# Chapter 3 <br> A Shorthand Notation for Musical Rhythm 

### 3.1 Introduction

This chapter presents a complete set of symbols to be used as shorthand notation for musical rhythms (SNMR). I will use this shorthand notation of rhythmic patterns to illustrate nearly all of the musical examples in this book. Its compact form not only allows me to quote rhythms within the running text, it also helps to visualize metric groups of various sizes in a clear and concise way. Based on the work of Giger (1993), I have extended his small set of symbols into a comprehensive system for notation. The notation's use of cognitive chunking enables musicians and composers to notate rhythms faster than usual, for example, when compared with common Western score notation. The only constraint of the proposed system is that it is dependant on a common underlying pulsation. Whilst our common notation system creates binary subdivisions that are based on the whole note, the proposed shorthand notation is built upon a sign for a small pulsation, and has signs for ternary as well as binary groupings that are multiples of a common small value. The system also frees the user from the use of rigid bar and meter structures, i.e. it does not imply regular changes of strong and weak beats. The method has value for music analysis because it leads to a transparent grouping of basic rhythmic elements, and it reveals their metric meaning within the surrounding context. The system can easily express variations of a rhythmic group within the same meter. The structuring of rhythms in groups is very useful for the analysis of musical impulse and release, i.e. tension and relaxation, which, as we have learned in the previous chapter, are an essential feature of the musical experience.

Composers and musicians need a system to notate music quickly by hand, but common practice notation can be quite complex. Therefore, it can slow down the speed of handwriting, which, in the case of composition or dictation, is then unable to keep up with the pace of musical events. The proposed system offers a solution to that problem, but it is restricted to the notation of rhythms. It has not been developed with the aim to encode pitch information, however there is a possibility to combine shorthand rhythm notation with the encoding of pitch in common standard notation.

A shorthand notation for rhythm is useful as an intermediate stage of composition, before a score is written down in common practice notation. It is also useful at the rhythm input stage of music typesetting programs. Our software, chunking, uses shorthand notation as its input format. In addition, it has several algorithms, which produce shorthand notation in ASCII format. Chunking can translate SNMR into a lilypond ${ }^{1}$ script, which then can be used to render a score. For musicians, the shorthand can raise the awareness for rhythmic grouping, articulation and form, whilst becoming independent of meter and bar lines. For the musicologist it is a useful tool for music analysis, to reveal commonalities and differences between rhythmic patterns. The simple format makes it also ideal for database searches. The current distribution of chunking contains an sqlite database ${ }^{2}$ of rhythm patterns. Within a large catalogue of rhythms, the user can, for example, search for common substrings at the beginning, middle, or end of patterns.

In the first section, I will give a brief overview of various approaches to rhythm notation. Then I will present a coherent system of symbols that extends and modifies Giger's rhythmoglyphs (Giger 1993, p. 174). Several well-known music examples written in this system shall demonstrate its general purpose, speed and versatility. The chapter concludes with a summary of the results.

### 3.2 Overview of Rhythm Notation

Many approaches exist to the notation of rhythm and meter. The reader is referred to Sethares (2007), London (2012), Toussaint (2004), and Arom (1991) for detailed discussions. Current Western notation is based on the concept of meter, which is a regular grid formed on top of a constant underlying pulsation. Musical meter implies a ranking of the individual pulses within a bar. The importance and statistical weight of these pulses is directly dependant upon their location (Barlow 2008). For example, the first pulse of a bar in any meter usually has the strongest accent and it also carries the highest probability for an event to occur at that point. In order to place notes onto a metric grid, Western rhythm notation uses a set of symbols to denote integer multiples or fractions of a standard note length. It uses a relatively small set of integer ratios, as well as ties, rests, and articulation signs in order to vary note durations.

Musical meters, for example $4 / 4,3 / 4,5 / 4$, or $12 / 8$, repeat in cycles. The repetitive character of meter has been known also in other musical cultures for a long time. For example, already in the 13th century, Arab music theory developed a so-called necklace notation (Demaine et al. 2009; Sethares 2007; Chew and Rastall 2001). Rhythmic patterns and metric structures are represented by black and white circles on a ring. A black circle means a note onset and white circles count the space between notes. The total number of circles on the ring represents $n$ pulses of a complete metric cycle. This type of notation has been revisited in recent publications on rhythm and meter (Sethares 2007; London 2012). Closely related to necklace notation is the

[^0]

Fig. 3.1 A polyphonic score where the note onsets within a bar coincide with the filtered Farey Sequence $F_{12}=\left\{\frac{0}{1}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{5}{12}, \frac{1}{2}, \frac{7}{12}, \frac{2}{3}, \frac{5}{6}\right\}$


Fig. 3.2 Example of box notation: The 12-beat Ewe rhythm

Table 3.1 The set of Hindu symbols reported by Messiaen for the notation of the Deci-talas

| Name | Symbol Transcription |  |
| :---: | :---: | :---: |
| laghu | I | 0 |
| guru | S | $d$ |
| pluta | $\mathrm{S}^{-}$ | $d$. |
| druta | O | 0 |
| laghu plus virama | $\mathrm{I}^{c}$ | $d$. |
| druta plus virama | $\mathrm{O}^{c}$ | d. |

box notation, see Fig. 3.2. From this representation, binary and integer sequences are easily derived as well. A binary sequence for a rhythm uses ' 1 ' to denote a note onset and ' 0 ' to denote the time between onsets. A sequence of integers is yet another form of representation, and it counts the number of equidistant pulses between note onsets including the first note onset. This practice is also used in India (Giger 1993, p. 117). The specific Hindu notation reported by Messiaen (1995) also uses a small set of symbols, see Table 3.1. Furthermore, in Chap. 7, I propose the use of filtered Farey Sequences to represent rhythm and meter. They are particularly useful in order to apply weighted probabilities to the different onset locations within a metrical grid, see Fig.3.1.

The main issues for a shorthand notation system are general usability, speed and flexibility. When it comes to selecting a shorthand notation for any form of rhythm
that is based on a common pulsation, all of the above methods are problematic. One of the main difficulties is the amount of counting that is involved in box, binary, integer or necklace notation. A unit or slot in these forms of notation usually represents a subdivision of a beat. Therefore, in order to notate, the user has to focus the attention on a low level of the metric structure and the tempo of the subdivision can be very fast. For example, a sixteenth note within a tempo of quarter $=120$ BPM has a tempo of 480 BPM. ${ }^{3}$ Also, a change of the subdivision of the beat, for example from eighth notes to eighth note triplets, is very difficult to represent due to the fixed length of the beat subdivision. The Hindu notation in Table 3.1 represents a very specific style of rhythm. In many of his compositions Messiaen has used some of the 120 deci-talas that were written in this form in Śārngadeva's Sañgita Ratnākara (Bruhn 2007). Note that the symbols represent single note values, and because of this limitation, they are not general enough for our purpose.

Filtered Farey Sequences are a mathematical model for the representation of rhythm and meter. In Chap.7, we will see that all rhythms, which are based on an underlying pulsation, can be represented by a filtered Farey Sequence. This includes structures that contain nested tuplets, i.e. integer subdivisions of a note value. But, they require the computation of ratios of note durations, and therefore, Farey Sequences have their role as a tool for music analysis, but they cannot function as a form of shorthand notation. Traditional Western notation is very precise, but often requires a combination of different symbols to encode a single note duration. It can be therefore quite slow for composing, sketches or for real-time dictation.

The problem is the demand for speed when capturing musical rhythms, handwritten or typed, combined with the demand for precision, and with the requirement to be easy to read. The proposed solution to the problem employs a technique called cognitive chunking, meaning that one can represent often recurring rhythms by one special symbol. Cognitive chunking is a well known psychological method to increase the number of elements that can be held in short-term memory (Gobet and Simon 1996; Miller 1956). The key concept is to find a memorable symbol that represents a rhythm that is either two, three or four pulses long. The set of symbols then forms a code that can compress the amount of rhythmic information more efficiently than in all of the above cases. This code can significantly speed up the notation process.

### 3.3 Chunks of Musical Time: A Shorthand Notation for Rhythm

### 3.3.1 Rhythm and the Psychology of Chunking

The Swiss percussionist Peter Giger introduced a handful of symbols for the notation of simple rhythmic patterns, which he calls rhythmoglyphs, ${ }^{4}$ see Table 3.2. These symbols are easy to understand and to execute regardless of the level of knowledge

[^1]Table 3.2 Giger's rhythmoglyphs are representing five basic chunks of rhythm. Within the binary form, ' 1 ' denotes an onset, whereas ' 0 ' denotes silence


Table 3.3 Complete set of six permutations of a pattern formed by three elementary chunks. The pattern has a cycle length of $n=9$. The pattern is based on a template, which is the partition of 9 into $2+3+4$. Each slot of this template is then filled by the chunk of the corresponding length. There is only one choice per slot possible, because this is coming as a restriction from within Giger's set of symbols, see Table 3.2

| Pattern | Transcription | inary Form |
| :---: | :---: | :---: |
| I X $\triangle$ | $d y \sqrt{\text { dy }}$ dy | 101101110 |
| I $\triangle$ X | d) $4 \sqrt{10]}$ | 101110110 |
| X I $\triangle$ | , | 110101110 |
| $\mathrm{X} \triangle \mathrm{I}$ | 『rdody | 110111010 |
| $\triangle \mathrm{XI}$ | dydydy | 111011010 |
| $\triangle \mathrm{IX}$ | doldydy | 111010110 |

of Western common notation. They are intuitive to use because the number of lines for drawing a symbol is equal to the number of sounding beats (except for the circle). With these elementary patterns, which I call chunks, one is able to construct a systematic table of combinations that invite the user to improvise and to invent new combinations by permutation, see Table 3.3. The resulting phrases are in alignment with a steady pulsation in time, and they do not necessarily invoke a sense of regular meter in the meaning of Western music traditions (London 2012; Arom 1991). The combinatorial power of Giger's approach is impressive. It makes it easy to create shorter and longer rhythmic phrases without thinking in terms of bars and meter. Instead, to play with these chunks seems closer to the way the mind works (Gobet et al. 2001; Miller 1956). It leads to a rich and embodied rhythmic experience. This method offers a huge range of possibilities for rhythmic variation. For example, after choosing one of the combinations of chunks, the performer is invited to swap their positions, which instantly creates new patterns. Some examples are given in Table 3.3. Furthermore, through repetition and sequencing of rhythmoglyphs one is able to build up higher level structures of climax and release, very similar to the process of thematic variation.

Within the context of music notation, Giger's ideas free the notation from bar lines and metric templates and it shifts the attention towards rhythmic groupings that can be re-assembled together in many playful ways. Through the concept of cognitive chunks and by practising the execution of those simple rhythmic patterns it is also relatively easy to leave behind the idea of counting beats, such as ' 1 -and-a-2-and-a-3-and-a' in a 9/8 meter, for example. This freedom in turn allows the player to concentrate on the movements, on accentuation and on the 'groove' of the phrase. Continued practising and growing expertise will lead to bigger chunk sizes that can be held in working memory (Gobet and Simon 1996). That means that the length of rhythmic phrases that can be memorized and recalled will grow, and therefore it is likely that musical abilities and improvisational skills will increase as a consequence. Although this system already leads to a great number of different patterns, it is not covering every possibility for a rhythmic pattern. For that reason, I extended Giger's set of chunks with some more symbols, see Table 3.4, in order to have a complete set of unary, binary and ternary chunks available. In addition, following Giger's idea, silence is expressed by putting round brackets around the symbol. With this new set it is very easy to notate any kind of complex rhythmic phrase. Note the use of different signs for $\Delta, \square$, because they are not part of the printable ASCII codes 32-127, nor are they included in the extended set of ASCII codes 128255. Therefore, in order to enhance the practicality of the shorthand notation on the computer - bearing in mind that it should be easy for the symbols to be typed - I am using $:$ II and iI respectively. Various subdivisions of a unit, also known as tuplets, can be expressed via square brackets surrounding the symbols, for example I[3III] I[3III] II I]. The divisor of the symbols inside the brackets is given as a rational number on the left-hand side. The following Table 3.5 gives an overview of the most common subdivisions and their transcription into shorthand notation.

The pulse lengths 2 and 3 are represented as $\quad \mathrm{I}$ and $\square$. The latter is the sign for 2 rotated by $90^{\circ}$. The orthogonal position helps to distinguish binary from ternary chunks. The rhythmic constellation of 2 against 3 forms also a very strong musical opposition (Celibidache 2008).

Finally, for the alignment of chunks in multiple voices, an extra line of dots can visualize the common underlying pulsation, see Table3.6.

### 3.3.2 Subdivisions

As proposed in Table 3.5, it is possible to use any form of subdivision in conjunction with the shorthand symbols in Table 3.4. The power of chunking and metric shifts is illustrated by the following examples in Table3.7. A transcription of Table 3.7 is shown in Fig. 3.3.

Table 3.4 Extended set of shorthand symbols (left) to transcribe chunks of rhythms

| ASCII Symbol | Transcription | inary Form | Category | ASCII code |
| :---: | :---: | :---: | :---: | :---: |
| . | d) | 1 | unary | 46 |
| I | - | 10 | binary | 73 |
| : | d) | 11 |  | 58 |
| v | y) | 01 |  | 118 |
| - | $\bullet$. | 100 | ternary | 45 |
| < | \% | 010 |  | 60 |
| w | $9 \%$ ) | 001 |  | 119 |
| X | dd | 110 |  | 88 |
| > | d d | 101 |  | 62 |
| + | 7.6 | 011 |  | 43 |
| i | J. | 111 |  | 105 |
| H | $\bigcirc$ | 1000 | quarternary | 72 |
| II |  | 1010 |  | 7373 |
| : | dodd | 1111 |  | 5858 |
| .I. | dod | 1101 |  | 467346 |
| I: | d do | 1011 |  | 7358 |
| : I | dod | 1110 |  | 5873 |
| - | d. d) | 1001 |  | 4546 |
| ! | d.d. | 1100 |  | 33 |
| ~ | $\mathrm{H}^{\sim} \mathrm{I}={ }^{\text {d }}$. | 100000 | tie | 126 |
| ( ) | $(-) \sim I=r \cdot d$ | 00010 | silence | 4041 |
| ' ' ' ' | ' 'I ', '. | n/a | appogiatura | 39 |

### 3.4 Examples

In this section, I present a series of examples to demonstrate the main characteristics of the shorthand notation. They will show that the symbols are easy to memorize and they are quick to write by hand or by using a standard computer keyboard. The notation also helps to reflect the formal structure of the music by helping to visualize musical groupings and formal hierarchies. Bar lines are not necessary because the notation is based upon an underlying small pulsation. It is not dependent on a metrical grid, although bar lines and accentuation marks could be added if needed.

What follows are excerpts from various musical styles including African Percussion, Latin-American Music, Greek Rhythms and Classical Music.

Table 3.5 The main forms of subdivisions. The ratio divides the lengths of the units within the square brackets. If no ratio is given, then the default value of $2: 1$ is applied

| Subdivision | Name of the value | Shorthand transcription |
| :---: | :---: | :---: |
| 1:1 | Quarter | I |
| 2:1 | Eighth | [II] or : |
| 3:1 | Eighth Triplet | [3III] |
| 4:1 | Sixteenth | [4IIII] or [: $]$ |
| 5:1 | 16th Quintuplet | [5III II] |
| 6:1 | 16th Sextuplet | [6III III] |
| 7: 1 | 16th Septuplet | [7IIII III] |
| 8:1 | 32nd | [8IIII IIII] or [[::::]] |
| 9:1 | 32nd Nonuplet | [9III III III] |
| 10: 1 | 32nd Decuplet | [10II III II III] |
| 11: 1 | 32nd Undecuplet | [11II III III III] |
| 12:1 | 32nd Duodecuplet | [12III III III III] |
| 1:4 | Whole | W |
| 1:2 | Half | H |
| 2:6 | Dotted Half | $\mathrm{H}^{\sim} \mathrm{I}$ |
| 2:3 | Dotted Quarter | - |
| 4:3 | Dotted Eighth | [4/3I] or [-] |
| 3: 4 | Half Triplet | [3/4III] |
| $3: 2$ | Quarter Triplet | [3/2III] |
| $5: 4$ | Quarter Quintuplet | [5/4III II] |
| 5:2 | Eighth Quintuplet | [5/2III II] |
| $7: 2$ | Eighth Septuplet | [7/2IIII III] |

Table 3.6 Alignment of chunks between two voices

| Pulse | $\ldots \ldots \ldots$ |
| :--- | :--- |
| Right hand | I I I > |
| Left hand | X X X |

Table 3.7 The use of different subdivisions together with the pattern I- I: creates a perceptual shift of the pattern in relation to the underlying meter

| Subdivision | Shorthand | Time signature |
| :--- | :--- | :--- |
| 0.5 | $[1 / 2$ I- I:] | $9 / 4$ |
| 1 | I- I: I- I: | $9 / 4$ |
| 2 | [I- I: I- I: I- I:] | $9 / 4$ |
| 3 | $[3$ I- I:] | $3 / 4$ |
| 6 | $[6$ I- I: I- I:] | $3 / 4$ |
| 9 | $[9$ I- I:] | $2 / 4$ |



Fig. 3.3 The pattern I- I: subjected to various subdivisions
Table 3.8 Two metric groupings of the same African Ewe pattern: IIXI>

| Pulse | $\ldots \ldots \ldots \ldots$ |  |
| :--- | :--- | :---: |
| Groups | H H $\quad$ H |  |
| Pattern | I I . I I $>$ |  |
| Pulse | $\ldots \ldots \ldots \ldots \ldots$ |  |
| Groups | $-\quad-\quad-\quad-$ |  |
| Pattern | $>+\quad\langle\quad\rangle$ |  |

### 3.4.1 The Ewe Rhythm

This is the well-known bell rhythm of the Ewe people in shorthand notation: IIXI> Seven beats are distributed over twelve underlying pulses. Musical meter is a concept that does not exist in African drumming (Arom 1991), however, there are at least two ways to layer this rhythm with a regular beat pulsation. Table 3.8 shows the subdivision of the twelve pulses into three groups of four, and into four groups of three pulses. This demonstrates that the shorthand notation can visualize different metric groupings, which has an influence on how one perceives and performs the rhythmic pattern. The latter is very often referred to as the groove.

Here is another example of this phenomenon called metric shifts. A small variation of the Ewe rhythm: III X> is used in Table 3.9. The number of pulses is twelve.

Table 3.9 Two metric interpretations of a similar pattern: III X>

| Pulse | $\ldots \ldots \ldots \ldots$. |
| :--- | :--- |
| Groups | $\mathrm{H}^{\sim}$ I $\mathrm{H}^{\sim}$ I |
| Pattern | I I I X $>$ |
| Pulse | $\ldots \ldots \ldots \ldots$ |
| Groups | I I I I I I |
| Pattern | I I I . I I . |

Table 3.10 Latin-American and African bell patterns and claves

| Name | Pulse length | Shorthand |
| :--- | :--- | :--- |
| $3-2$ claves | $(334)(24)$ | --H IH |
|  | $(343)(33)$ | $-\mathrm{H}-\quad--$ |
|  | $(3313)(24)$ | $--!$ IH |
|  | $(3313)(33)$ | $--!~--$ |
| 3-2 Rhumba | $(343)(24)$ | $-\mathrm{H}-\mathrm{IH}$ |
| Bossa Nova | $(334)(33)$ | $--\mathrm{H}--$ |
| Soukous | $(334)(15)$ | $--\mathrm{H}: \sim \mathrm{H}$ |
| Gahu | $(334)(42)$ | --H HI |
| Tresillo | 332 | --I |
| Cinquillo | 21212 | $\gg$ I |
| Baqueto of Danzon | $(21212)(2222)$ | $\gg$ I IIII |
| 6/8 clave | 2212212 | IIX >I |

Beat subdivisions are possible in six, four, three and two. What is shown is the subdivision into two and six. In general terms, any rhythmic pattern over $n$ pulses can be placed into any metric grid of pulsations that is based on the divisors of $n$.

### 3.4.2 Latin-American Music

Table 3.10 lists a selection of 3-2 claves and bell rhythms used in Latin-American music. The common feature of those 16 -pulse rhythms is a characteristic split into $10+6$, i.e. three beats are distributed over ten pulses, followed by 2 beats over six pulses. The first half is perceived as carrying impact, or musical tension, whilst the other half brings it to resolution. Samba rhythms behave differently in that they can have a variety of different groupings, see Table 3.11 , for example: $4+12$ or $7+9$. Here the opposition of the ternary beat $>$ or - versus the binary beat $I$ creates impact, whereas the repetitions of binary beats offer resolution.

Table 3.11 Samba patterns

| Pulse length | Shorthand |
| :--- | :--- |
| $(22)(322212)$ | II -II>I |
| $(2221)(22212)$ | II> II>I |

### 3.4.3 Greek Verse Rhythms

The analysis of rhythms, especially in in classical music, often refers to the feet of the classical Greek verse in order to explain rhythmic patterns and phrases: Igor Markevitch, Olivier Messiaen and his teacher, Marcel Dupré, all have used the terminology of the Greek verse rhythms in their analytical and pedagogical publications (Dupré 1925; Markevitch 1983; Messiaen 1995). As Georgiades (1982) has pointed out, the classical Greek language and poetry was intrinsically musical because of the measured short and long values of the syllables. When arranged into repetitive patterns, poets were able to create a regular meter, for example the hexameter in Homer's Iliad: I: I: I: II I: II, ${ }^{5}$ see Silk (2004). Table 3.12 shows the names of the feet, their pulse lengths and their shorthand notation.

### 3.4.4 Messiaen

Messiaen took inspiration from a great range of different sources: Greek verse rhythms, Indian talas documented in the 13th century, ${ }^{6}$ bird songs, and rhythmic palindromes. He published detailed catalogues of his compositional practices that include important accounts on the subject of rhythm (Messiaen 1995). I would like to present an example from his Turangalîla Symphony to illustrate that one can reveal the structure of complex rhythmic passages very easily by using shorthand notation. The final movement uses a counterpoint between the full orchestra, which includes piano and ondes martenot, and one percussionist who uses the woodblocks and a small turkish cymbal. Messiaen often uses bar lines and meters only for the purpose of synchronization. The main theme features frequent metric shifts that break the perception of the ternary $3 / 16$ meter, for example in bars $4-5$. Two Trochees in bars 1 and 2 ( 6 pulses) are followed by an Amphibrach ( 4 pulses) and a long note (3 pulses), therefore, the 13 pulses of the antecedent phrase exceed the first four bars by one 16th note. The consequent phrase has 14 pulses and splits into eight plus six. The ending of the phrase is a Dactyl with a prolonged final note. This sentence is 27 pulses long. It gets first repeated and then extended at study number 1 . The extension features a repetition of the antecedent phrase, so one has two times 13

[^2]Table 3.12 Greek verse rhythms

| Foot | Pulse length | Shorthand |
| :---: | :---: | :---: |
| Pyrrhic | 11 | $\cdots$ |
| Trochee | 21 | > |
| Iamb | 12 | X |
| Tribach | 111 | i |
| Spondee | 22 | II |
| Dactyl | 211 | I: |
| Anapest | 112 | : I |
| Procleusmatic | 1111 | : |
| Amphibrach | 121 | . I. |
| Bacchius | 122 | XI |
| Amphimacer | 212 | >I |
| Antibacchius | 221 | I> |
| Peon I | 2111 | > |
| Peon II | 1211 | X: |
| Peon III | 1121 | :> |
| Peon IV | 1112 | : X |
| Ionic Major | 2211 | II: |
| Ionic Minor | 1122 | : II |
| Molossus | 222 | III |
| Epitrite I | 1222 | XII |
| Epitrite II | 2122 | >II |
| Epitrite III | 2212 | $\mathrm{I}>\mathrm{I}$ |
| Epitrite IV | 2221 | II> |
| Ditrochee | 2121 | >> |
| Diiamb | 1212 | XX |
| Choriamb | 2112 | I: I |
| Antispast | 1221 | . II. |
| Dochmius | 12212 | X > I |
| Dispondee | 2222 | IIII |
| Dactylo-epitrite | 2111222 | >: III |

pulses. Again, it is the binary Amphibrach .I. that disturbs the regular ternary meter. Adding to this metric ambiguity between binary and ternary chunks are two accents on the first and on the last 16th note of the Amphibrach. A rhythmic counterpoint to these sentences is played by woodblock and small turkish cymbal in unison:
H H H I - I I I I - - X - H HH . Because its length of 52 pulses is not an integer multiple of 27, there are ongoing metric shifts between the orchestra's sentences against this repeating counterpoint. With its many chunks of 4 pulses and 2 pulses, the counterpoint contrasts the predominantly ternary rhythm of the full
orchestra. With the orchestra in the forefront, the percussive counterpoint creates a polymetric situation and it also works very similar to a hocket, because it frequently falls in-between the notes of the orchestra.

```
$A bars 1 - 9
antecedent consequent
>>.I.- :ii:I~I
$A bars 10 - 18
>>.I.- :ii:I~I
$B num 1;
>>.I.>>>.I.-:ii:i.:i.:I~I
$A
>>.I.- :ii:I~I
$C
>>.I.- :i: iiii iii:I~I
```


### 3.4.5 Beethoven

In Beethoven's music one admires his capacity to use rhythm as a means for building thematic contrasts and energetic movement. In his analysis of Beethoven's Symphonies, Markevitch (1983) uses Greek verse meters as a system for analysis and he refers also to the articulation and placement of accents in German language. In order to demonstrate the flexibility of shorthand notation, here is a transcription of the theme of the 32 Variations in c-minor, WoO 80. This is not just a display of the rhythm of a Sarabande I-., but through the use of various forms of articulations, silences and anacrusis it is clearly driving forwards until the expansion of the theme reaches its maximum in bar six, and, after a rhetoric silence, the tension is rapidly released in a simple cadential downward movement to the tonic.

```
$bar 1
I~I I~I~-.
$bar 2
I(I) I~I~I [5IIIII]
$bar 3
I(I) I~ I~-.
$bar 4
I(I) I~I~I [::]
$bar 5
I(I) I~I~I [::]
$bar 6
I(I) I~I~I~I
$bar }
(-). I(I) I(I)
$bar }
I(I) I(I) I(I)
```


### 3.4.6 Mussorgsky

Mussorgsky's opening Promenade from his Pictures of an Exhibition is a masterpiece of economy - just two different durations, quarters and eighth notes, are used to illustrate a walk towards and between the pieces of the exhibition. Interestingly, one finds mirror-like melodic movements, opening and closing phrases, in the first two bars, a change of meter between $5 / 4$ and $6 / 4$, and over the course of the piece there is a wonderful variation of the dactyl motive, which is presented twice at the beginning, $: I: I$. Afterwards, it is developed and varied to become $\quad:: \mathrm{I}$ until the dactyl figure spans an entire bar of six quarters in bars 9 and 13, $:::::: \mathrm{I}$. After this climax, the expansion of the dactyl is reversed again to become $\quad:: \mathrm{I}$ and $: \mathrm{I}]$. The movement of expansion and contraction, of breathing in and out, of accelerating and slowing down, of experiencing impact and resolution, these phenomena are not only characteristic for music of the Romantic period, but they are much more general and frequently used across different styles and diverse musical cultures (Giger 1993). They are clearly manifest on the level of rhythm and through the use of rhythmic patterns, phrases and sentences. The shorthand notation provides a good framework for visualizing the musically very important forces of tension and release.

```
$Promenade, bars 1 and 2
III:I :IIIII
$ bars 3 and 4
III:I :IIIII
$ bars 5 and 6
III:I :III:I
$ bars 7 and 8
III:I :III:I
$ bars 9 and 10
III::I :::::I
$ bars 11 and 12
III:: III::I
$ bars 13 and 14
:::::I :IIIII
$ bars 15 and 16
:III:I :II:I:
$ bars 17 and 18
IIII:: III:II
$ bars 19 and 20
I::III :IIIII
$ bars 21 and 22
:IIIII I:I:II
$ bars 23 and 24
IIIIII :IIIII
```

Table 3.13 Compound polyrhythm of 2:4:9:3 in shorthand notation $s$

| 2 | $\downarrow$ |  |  |  |  |  | $\downarrow$ |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 4 | $\downarrow$ |  |  | $\downarrow$ |  |  | $\downarrow$ |  |  | $\downarrow$ |  |  |
| s | H | H | . | - | H | I | I | H | - | . | H | H |
| 9 | $\uparrow$ | $\uparrow$ | $\uparrow$ |  | $\uparrow$ | $\uparrow$ |  | $\uparrow$ | $\uparrow$ |  | $\uparrow$ | $\uparrow$ |
| 3 | $\uparrow$ |  |  |  | $\uparrow$ |  |  |  | $\uparrow$ |  |  |  |

### 3.4.7 Debussy

Debussy's beginning of Syrinx is another example of a climax technique that involves great rhythmic contrasts. This time it is achieved through the use of dotted rhythms versus regular sixteenth notes and versus sixteenth note triplets, which creates a special contrast of 2:3. A dramatic silence is used to emphasize the climax, which presents the longest note duration of this section.

```
$Syrinx beginning of
-[:]-[:]:: -[:] I~ I~ I~ I
$ bar 3
-[:]-[:]:: -[:] I~[3III] [3III][3I'II]
$ bar 5
-[:]I~I [3(I)II][3III] (-). I~ I~ I~ I~ I~ I~ I~ I IN I
$ bar 8
I~I~I~
```


### 3.4.8 Polyrhythm

This section will demonstrate that it is easy to write polyrhythms with the proposed shorthand notation and that it is a good tool in order to learn how to execute polyrhythms as well. Consider the polyrhythmic pattern of 2:4:3:9. over thirty-six pulses. The sequence of pulses per beat is: $4,4,1,3,4,2,2,4,3,1,4,4$. Table 3.13 shows how one can write it as shorthand. Small arrows indicate the layers of 2, 4, 9 and 3 beats, which together form a compound pattern $s$.

### 3.4.9 Conclusion of Examples

The examples have shown that the proposed system of shorthand notation is able to capture music of varying rhythmic complexity and from different periods and cultures. It can do this because of the basic psychological principle of chunking, and because it is not dependant on the concept of meter and and its associated
patterns of accentuation. Therefore, and this has important musical consequences, the visualization of the difference between binary and ternary chunks of rhythm is very easy to realize. It is then easier to analyze and to musically execute the alternation of the impact of a certain rhythmic pattern and its subsequent resolution, as shown in the examples of African and Latin-American bell patterns and claves. We have also seen that the rhythm of the Greek Verse remains a very helpful system to explain prominent rhythmic structures in music of different styles, for example in Beethoven, Mussorgsky and Messiaen. The shorthand notation makes it easy to quickly grasp an overview of the rhythm and form of a piece of music, and it is helpful in discovering the build-up of a climax when it is played out by contrasting patterns and through the use of different note lengths, see Debussy's Syrinx and Beethoven's c-minor theme. Another interesting feature provided by the system is the aid to capture and to execute polyrhythms and metric shifts. The examples of using subdivisions in combination with basic chunks, as well as the demonstration of different metric interpretations of the same rhythm pattern, are able to support this point.

### 3.5 Conclusion

The proposed shorthand notation has a number of advantages: It is fast to write and to read, and easy to recall due to the cognitive principle of chunking. It is intuitive, for example the symbol ' X ', which represents two beats and a silence, is made of two pen strokes. The shorthand notation can be extended to cover all cases of Western music notation, for example subdivisions (tuplets), polyrhythms and metric shifts. The notation is not making assumptions about any fixed metric structure, the only condition is an underlying common pulsation. The electronic storage of the notation can be accomplished through ASCII characters in text files or databases It is easy to parse the format and to convert it into a different output format, for example lilypond, MIDI, or MusicXML. Database entry and searches are easy to manage, and the proposed notations support these powerful tools for music analysis. The many music examples from different eras and different styles underpin the general purpose and usage of this particular method of notation. The shorthand notation also lends itself to the area of Ethnomusicology where the standard notation with its implied metric structure is seen as problematic (Arom 1991).

The dualism between meter and rhythm enables a technique, in which rhythmic phrases are shifted away or towards metric beats. If the length of the pulse sequence that forms the rhythmic phrase is a highly divisible number, then the same phrase may be re-interpreted in alignment with different forms of meters where the length of a beat is a divisor of the number of pulses in that phrase. A change of the length of the beat leads to a shift of metric accents and to a change in the perception of tempo, which is a very interesting compositional device.

Equipped with this new way of notation, we can proceed to make use of it in the following chapters, which deal with rhythm analysis and composition.

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[^0]:    ${ }^{1}$ http://lilypond.org.
    ${ }^{2}$ https://www.sqlite.org.

[^1]:    ${ }^{3}$ beats per minute.
    ${ }^{4}$ Glyph means letter or symbol. A rhythmoglyph is a letter or a symbol representing a rhythm.

[^2]:    ${ }^{5}$ I130 tòn d'apameibómenos proséphē kreíōn Agamémnōn.
    ${ }^{6}$ Śārñgadeva's Sañgita Ratnākara (Bruhn 2007).

