments have shown that the evolutionary brain, as a genetic disposition, can only count up to 4 without even having learned to count arithmetically. A duck traveling with four chicks notices immediately if one of them is missing. With five chicks, however, she doesn't notice if one of them has gone its own way.

Modern humans are also equipped with an evolutionary brain. Anyone can easily observe this by using objects sitting in front of them. If there are up to four objects on the table, the exact number can be recognized immediately; if there are five objects, you must explicitly count from the first to the last object, because numerical recognition at first glance is no longer possible with the number 5. Alternatively, counting your fingers also works.

The advantage of a human mother over a mother duck is that one has learned to count beyond the evolutionary limit of 4 as part of an intellectual process, while the other has not.

This evolutionary cognitive problem of automatically recognizing numbers up to the quantity four can also be transferred to music staffs.

Up to the number of four lines in a staff (**acaNotation**), every note position can be evaluated directly by the brain without any cognitive effort. With five staff lines (classical staff system) this is no longer so easy. Then additional cognitive effort is required when reading music. This effort may decrease with experience, but it is and will always be there and has a detrimental effect on concentration and thus also on the frequency of errors in recognizing notes.

9 A criterion against the space requirements of acaNotation

One criterion against using **acaNotation** could be the increased space requirement. It's true, on average, **aNs** requires a little more space to accommodate notes compared to the classical notation system. In the classical staff system, one ledger line and two spaces adjoin immediately above and below a staff. In the **acaNotation** system, on the other hand, the space of two ledger lines and three spaces (which corresponds to five notes altogether) is sacrificed for optical clarity between two staffs.

However, on the other hand, the staffs of **acaNotation** can be printed much smaller on a sheet of music due to their much easier to read 4-line system, without increasing the effort required to recognize the notes. The space saved as a result should compensate for the increased space requirements between two staffs.

10 The prefix "aca" in acaNotation

The prefix "aca" stands for *academic*. Academic disciplines are known for the fact that preliminary intellectual work must first be achieved in the form of a demanding training called studying, which later pays off many times over through the knowledge and skills acquired.

As with the paradigms **acaChords Notation (aCN)** in the area of transposition-free chord playing and **acaLead Notation (aLN)** with regard to melody playing according to notes on the higher frets of the guitar's non-unique fingerboard, the paradigm of **symmetrical acaNotation (aNs)** also applies in the area of comfortable and stress-free writing and reading of notes for people who recognize the value of laborious intellectual advance, and who are willing to invest some time in it.

In order to successfully use **acaChords Notation**, users first have to learn scales[22] by heart. The competence gained in this way when changing keys[23] makes it very easy to determine the chords required for the new key.

The confident mastery of playing notes on the higher frets according to the **acaLead Notation** method required, in a first step, to learn to play the melody using notes on the lowest four frets, as these notes can be transferred - by abstraction or reduction - to the higher frets in a very simple way.

In order to be able to use **symmetrical acaNotation** comfortably, there also is a functional-formal prerequisite that someone must fulfill if they want to

[22] scale = Tonleiter
[23] key = Tonart

benefit from this method: when applied to a musical instrument or a singing voice, the underlying pitches must be reproduced correctly, meaning the octave-right areas of the instrument or the singing voice that are controlled in the form of numerical indexes, must be known. (Actually, this requirement is so trivial that you can't really call it *academic* ...)

In the entire existing range of tones - starting with the note a_0 up to the note c_8 - instrumentalists and singers face different requirements. Pianists have to master the largest number of tones numerically, because the lowest key on the piano is a_0, the highest is c_8, which is a total of seven complete octaves plus 3 more whole tones[24] below and above.

[24] whole tone = Ganzton

11 Ranges of the most famous instruments and vocals

The following table lists the tone ranges of the most famous instruments and vocals:

Instrument	lowest tone	highest tone
Piano	a_0	c_8
Accordeon	g_1	a_6
Harp	b_0	$g\#_7$
Guitar (notation +1 octave)	e_2	f_5
Ukulele	g_3	c_6
Zither	c_1	a_6
Brass Instruments		
Trumpet (Bb) Cornet Flugelhorn (+1 whole tone)	e_3	d_6
Trombone	e_2	a_4
Bass Tuba	e_1	b_3
Alphorn	c_2	c_6
Woodwind Instruments		
Piccolo Flute	d_5	b_7
Transverse Flute	c_4	c_7
Oboe	b_3	g_6
Clarinet	d_3	b_6
Bassoon	a_2	e_5
Soprano Saxophone (+1 octave)	ab_3	eb_6
Alto Saxophone (Eb) (+1 major sixth)	db_3	a_5
Tenor Saxophon (Bb) (+1 major ninth)	ab_2	eb_5
Baritone Saxophone (Eb) (+1 major sixth + 1 octave)	db_2	a_4
String Instruments		
Violin	g_3	a_7
Viola	c_3	a_6
Cello	c_2	a_5
Bass (+1 octave)	e_1	g_4
Vocals		
Soprano	c_4	a_5
Alto	g_3	f_5

Tenor	d_3	a_4
Baritone	a_2	g_4
Bass	e_2	d_4

Note: To make notes easier to read, the guitar is notated one octave higher (+1 octave) than it actually sounds. On the bottom four frets these are the notes e_3 - ab_5 instead of e_2 - ab_4. In some classical notations for guitar, an octave "8" is placed underneath the treble clef as a reminder. Very often, however, this special identifier is omitted because the notation offset is assumed to be known. In **acaNotation**, this tradition can either be continued, or the correct octave index can be used straight away - ultimately it doesn't matter for correct melody reproduction.

As the table shows, some other instruments are also notated differently than they sound. However, this will not be discussed in more detail here.

12 Alternative octave names

Deviating from the purely numerical octave system (0 .. 8), which is preferred in **acaNotation** for practical reasons, and in which counting is stringent from zero upwards (and therefore easy to manage), for the sake of completeness the following table refers to the otherwise existing octave names in music literature:

acaNotation	**Name**	**Alternative Name 1**	**Alternative Name 2**	**Alternativ Name 3**	
a_0 - b_0	sub-contra octave	A2 - B2	,,A - ,,B	A'' - B''	
c_1 - b_1	contra octave	C1 - B1	,C - ,B	C' - B'	
c_2 - b_2	great octave	C - B	C - B	C - B	
c_3 - b_3	small octave	c - b	c - b	c - b	
c_4- b_4	1-line octave	c1 - b1	c1 - b1	c' - b'	concert pitch a
c_5 - b_5	2-line octave	c2 - b2	c2 - b2	c'' - b''	
c_6 - b_6	3-line octave	c3 - b3	c3 - b3	c''' - b'''	
c_7 - b_7	4-line octave	c4 - b4	c4 - b4	c'''' - b''''	
c_8	5-line octave	c5	c5	c'''''	

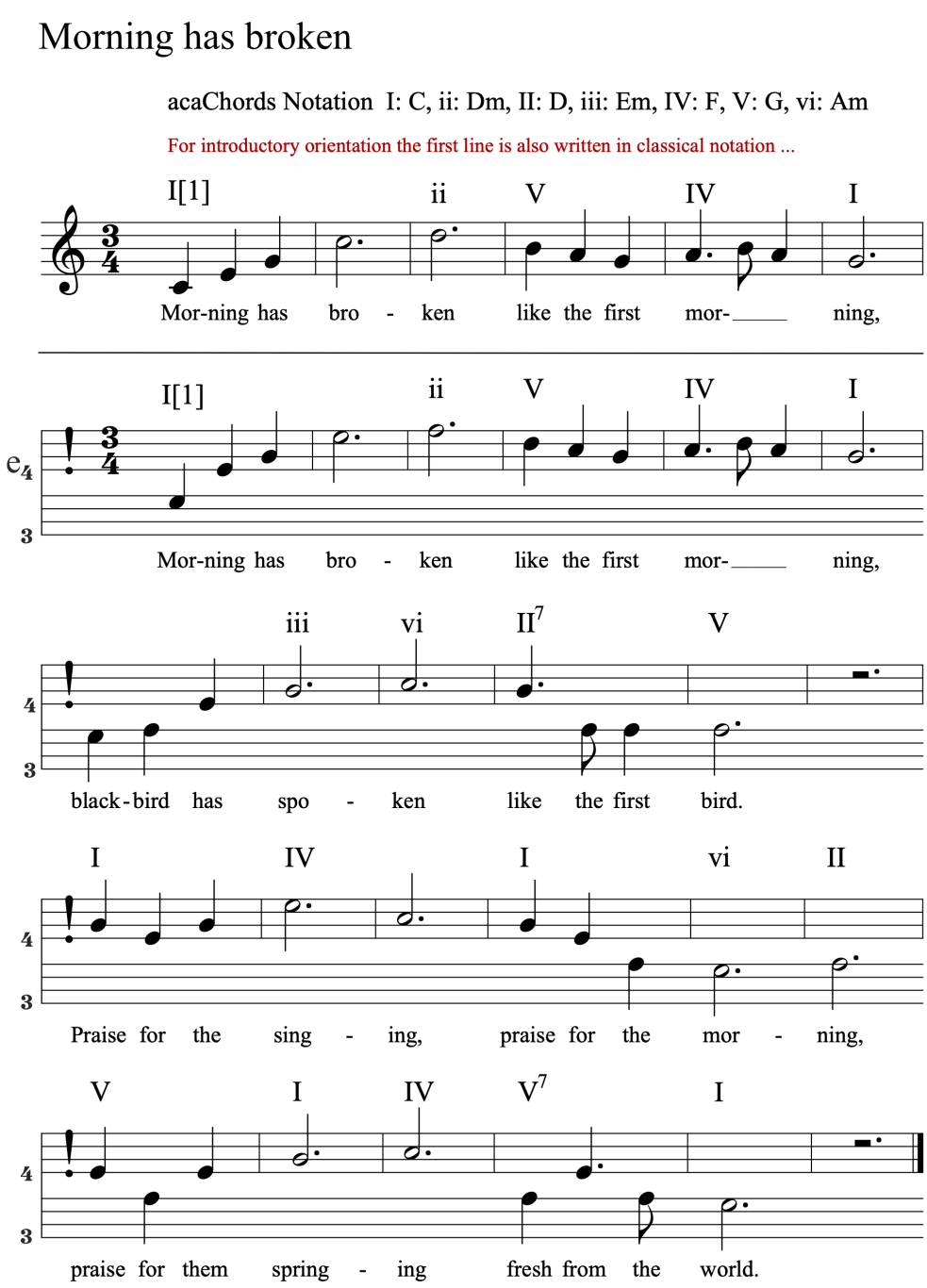
13 Three song examples

In order to give a practical impression of how the system of **symmetrical acaNotation** can hold its own in the completeness of a song, three well-known songs will be presented in this notation on the following pages. The third song, the theme from the *Triumph March* by Marc Antoine Charpentier (1634-1704)[25], is a polyphonic arrangement for classical guitar.

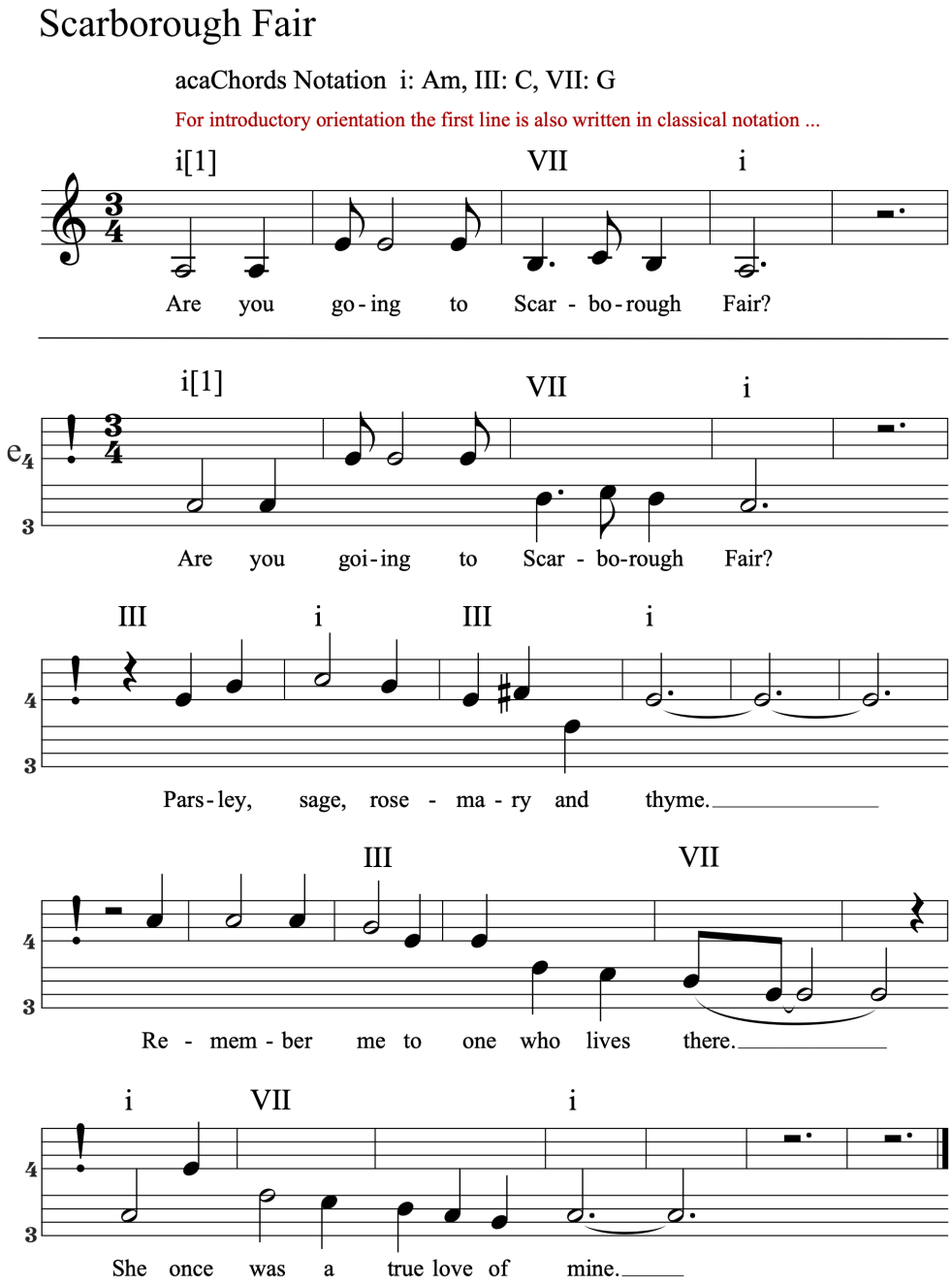
To make it easier to get used to the symmetrical staff system, the first line of music is also included in the classical notation.

[25] This piece is known as the Eurovision song.

13.1 Morning has broken



13.2 Scarborough Fair



13.3 Triumph March (Marc Antoine Charpentier)