

# Modes of internal symmetry - taking a closer look at Messiaen's modes of limited transposition

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## 1 Introduction

Before we start, make sure to get the latest version of this document from <https://github.com/shimpe/mints>. If you are unsure what to do on that page, click "Download ZIP". It will download an archive containing all the files required to recreate this document. In the *out* folder is a document.pdf file which corresponds to the article itself. In the *output* folder are .pdf and .midi files of the modes listed in sections 8, 9, 10, 11, 12, 13 and 14. Feel free to send your questions and remarks with respect to this document to [stefaan.himpe@gmail.com](mailto:stefaan.himpe@gmail.com). Feel free to report errors, or corrections, additions, to <https://github.com/shimpe/mints/issues>

After reading Olivier Messiaen's book "The technique of my Musical Language" I started wondering how exactly his "modes of limited transposition" create the sound they create. Major questions for me became:

- What is so special about the property of *limited transposition* that makes the music derived from it work so well?
- Is music derived from a random subset of a chromatic scale on some sense "crippled" compared to music written based on Messiaen's modes? Can we find some kind of intuitive explanation why Messiaen's modes work well, arguably better than other non-diatonic modes? Can we use this insight to propose other modes that perhaps do not have limited transposition, but still might result in an interesting, fresh, sound?

I set out to do a series of experiments and came up with some insights that I intend to explain here. I apologize in advance if what I'm about to describe is already well-known and obvious to more informed readers. Please accept that I'm writing this down only to further my own understanding of the matter. I do not claim to have found something new.

## 2 Symmetry? What symmetry?

Messiaen himself explains how his modes can be thought of as consisting of *symmetrical* groups of notes. The exact nature of this symmetry was not entirely clear to me. In fact, at first sight it seemed more like repeating patterns than symmetry, and this is what I wanted to clarify.

As a starting point I set out to systematically enumerate all modes derived from a chromatic scale that have intervals symmetrically distributed around the  $f\sharp$  (the middle note of the chromatic scale starting on  $c$ ). Note that during the experiments I don't directly take into account any property of *limited transposition* but I will find back many of Messiaen's modes by considering only symmetry arguments anyway.

## 2.1 Systematic enumeration

The first thing to explain is how the modes with intervals symmetrically distributed around  $f\sharp$  can be systematically enumerated.

I started from a chromatic scale. On that scale I added symbols under each note. Note how the symbols that occur left of  $f\sharp$  return later on to the right of  $f\sharp$ . This is important to keep symmetry of the intervals around  $f\sharp$ , as will hopefully become clearer in the next step. For now, remember that the symbols under the complete chromatic scale form a *palindrome*, i.e. if you read them left-to-right you get exactly the same sequence of symbols as when you read them right-to-left.



In what follows we will now construct modes by assigning values 0 or 1 to each of the symbols  $p, q, r, s, t, u, v$ . A value of 0 indicates that the note to which the symbol is attached is not to be selected from the chromatic scale while constructing a mode. A value of 1 indicates that the notes to which the symbol is attached are to be selected from the chromatic scale.

E.g. if we set  $p=1, q=1, r=1, s=1, t=1, u=1, v=1$  we retain all the notes from the chromatic scale and end up with the chromatic scale itself. We can say that the chromatic scale is characterized by a "key"  $(p, q, r, s, t, u, v) = (1, 1, 1, 1, 1, 1, 1)$ . If we set  $p=1, q=0, r=1, s=0, t=0, u=0, v=1$ , we end up with a mode that contains the notes  $c, d, f\sharp, a\sharp, c'$ . This mode is characterized by a key  $(p, q, r, s, t, u, v) = (1, 0, 1, 0, 0, 0, 1)$ .



This method for constructing modes has some properties:

- Any combination of values 0,1 assigned to all of  $p, q, r, s, t, u, v$  results in a mode derived from the chromatic scale with intervals distributed symmetrically around  $f\sharp$ .
- A different combination of values 0,1 assigned to  $p, q, r, s, t, u, v$  results in a different mode. In other words, there are no two different keys

(p,q,r,s,t,u,v) that result in the same set of notes selected from the chromatic scale.

- If we look at all possible ways that we can assign 0, 1 to p, q, r, s, t, u, v, we construct all possible subsets of the chromatic scale with intervals distributed symmetrically around f#. In other words, we don't skip any modes symmetrical around f# by using this method.
- All in all, this means that any (p,q,r,s,t,u,v) key uniquely defines one mode with intervals symmetrically distributed around f#.
- There are  $2^7 = 128$  different ways to assign the values 0, 1 to the variables p, q, r, s, t, u, v. This means that there are 128 unique modes with symmetrical distribution of intervals around f#. One of those modes is mode 0, which has no notes at all. We don't consider it further.

## 2.2 Intermezzo: binary numbers

In computer science a key like (0,1,1,0,0,1,0) can be interpreted as a binary number. Each number 1 or 0 is called a "bit". For every binary number, there's an equivalent decimal number and vice versa. In the systematic enumeration of modes in the appendices of this explanation, I use decimal equivalents of binary numbers, because they take much less typesetting space. If you want to make sense of the explanations that follow, it's useful to understand how binary numbers relate to decimal numbers, as explained now:

### 2.2.1 Conversion from binary number to decimal number

In order to convert from a binary number to a decimal number, one writes powers of two underneath the binary number and then multiplies and adds the results. As an example, consider conversion of number (0,1,1,0,0,1,0) to decimal:

0	1	1	0	0	1	0	← write binary digits
64	32	16	8	4	2	1	← write powers of 2
*↓	*↓	*↓	*↓	*↓	*↓	*↓	↓ multiply one by one
0	32	16	0	0	2	0	→ sum to get: $32 + 16 + 2 = 50$

Note that if I add extra 0's to the left of a binary number, its value doesn't change. The same is true for a decimal number: if you write 6 or you write 06 you really have the same number.

### 2.2.2 Conversion from a decimal number to a binary number

In order to convert a decimal number back to a binary number one keeps on dividing the number by 2, and notes down the rest after division. As an example, consider converting 50 back to binary representation:

- We start from 50
- divide 50 by 2 to get 25, with rest after division=0
- divide 25 by 2 to get 12, with rest after division=1

- divide 12 by 2 to get 06, with rest after division=0
- divide 06 by 2 to get 03, with rest after division=0
- divide 03 by 2 to get 01, with rest after division=1
- divide 01 by 2 to get 00, with rest after division=1

If you now look at the rests after division from bottom to top, you get (1,1,0,0,1,0). Remember from section 2.2.1 that one can add zeros to the left of any number without changing its value. Since we prefer to work with binary numbers (keys) of length 7 (i.e. the number of symbols p,q,...,v) we turn the binary number into key (0, 1, 1, 0, 0, 1, 0).

### 2.2.3 Tip about binary/decimal conversion

Practically all operating systems nowadays have some built-in calculator application that knows how to convert between binary and decimal should you ever need to do so.

## 3 What's the point? How do these binary numbers help us analyze music?

Using this enumeration method, I listed all the 127 non-empty modes that are symmetrical around f# as can be seen in section 8. I've sorted the modes by length. Mode 0 with zero notes was left out. Each mode is annotated with a few numbers, e.g. 74:(2)7-71. The number 74 means it's the 74th mode in the list of modes sorted by length. The number (2) means that we're looking at modes with binary symmetry (the mode is divided in two symmetrical parts). The number 7 means that the mode consists of 7 notes, distributed symmetrically around f#. The number 71 is the decimal number that corresponds to the binary key (p,q,r,s,t,u,v) = (1,0,0,0,1,1,1) that uniquely defines the mode:



### 3.1 The symmetry of Messiaen's modes around f#

A first thing that struck me as interesting is that all of Messiaen's modes can be found back in the list of 127 modes enumerated in section 8 (albeit not always in first transposition, which is caused by our restriction to only look at modes symmetrical around f#, and not to look at modes symmetrical around – say – g.):

- Messiaen's mode 1 corresponds to our mode (2)85  $(p,q,r,s,t,u,v) = (1,0,1,0,1,0,1)$



- Messiaen's mode 2 corresponds to our mode (2)54  $(p,q,r,s,t,u,v) = (0,1,1,0,1,1,0)$



- Messiaen's mode 3 corresponds to our mode (2)93  $(p,q,r,s,t,u,v) = (1,0,1,1,1,0,1)$



- Messiaen's mode 4 corresponds to our mode (2)103  $(p,q,r,s,t,u,v) = (1,1,0,0,1,1,1)$



- Messiaen's mode 5 corresponds to our mode (2)99  $(p,q,r,s,t,u,v) = (1,1,0,0,0,1,1)$



- Messiaen's mode 6 corresponds to our mode (2)107  $(p,q,r,s,t,u,v) = (1,1,0,1,0,1,1)$



- Messiaen's mode 7 corresponds to our mode (2)119  $(p,q,r,s,t,u,v) = (1,1,1,0,1,1,1)$



### 3.2 More symmetry in Messiaen's modes

Now take a close look at the binary keys for Messiaen's modes. *In all but one of his modes, the binary keys are themselves palindromes*, indicating that not only are the modes symmetrical around f#, but they also have extra internal symmetry around d# (left-hand side of f#) and around a (right-hand side of f#). Having a palindromic key thus implies that there's a second level of symmetrical interval distribution inside the upper and lower halves of the modes.

It would not be correct to say that only modes with palindromic binary keys sound good. Look e.g. at mode of binary internal symmetry number (2)90  $(1,0,1,1,0,1,0)$ , which is better known as "c dorian". The binary key is not

palindromic but it does show other extra symmetries in its structure (observe how its binary key becomes a palindrome if you leave out the last 0). Similarly, Messiaen's fourth mode of limited transposition also becomes a palindrome if you leave out the last 1 in its binary key, indicating that it has significant internal symmetries beyond the always present symmetry around f#.

I'd like to speculate here that additional internal symmetries play an important role in making modes (and their "modes") sound good. The human brain is optimized for pattern matching. It is sensitive to symmetries and the listener probably subconsciously picks up the patterns and hears the symmetries present in the intervals that make up the mode. (If that were true, we might even nominate the "Dorian" mode as the most natural of modes based on a diatonic scale.) Modes with extra internal symmetries look like good candidates for harmony and melody experiments.

### 3.3 Are there any modes with similar internal symmetries that are not Messiaen modes?

#### 3.3.1 Perfect internal symmetry

In section 9 all modes are listed that have palindromic binary keys. Note that almost all of Messiaen's modes appear here in one form or another, and that some modes appear that are not part of Messiaen's musical language. This is because we used *internal symmetry* instead of *limited transposition* as criterion. From these results, it's quite clear that there's a close connection between the two criteria. It's also interesting that a number of (shorter) modes appear which, to the best of my knowledge, were not used directly by Messiaen, but which may be interesting for further harmonic and melodic experiments.

In what follows, remember that the notation "mode (2)x-y" means "a mode with binary symmetry, x notes and key y, where y should be converted to binary to see which notes are present in the mode. Compare the descriptions given here to the modes as listed in section 9.

- Mode (2)02-008 (0,0,0,1,0,0,0) is a ditonic mode. Two notes may be a bit limited for a composition. Interesting though that it is a tritone, which is one of the basic building blocks for Messiaen's musical language.
- Mode (2)04-020 (0,0,1,0,1,0,0) is a tetratonic mode.
- Mode (2)06-028 (0,0,1,1,1,0,0) is a hexatonic mode.
- Mode (2)04-034 (0,1,0,0,0,1,0) is a tetratonic mode. Interesting about this mode is that there's even more symmetry present in the lower and upper half of the binary key. This is a third level of symmetry in the mode.
- Mode (2)06-042 (0,1,0,1,0,1,0) is a hexatonic mode. Interesting about this mode is that there's even more symmetry present in the lower and upper half of the binary key. This is a third level of symmetry in the mode.
- Mode (2)08-054 (0,1,1,0,1,1,0) is an octotonic mode. It's also known as Messiaen's second mode of limited transposition.

- Mode (2)10-062 (0,1,1,1,1,0) is a decatonic mode. This mode is not listed by Messiaen. However, if we extend this mode with a  $c\sharp$  at the right, we get a "mode" of Messiaen's seventh mode of limited transposition built on note d.
- Mode (2)03-065 (1,0,0,0,0,1) is a tritonic mode. It consists of 2 tritones.
- Mode (2)05-073 (1,0,0,1,0,0,1) is a pentatonic mode.
- Mode (2)07-085 (1,0,1,0,1,0,1) is a heptatonic mode. It's also known as Messiaen's first mode of limited transposition, or as the whole-tone scale. Interesting about this mode is that there's even more symmetry present in the lower and upper half of the binary key. This is a third level of symmetry in the mode.
- Mode (2)09-093 (1,0,1,1,1,0,1) is a nonatonic mode. This is Messiaen's third mode of limited transposition. Interesting about this mode is that there's even more symmetry present in the lower and upper half of the binary key. This is a third level of symmetry in the mode.
- Mode (2)07-099 (1,1,0,0,0,1,1) is a heptatonic mode. This is Messiaen's fifth mode of limited transposition.
- Mode (2)09-107 (1,1,0,1,0,1,1) is a nonatonic mode. This is a "mode" of Messiaen's sixth mode of limited transposition built on note  $c\sharp$ .
- Mode (2)11-119 (1,1,1,0,1,1,1) is an undecatonic mode. This is a "mode" of Messiaen's seventh mode of limited transposition built on note b. Interesting about this mode is that there's even more symmetry present in the lower and upper half of the binary key. This is a third level of symmetry in the mode.
- Mode (2)13-127 (1,1,1,1,1,1,1) is the chromatic scale itself. This mode also has a third and even fourth level of symmetry.

### 3.3.2 Partial internal symmetry

Now follows a list of modes that are partially palindromic as follows: the binary keys of the modes listed here become palindromic if you leave out either the first or last bit. They are listed in musical form in section 10. These form another subset of modes (slightly less "perfect" than the modes in the previous section). Probably some of these modes are better known under other names, but my knowledge of existing scales is not large enough to recognize all of them.

By reducing the constraints on symmetry also other interesting modes can be selected (e.g. modes that are a palindromic if you leave out 2 outer bits), but listing those is left as an exercise to the interested reader.

- (2)001 ( 0,0,0,0,0,1 ) is a mode consisting of a single note  $f\sharp$ . This is a bit limited to compose with :)
- (2)012 ( 0,0,0,1,1,0,0 ) tetratonic
- (2)018 ( 0,0,1,0,0,1,0 ) tetratonic

- (2)024 ( 0,0,1,1,0,0,0 ) tetratonic
- (2)025 ( 0,0,1,1,0,0,1 ) tetratonic. Sounds quite exotic (arabic?).
- (2)030 ( 0,0,1,1,1,1,0 ) octatonic
- (2)033 ( 0,1,0,0,0,0,1 ) tritonic
- (2)036 ( 0,1,0,0,1,0,0 ) tetratonic
- (2)037 ( 0,1,0,0,1,0,1 ) pentatonic
- (2)045 ( 0,1,0,1,1,0,1 ) heptatonic. This is  $c\#$  aeolian mode (natural minor diatonic scale).
- (2)051 ( 0,1,1,0,0,1,1 ) heptatonic. Sounds quite exotic (arabic?).
- (2)060 ( 0,1,1,1,1,0,0 ) octatonic
- (2)061 ( 0,1,1,1,1,0,1 ) nonatonic
- (2)063 ( 0,1,1,1,1,1,1 ) undecatonic. Like a chromatic scale but without note  $c$ .
- (2)064 ( 1,0,0,0,0,0,0 ) ditonic. Consists of only notes  $c$ .
- (2)066 ( 1,0,0,0,0,1,0 ) tetratonic. Consists of the notes of a  $\text{sus}4$  chord built on  $c$ .
- (2)067 ( 1,0,0,0,0,1,1 ) pentatonic.
- (2)076 ( 1,0,0,1,1,0,0 ) hexatonic.
- (2)082 ( 1,0,1,0,0,1,0 ) hexatonic.
- (2)090 ( 1,0,1,1,0,1,0 ) octatonic. This is really just the dorian mode of  $c$ .
- (2)091 ( 1,0,1,1,0,1,1 ) nonatonic. Like the dorian mode of  $c$  but with  $f\#$  added.
- (2)094 ( 1,0,1,1,1,1,0 ) decatonic.
- (2)097 ( 1,1,0,0,0,0,1 ) pentatonic.
- (2)102 ( 1,1,0,0,1,1,0 ) octatonic. Sounds quite exotic (arabic?).
- (2)103 ( 1,1,0,0,1,1,1 ) is the fourth mode of limited transposition of Messiaen.
- (2)109 ( 1,1,0,1,1,0,1 ) nonatonic. Left halve sounds darker than right halve.
- (2)115 ( 1,1,1,0,0,1,1 ) nonatonic.
- (2)126 ( 1,1,1,1,1,1,0 ) dodecatonic. Like a chromatic scale, but with  $f\#$  left out.
- (2)127 ( 1,1,1,1,1,1,1 ) is the chromatic scale. This is the only key that also appears in the fully palindromic modes.



## 4 Ternary symmetries

So far we've only considered symmetries that divide the chromatic scale in a symmetrical left half and a right half. But a chromatic scale consists of 12 half tones, and therefore it can also be divided in groups of 3. The way of working remains more or less the same. First we propose an enumeration scheme. Note that to find ternary symmetries, we leave out the repeated tonic at the end of the mode. We then need a 4-bit binary key. Note how the mode now is divided in three parts  $p, q, r, s \rightarrow s, r, q, p \rightarrow p, q, r, s$ . This unfolded key (p,q,r,s,s,r,q,p,p,q,r,s) is not a palindrome anymore. This is a fundamentally different form of symmetry, namely between d#,e and between g,g#.



We can now reuse the knowledge we gathered before: given that we use 4-bit binary keys, there must be  $2^4 = 16$  such modes (of course mode 0 has no notes, so we don't consider it further). As before we can translate the binary keys to decimal numbers, but the decimal denote a different mode than the same decimal numbers we used while examining binary symmetries. The difference lies in the structure of the unfolded key. In the binary symmetry case we had a key (p,q,r,s,t,u,v) that after unfolding becomes (p,q,r,s,t,u,v,u,t,s,r,q,p). Now in the ternary case we have a key (p,q,r,s) that after unfolding becomes (p,q,r,s,s,r,q,p,p,q,r,s). To distinguish the decimal numbers for modes with binary symmetry from the decimal numbers for modes with ternary symmetry, we preceded the former ones with (2) and we precede the latter ones with (3).

Also as before we can look for extra symmetries by looking at 4-bit keys that are palindromic. Those non-empty keys are:

- mode (3)6 (0110): a hexatonic mode
- mode (3)9 (1001): a hexatonic mode (really a transposed "mode" of mode (3)6).
- mode (3)15 (1111): the chromatic scale

Sections 15, 16, 17, 18, 19 list all 16 modes with ternary symmetry.

## 5 Deriving harmonies from modes of internal symmetry

Another question I was struggling with was why Messiaen chose to build chords based on the interval of a fourth. During my investigation I think I saw a possible explanation as follows:

- Sections 11, 12, 13, 14 systematically list the chords built on the modes of binary internal symmetry by taking notes from consecutive mode (scale) degrees, every third mode degree, every fourth mode degree, every fifth mode degree respectively. Sections 16, 17, 18 and 19 do the same for modes of ternary internal symmetry.
- As is clearly visible, the fewer notes are in a mode that is symmetrical around  $f\sharp$ , the more widely spaced those notes are (on average).
- In wider spaced modes (many 0's in the binary key), it makes sense to build chords from mode degrees that are close enough to each other.
- In more dense modes (many 1's in the binary key), it makes sense to build chords from mode degrees that are spaced further apart. If we use notes too close together, every chord sounds very dissonant and there's not much room for creating harmonic contrasts.
- Since Messiaen's modes are relatively dense compared to - say - a diatonic scale (Messiaen's modes all have 8 or more notes, whereas a diatonic scale has 7 notes), my guess is that the harmonies as built using every third note sound a bit too harsh, and Messiaen therefore decided to use fourths.

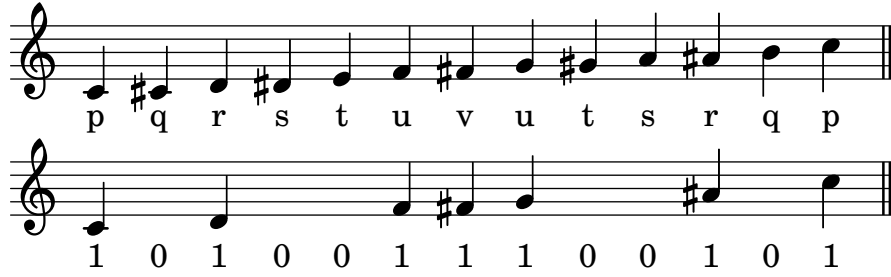
It would seem that when deriving harmonies from a set of notes we want to avoid uneven spreading of intervals over the mode, to avoid ending up with a series of very closely spaced chords, followed by a series of much more widely spaced chords. In other words: a mode that consists of a left part with many half tones, and a right part with many whole tones will tend to result in much more dissonant chords derived from that left part, and much more open sounding chords derived from the right part. Can the binary keys can help us see in which modes the intervals are better spread out than in other modes?

## 5.1 From binary key to intervals in symmetric modes

First we can convert the binary keys back to intervals between successive notes in the mode. Doing so is simple once we think back of what the binary keys really mean: each 1 or 0 is an inclusion respectively exclusion of a particular note from the chromatic scale built on  $c$ . We can find back the intervals in the mode as follows:

- Write down the binary key  $(p,q,r,s,t,u,v)$  and unfold it to form the complete mode:  $(p,q,r,s,t,u,v,u,t,s,r,q,p)$ . Or in the case of a ternary symmetrical mode, take the key  $(p,q,r,s)$  and unfold it to  $(p,q,r,s,s,r,q,p,p,q,r,s)$ .
- Now each time count the number of 0's between successive 1's. Each count is one less than the number of half steps in the interval.

An abstract description like the above begs for an example. Let's take mode 83:



Number (2)83 in binary is (1,0,1,0,0,1,1). After unfolding we get (1,0,1,0,0,1,1,1,0,0,1,0,1) (see music example). Now we count zeros between successive 1's. We find 1 zero, 2 zeros, 0 zeros, 0 zeros, 2 zeros, 1 zero:

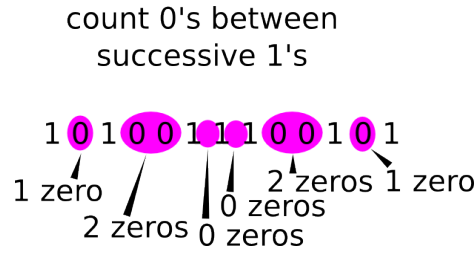


Figure 1: Turning binary keys back into intervals

If we count zero 0's, then the interval between successive notes is  $1/2$  tone. If we count one 0, the interval is 1 tone. In general, if  $z$  is the number of zeros we counted, the number of half tones in the interval is  $h = (z + 1)$ . And then the number of tones in the interval is  $t = h/2 = (z + 1)/2$ . In the case of mode (2)83, we apply this formula as follows:

- we counted 0's between successive 1's: (1,2,0,0,2,1).
- we apply the formula:  $((1+1)/2, (2+1)/2, (0+1)/2, (0+1)/2, (2+1)/2, (1+1)/2) = (1, 1.5, 0.5, 0.5, 1.5, 1)$ .
- so we have a mode with intervals 1 tone, 1.5 tones, 0.5 tones, 0.5 tones, 1.5 tones, 1 tone
- we double check with the musical example and see indeed that  $c \rightarrow d = 1$  tone,  $d \rightarrow f = 1.5$  tones,  $f \rightarrow f\# = 0.5$  tones,  $f\# \rightarrow g = 0.5$  tones,  $g \rightarrow a\# = 1.5$  tones,  $a\# \rightarrow c = 1$  tone

## 5.2 Ideal interval size. Avoiding clusters and gaps

Intuitively, when one wants to derive harmonies by stacking notes from every  $n$ -th scale degree, one could decide to avoid too small intervals (clusters) and too large intervals (gaps), e.g. to avoid a concentration of too dissonant chords on one side of the scale. For this reason it's useful to think about what intervals one reasonably can expect to occur in a mode.

Suppose you create a mode of only 2 different notes. These 2 notes have to span an octave, i.e. 12 half tones. To have maximal spreading of the notes over the mode one should have intervals between the notes of 6 half tones ( $c \rightarrow f\#$ ).

The interval ( $f\# \rightarrow c$ ) closes the construction by repeating the first note  $c$ , so this second " $c$ " it is not a "third note" in our mode. More general, for  $n$  notes spanning an octave (12 half tones), the ideal interval has  $12/n$  half tones.

Suppose this assumption makes sense, then in an octotonic scale (8 distinct notes) the ideal interval between notes is  $12/8 = 1.5$  half tones. There's one problem with this: 1.5 half tones leads to microtonal music. If we don't want to go there, we need to do the next best thing: round to multiples of 1. We can't round all 1.5 half tone intervals to 2 half tone intervals because then we end up with way too many half tones to fit in an octave. Similarly we can't round all 1.5 intervals down to 1 because then we end up with too few half tones to span the octave. We can however approximate this 1.5 by alternating between rounding 1.5 up to 2 and rounding 1.5 down to 1 to get the following configuration of half tone intervals: (1,2,1,2,1,2,1,2) which nicely adds up to  $1 + 2 + 1 + 2 + 1 + 2 + 1 + 2 = 12$  half tones over 8 notes. But now look closely at what we really constructed...

We find Messiaen's second mode of limited transposition! Even though I didn't present a rigorous mathematical proof here, I hope it is clear that Messiaen's second mode of limited transposition is a best possible approximation of evenly spread intervals in an octotonic scale (best possible if we don't allow microtonal intervals).<sup>1</sup>

When we select modes for our own compositions, we may want to pay some attention to avoiding clusters and gaps in the intervals that lie between the notes in the modes we select. An interval  $G$  can be named a "gap" if it has more half tones than the ideal interval rounded up, and an interval  $C$  can be named a "cluster" if it has less half tones than the ideal interval rounded down. In all this, the ideal interval is itself a function of the number of notes in the mode. Summarizing:

- The ideal interval  $I(n)$  in a mode is  $I(n) = 12/n$  where  $n$  is the number of distinct notes in the mode.
- An interval  $G$  is a gap if  $B > \lceil I(n) \rceil$ . (The symbols  $\lceil$  and  $\rceil$  should be read as "round up")
- An interval  $C$  is a cluster if  $S < \lfloor I(n) \rfloor$ . (The symbols  $\lfloor$  and  $\rfloor$  should be read as "round down")

## 6 Conclusions

To summarize:

- First we systematically listed all modes with internal symmetry around  $f\#$  derived from a chromatic scale. We found that there are 127 non-empty such modes.
- Then, we saw how all of Messiaen's modes are part of this list of 127 modes, meaning that they at least have some symmetry in interval distribution.
- After that, we noticed how all but one of the Messiaen modes contain extra symmetries in the lower half and upper half of the mode (palindromic

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<sup>1</sup>This makes me wonder how octotonic scales sound if we do allow microtonal intervals.

keys). We listed all modes that have both symmetry around  $f\#$  and the extra symmetries in the lower half and upper half of the mode, and discovered some potentially interesting modes not directly used by Messiaen (with fewer notes). Even though we didn't care about the property of *limited transposition*, by just considering symmetry arguments we arrived at a very similar set of modes.

- We continued by looking for other forms of symmetry and looked in detail at ternary symmetries yielding different set of modes.
- While doing so, we also formulated a possible explanation for why Messiaen may have chosen to build his chords using fourths, and we speculated about how internal symmetry and even spreading of intervals may contribute to make Messiaen's modes work better than other, randomly chosen, modes.
- In the reference sections 20 - 161 we list all the modes examined in this document and create a detailed passport, which can be used while exploring its musical possibilities.

## 7 Some resources

While investigating I made extensive use of Jackson Hardaker's Messiaen mode visualizer: <http://messiaen.jacksonhardaker.com/>

The complete code required to reproduce the experiments and the text in this document (together with midi files for the listed modes and chords in the following sections) can be found online at <https://github.com/shimpe/mints>. To recreate this document you need at the very least the following free software:

- python 2.x
- lilypond
- LaTeX
- a .pdf viewer (I used okular, but any viewer should do).

The provided build script is written in bash. For windows or other systems, you may need to translate to an appropriate format.

Feel free to send your questions and remarks with respect to this document to [stefaan.himpe@gmail.com](mailto:stefaan.himpe@gmail.com). Feel free to report errors, or corrections, additions, to <https://github.com/shimpe/mints/issues>

## 8 All modes with binary internal symmetry around f#, ordered by length

Piano

1:(2)1-1 2:(2)2-2 3:(2)2-4 4:(2)2-8 5:(2)2-16 6:(2)2-32 7:(2)2-64 8:(2)3-3 9:(2)3-5 10:(2)3-9  
 11:(2)3-17 12:(2)3-33 13:(2)3-65 14:(2)4-6 15:(2)4-10 16:(2)4-12 17:(2)4-18 18:(2)4-20  
 19:(2)4-24 20:(2)4-34 21:(2)4-36 22:(2)4-40 23:(2)4-48 24:(2)4-66 25:(2)4-68  
 26:(2)4-72 27:(2)4-80 28:(2)4-96 29:(2)5-7 30:(2)5-11 31:(2)5-13  
 32:(2)5-19 33:(2)5-21 34:(2)5-25 35:(2)5-35 36:(2)5-37 37:(2)5-41  
 38:(2)5-49 39:(2)5-67 40:(2)5-69 41:(2)5-73 42:(2)5-81 43:(2)5-97  
 44:(2)6-14 45:(2)6-22 46:(2)6-26 47:(2)6-28 48:(2)6-38  
 49:(2)6-42 50:(2)6-44 51:(2)6-50 52:(2)6-52 53:(2)6-56  
 54:(2)6-70 55:(2)6-74 56:(2)6-76 57:(2)6-82 58:(2)6-84  
 59:(2)6-88 60:(2)6-98 61:(2)6-100 62:(2)6-104 63:(2)6-112  
 64:(2)7-15 65:(2)7-23 66:(2)7-27 67:(2)7-29  
 68:(2)7-39 69:(2)7-43 70:(2)7-45 71:(2)7-51  
 72:(2)7-53 73:(2)7-57 74:(2)7-71 75:(2)7-75  
 76:(2)7-77 77:(2)7-83 78:(2)7-85 79:(2)7-89

80:(2)7-99      81:(2)7-101      82:(2)7-105      83:(2)7-113

84:(2)8-30      85:(2)8-46      86:(2)8-54      87:(2)8-58

88:(2)8-60      89:(2)8-78      90:(2)8-86      91:(2)8-90

92:(2)8-92      93:(2)8-102      94:(2)8-106      95:(2)8-108

96:(2)8-114      97:(2)8-116      98:(2)8-120      99:(2)9-31

100:(2)9-47      101:(2)9-55      102:(2)9-59

103:(2)9-61      104:(2)9-79      105:(2)9-87

106:(2)9-91      107:(2)9-93      108:(2)9-103

109:(2)9-107      110:(2)9-109      111:(2)9-115      112:(2)9-117

113:(2)9-121      114:(2)10-62      115:(2)10-94

116:(2)10-110      117:(2)10-118      118:(2)10-122

119:(2)10-124      120:(2)11-63      121:(2)11-95

122:(2)11-111      123:(2)11-119      124:(2)11-123

125:(2)11-125      126:(2)12-126      127:(2)13-127

## 9 All modes of binary internal symmetry with palindromic keys

Piano

1:(2)2-8 2:(2)4-20 3:(2)6-28 4:(2)4-34 5:(2)6-42

6:(2)8-54 7:(2)10-62 8:(2)3-65 9:(2)5-73

10:(2)7-85 11:(2)9-93 12:(2)7-99 13:(2)9-107

14:(2)11-119 15:(2)13-127



## 10 All modes of binary internal symmetry with partially palindromic keys

Piano

1: (2)1-1 2: (2)4-12 3: (2)4-18 4: (2)4-24 5: (2)5-25 6: (2)8-30

7: (2)3-33 8: (2)4-36 9: (2)5-37 10: (2)7-45 11: (2)7-51

12: (2)8-60 13: (2)9-61 14: (2)11-63 15: (2)2-64

16: (2)4-66 17: (2)5-67 18: (2)6-76 19: (2)6-82 20: (2)8-90

21: (2)9-91 22: (2)10-94 23: (2)5-97 24: (2)8-102

25: (2)9-103 26: (2)9-109 27: (2)9-115

28: (2)12-126 29: (2)13-127

# 11 All chords built by stacking every second note from the modes of internal binary symmetry

Piano

1:(2)1-1 2:(2)2-2 3:(2)2-4 4:(2)2-8 5:(2)2-16 6:(2)2-32 7:(2)2-64 8:(2)3-3

9:(2)3-5 10:(2)3-9 11:(2)3-17 12:(2)3-33 13:(2)3-65 14:(2)4-6

15:(2)4-10 16:(2)4-12 17:(2)4-18 18:(2)4-20 19:(2)4-24

20:(2)4-34 21:(2)4-36 22:(2)4-40 23:(2)4-48 24:(2)4-66

25:(2)4-68 26:(2)4-72 27:(2)4-80 28:(2)4-96 29:(2)5-7

30:(2)5-11 31:(2)5-13 32:(2)5-19 33:(2)5-21

34:(2)5-25 35:(2)5-35 36:(2)5-37

37:(2)5-41 38:(2)5-49 39:(2)5-67 40:(2)5-69

41:(2)5-73 42:(2)5-81 43:(2)5-97 44:(2)6-14

45:(2)6-22 46:(2)6-26 47:(2)6-28

48:(2)6-38 49:(2)6-42 50:(2)6-44

51:(2)6-50 52:(2)6-52 53:(2)6-56

54:(2)6-70 55:(2)6-74 56:(2)6-76

57:(2)6-82      58:(2)6-84      59:(2)6-88

60:(2)6-98      61:(2)6-100      62:(2)6-104

63:(2)6-112      64:(2)7-15      65:(2)7-23

66:(2)7-27      67:(2)7-29

68:(2)7-39      69:(2)7-43

70:(2)7-45      71:(2)7-51

72:(2)7-53      73:(2)7-57

74:(2)7-71      75:(2)7-75      76:(2)7-77

77:(2)7-83      78:(2)7-85      79:(2)7-89

80:(2)7-99      81:(2)7-101      82:(2)7-105

83:(2)7-113      84:(2)8-30

85:(2)8-46      86:(2)8-54

87:(2)8-58      88:(2)8-60

89:(2)8-78      90:(2)8-86

91:(2)8-90

92:(2)8-92

93:(2)8-102

94:(2)8-106

95:(2)8-108

96:(2)8-114

97:(2)8-116

98:(2)8-120

99:(2)9-31

100:(2)9-47

101:(2)9-55

102:(2)9-59

103:(2)9-61

104:(2)9-79

105:(2)9-87

106:(2)9-91

107:(2)9-93

108:(2)9-103

109:(2)9-107

110:(2)9-109

111:(2)9-115

112:(2)9-117

113:(2)9-121

114:(2)10-62

115:(2)10-94

116:(2)10-110

117:(2)10-118

118:(2)10-122

119:(2)10-124

120:(2)11-63

121:(2)11-95

122:(2)11-111

123:(2)11-119

124:(2)11-123

125:(2)11-125

126:(2)12-126

127:(2)13-127

## 12 All chords built by stacking every third note from the modes of internal binary symmetry

Piano

The musical score consists of 65 chords, each represented by a single note on a grand staff. The chords are arranged in a grid-like fashion, with 10 chords per row and 7 rows. Each chord is labeled with a number and a mode, indicating its position in the sequence and its internal binary symmetry. The labels are as follows:

- Row 1: 1:(2)1-1, 2:(2)2-2, 3:(2)2-4, 4:(2)2-8, 5:(2)2-16, 6:(2)2-32, 7:(2)2-64, 8:(2)3-3, 9:(2)3-5, 10:(2)3-9
- Row 2: 11:(2)3-17, 12:(2)3-33, 13:(2)3-65, 14:(2)4-6, 15:(2)4-10, 16:(2)4-12, 17:(2)4-18
- Row 3: 18:(2)4-20, 19:(2)4-24, 20:(2)4-34, 21:(2)4-36, 22:(2)4-40, 23:(2)4-48
- Row 4: 24:(2)4-66, 25:(2)4-68, 26:(2)4-72, 27:(2)4-80, 28:(2)4-96, 29:(2)5-7
- Row 5: 30:(2)5-11, 31:(2)5-13, 32:(2)5-19, 33:(2)5-21
- Row 6: 34:(2)5-25, 35:(2)5-35, 36:(2)5-37, 37:(2)5-41
- Row 7: 38:(2)5-49, 39:(2)5-67, 40:(2)5-69, 41:(2)5-73, 42:(2)5-81
- Row 8: 43:(2)5-97, 44:(2)6-14, 45:(2)6-22, 46:(2)6-26
- Row 9: 47:(2)6-28, 48:(2)6-38, 49:(2)6-42, 50:(2)6-44
- Row 10: 51:(2)6-50, 52:(2)6-52, 53:(2)6-56, 54:(2)6-70
- Row 11: 55:(2)6-74, 56:(2)6-76, 57:(2)6-82, 58:(2)6-84
- Row 12: 59:(2)6-88, 60:(2)6-98, 61:(2)6-100, 62:(2)6-104
- Row 13: 63:(2)6-112, 64:(2)7-15, 65:(2)7-23

66:(2)7-27 67:(2)7-29 68:(2)7-39

69:(2)7-43 70:(2)7-45 71:(2)7-51

72:(2)7-53 73:(2)7-57 74:(2)7-71

75:(2)7-75 76:(2)7-77 77:(2)7-83

78:(2)7-85 79:(2)7-89 80:(2)7-99

81:(2)7-101 82:(2)7-105 83:(2)7-113

84:(2)8-30 85:(2)8-46 86:(2)8-54

87:(2)8-58 88:(2)8-60 89:(2)8-78

90:(2)8-86 91:(2)8-90 92:(2)8-92

93:(2)8-102 94:(2)8-106 95:(2)8-108

96:(2)8-114 97:(2)8-116 98:(2)8-120

99:(2)9-31 100:(2)9-47

101:(2)9-55 102:(2)9-59

103:(2)9-61 104:(2)9-79

105:(2)9-87

106:(2)9-91

107:(2)9-93

108:(2)9-103

109:(2)9-107

110:(2)9-109

111:(2)9-115

112:(2)9-117

113:(2)9-121

114:(2)10-62

115:(2)10-94

116:(2)10-110

117:(2)10-118

118:(2)10-122

119:(2)10-124

120:(2)11-63

121:(2)11-95

122:(2)11-111

123:(2)11-119

124:(2)11-123

125:(2)11-125

126:(2)12-126

127:(2)13-127



### 13 All chords built by stacking every fourth note from the modes of internal binary symmetry

Piano

1:(2)1-1 2:(2)2-2 3:(2)2-4 4:(2)2-8 5:(2)2-16 6:(2)2-32 7:(2)2-64 8:(2)3-3 9:(2)3-5 10:(2)3-9

11:(2)3-17 12:(2)3-33 13:(2)3-65 14:(2)4-6 15:(2)4-10 16:(2)4-12 17:(2)4-18

18:(2)4-20 19:(2)4-24 20:(2)4-34 21:(2)4-36 22:(2)4-40 23:(2)4-48

24:(2)4-66 25:(2)4-68 26:(2)4-72 27:(2)4-80 28:(2)4-96 29:(2)5-7

30:(2)5-11 31:(2)5-13 32:(2)5-19 33:(2)5-21 34:(2)5-25

35:(2)5-35 36:(2)5-37 37:(2)5-41 38:(2)5-49 39:(2)5-67

40:(2)5-69 41:(2)5-73 42:(2)5-81 43:(2)5-97 44:(2)6-14

45:(2)6-22 46:(2)6-26 47:(2)6-28 48:(2)6-38 49:(2)6-42

50:(2)6-44 51:(2)6-50 52:(2)6-52 53:(2)6-56 54:(2)6-70

55:(2)6-74 56:(2)6-76 57:(2)6-82 58:(2)6-84 59:(2)6-88

60:(2)6-98 61:(2)6-100 62:(2)6-104 63:(2)6-112

64:(2)7-15      65:(2)7-23      66:(2)7-27

67:(2)7-29      68:(2)7-39      69:(2)7-43

70:(2)7-45      71:(2)7-51      72:(2)7-53

73:(2)7-57      74:(2)7-71      75:(2)7-75      76:(2)7-77

77:(2)7-83      78:(2)7-85      79:(2)7-89      80:(2)7-99

81:(2)7-101      82:(2)7-105      83:(2)7-113      84:(2)8-30

85:(2)8-46      86:(2)8-54      87:(2)8-58

88:(2)8-60      89:(2)8-78      90:(2)8-86

91:(2)8-90      92:(2)8-92      93:(2)8-102

94:(2)8-106      95:(2)8-108      96:(2)8-114

97:(2)8-116      98:(2)8-120      99:(2)9-31

100:(2)9-47      101:(2)9-55

102:(2)9-59      103:(2)9-61

104:(2)9-79      105:(2)9-87      106:(2)9-91

107:(2)9-93      108:(2)9-103      109:(2)9-107

110:(2)9-109      111:(2)9-115      112:(2)9-117

113:(2)9-121      114:(2)10-62

115:(2)10-94      116:(2)10-110      117:(2)10-118

118:(2)10-122      119:(2)10-124

120:(2)11-63      121:(2)11-95

122:(2)11-111      123:(2)11-119

124:(2)11-123      125:(2)11-125

126:(2)12-126      127:(2)13-127

## 14 All chords built by stacking every fifth note from the modes of internal binary symmetry

Piano

1:(2)1-1 2:(2)2-2 3:(2)2-4 4:(2)2-8 5:(2)2-16 6:(2)2-32 7:(2)2-64 8:(2)3-3 9:(2)3-5 10:(2)3-9

11:(2)3-17 12:(2)3-33 13:(2)3-65 14:(2)4-6 15:(2)4-10 16:(2)4-12 17:(2)4-18 18:(2)4-20

19:(2)4-24 20:(2)4-34 21:(2)4-36 22:(2)4-40 23:(2)4-48 24:(2)4-66 25:(2)4-68

26:(2)4-72 27:(2)4-80 28:(2)4-96 29:(2)5-7 30:(2)5-11 31:(2)5-13

32:(2)5-19 33:(2)5-21 34:(2)5-25 35:(2)5-35 36:(2)5-37

37:(2)5-41 38:(2)5-49 39:(2)5-67 40:(2)5-69 41:(2)5-73

42:(2)5-81 43:(2)5-97 44:(2)6-14 45:(2)6-22 46:(2)6-26

47:(2)6-28 48:(2)6-38 49:(2)6-42 50:(2)6-44

51:(2)6-50 52:(2)6-52 53:(2)6-56 54:(2)6-70

55:(2)6-74      56:(2)6-76      57:(2)6-82      58:(2)6-84

59:(2)6-88      60:(2)6-98      61:(2)6-100      62:(2)6-104      63:(2)6-112

64:(2)7-15      65:(2)7-23      66:(2)7-27      67:(2)7-29

68:(2)7-39      69:(2)7-43      70:(2)7-45      71:(2)7-51

72:(2)7-53      73:(2)7-57      74:(2)7-71      75:(2)7-75

76:(2)7-77      77:(2)7-83      78:(2)7-85      79:(2)7-89

80:(2)7-99      81:(2)7-101      82:(2)7-105      83:(2)7-113

84:(2)8-30      85:(2)8-46      86:(2)8-54

87:(2)8-58      88:(2)8-60      89:(2)8-78

90:(2)8-86      91:(2)8-90      92:(2)8-92

93:(2)8-102      94:(2)8-106      95:(2)8-108

96:(2)8-114      97:(2)8-116      98:(2)8-120

99:(2)9-31      100:(2)9-47      101:(2)9-55

102:(2)9-59

103:(2)9-61

104:(2)9-79

105:(2)9-87

106:(2)9-91

107:(2)9-93

108:(2)9-103

109:(2)9-107

110:(2)9-109

111:(2)9-115

112:(2)9-117

113:(2)9-121

114:(2)10-62

115:(2)10-94

116:(2)10-110

117:(2)10-118

118:(2)10-122

119:(2)10-124

120:(2)11-63

121:(2)11-95

122:(2)11-111

123:(2)11-119

124:(2)11-123

125:(2)11-125

126:(2)12-126

127:(2)13-127

## 15 All modes with ternary internal symmetry ordered by length

Piano

1: (3)3-1   2: (3)3-2   3: (3)3-4   4: (3)3-8   5: (3)6-3   6: (3)6-5

7: (3)6-6   8: (3)6-9   9: (3)6-10   10: (3)6-12   11: (3)9-7

12: (3)9-11   13: (3)9-13   14: (3)9-14   15: (3)12-15

## 16 All chords built by stacking every second note from the modes of ternary internal sym-

Piano

The image displays 15 chords in G major, each with a ternary internal symmetry label. The chords are arranged in six rows of musical notation (treble clef, key signature of one sharp). The labels are as follows:

- Row 1: 1:(3)3-1, 2:(3)3-2, 3:(3)3-4, 4:(3)3-8, 5:(3)6-3
- Row 2: 6:(3)6-5, 7:(3)6-6
- Row 3: 8:(3)6-9, 9:(3)6-10
- Row 4: 10:(3)6-12, 11:(3)9-7
- Row 5: 12:(3)9-11, 13:(3)9-13
- Row 6: 14:(3)9-14, 15:(3)12-15



# 17 All chords built by stacking every third note from the modes of ternary internal symme-

Piano

1:(3)3-1    2:(3)3-2    3:(3)3-4    4:(3)3-8    5:(3)6-3

6:(3)6-5    7:(3)6-6    8:(3)6-9

9:(3)6-10    10:(3)6-12    11:(3)9-7

12:(3)9-11    13:(3)9-13

14:(3)9-14    15:(3)12-15

# 18 All chords built by stacking every fourth note from the modes of ternary internal symmetry

Piano

1:(3)3-1 2:(3)3-2 3:(3)3-4 4:(3)3-8 5:(3)6-3 6:(3)6-5

7:(3)6-6 8:(3)6-9 9:(3)6-10 10:(3)6-12

11:(3)9-7 12:(3)9-11 13:(3)9-13

14:(3)9-14 15:(3)12-15

# 19 All chords built by stacking every fifth note from the modes of ternary internal symmetry

Piano

1:(3)3-1 2:(3)3-2 3:(3)3-4 4:(3)3-8 5:(3)6-3 6:(3)6-5

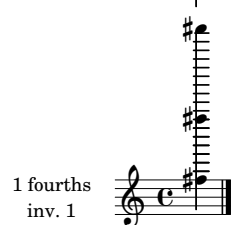
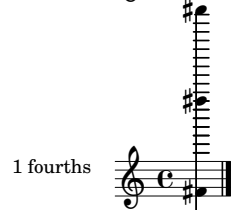
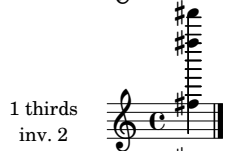
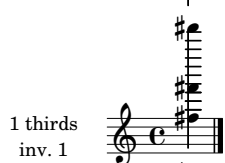
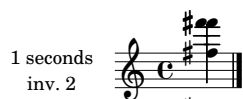
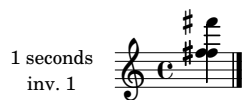
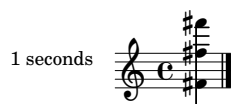
7:(3)6-6 8:(3)6-9 9:(3)6-10 10:(3)6-12

11:(3)9-7 12:(3)9-11 13:(3)9-13

14:(3)9-14 15:(3)12-15

## 20 Characterizing mode (2)1

**Mode (2)1**  
(binary key: 0000001)



2

1 fourths  
inv. 2

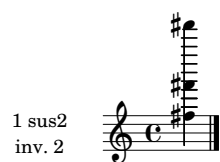
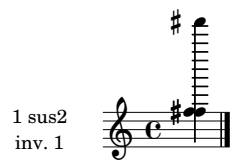
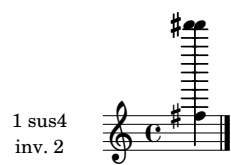
1 fifths

1 fifths  
inv. 1

1 fifths  
inv. 2

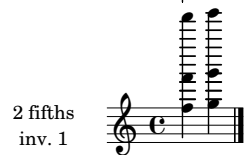
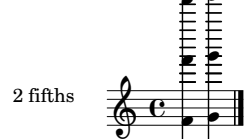
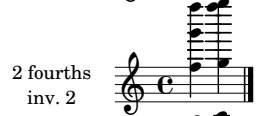
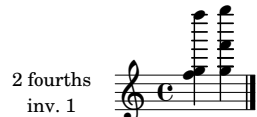
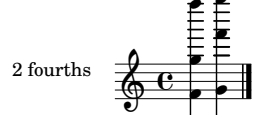
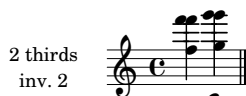
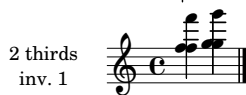
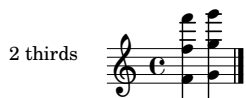
1 sus4

1 sus4  
inv. 1

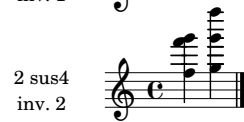


## 21 Characterizing mode (2)2

**Mode (2)2**  
(binary key: 0000010)



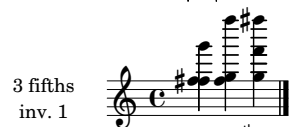
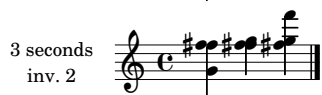
2



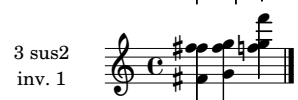
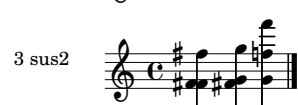


## 22 Characterizing mode (2)3

**Mode (2)3**  
(binary key: 0000011)





2





## 23 Characterizing mode (2)4


### Mode (2)4 (binary key: 0000100)


4 plain 

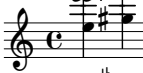
4 seconds 


4 seconds  
inv. 1 


4 seconds  
inv. 2 


4 thirds 

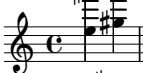
4 thirds  
inv. 1 


4 thirds  
inv. 2 

4 fourths 

4 fourths  
inv. 1 

4 fourths  
inv. 2 

4 fifths 

4 fifths  
inv. 1 

2

4 fifths  
inv. 2

4 sus4

4 sus4  
inv. 1

4 sus4  
inv. 2


4 sus2


4 sus2  
inv. 1


4 sus2  
inv. 2


## 24 Characterizing mode (2)5


**Mode (2)5**  
(binary key: 0000101)


5 plain 


5 seconds 


5 seconds  
inv. 1 


5 seconds  
inv. 2 


5 thirds 


5 thirds  
inv. 1 


5 thirds  
inv. 2 


5 fourths 

5 fourths  
inv. 1 

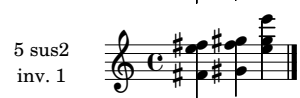
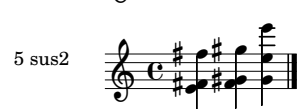
5 fourths  
inv. 2 

5 fifths 

5 fifths  
inv. 1 


5 fifths  
inv. 2 


2





## 25 Characterizing mode (2)6


**Mode (2)6**  
(binary key: 0000110)


6 plain 

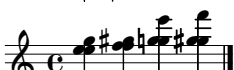
6 seconds 


6 seconds  
inv. 1 


6 seconds  
inv. 2 

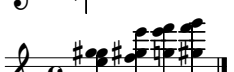
6 thirds 


6 thirds  
inv. 1 

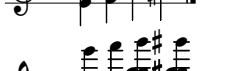
6 thirds  
inv. 2 


6 fourths 


6 fourths  
inv. 1 

6 fourths  
inv. 2 

6 fifths 

6 fifths  
inv. 1 

6 fifths  
inv. 2 

6 sus4 

2

6 sus4  
inv. 1

6 sus4  
inv. 2

6 sus2

6 sus2  
inv. 1


6 sus2  
inv. 2



## 26 Characterizing mode (2)7

### Mode (2)7 (binary key: 0000111)

7 plain 

7 seconds 

7 seconds  
inv. 1 

7 seconds  
inv. 2 

7 thirds 

7 thirds  
inv. 1 

7 thirds  
inv. 2 

7 fourths 

7 fourths  
inv. 1 

7 fourths  
inv. 2 

7 fifths 

7 fifths  
inv. 1 

7 fifths  
inv. 2 

2  
7 sus4

7 sus4  
inv. 1

7 sus4  
inv. 2

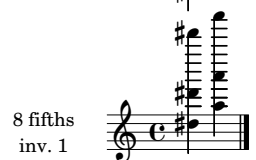
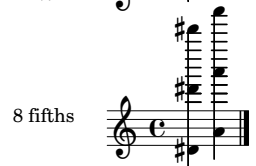
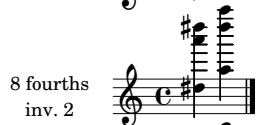
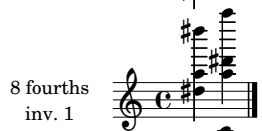
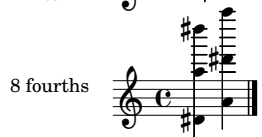
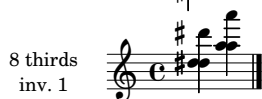
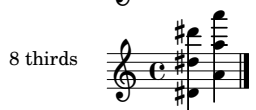
7 sus2

7 sus2  
inv. 1

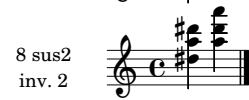
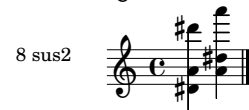
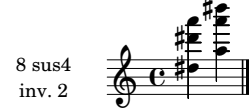
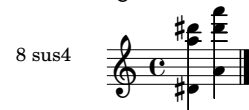
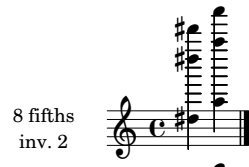
7 sus2  
inv. 2

## 27 Characterizing mode (2)8

**Mode (2)8**  
(binary key: 0001000)





2





## 28 Characterizing mode (2)9


### Mode (2)9 (binary key: 0001001)


9 plain 


9 seconds 


9 seconds  
inv. 1 


9 seconds  
inv. 2 

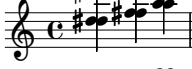
9 thirds 


9 thirds  
inv. 1 


9 thirds  
inv. 2 


9 fourths 

9 fourths  
inv. 1 

9 fourths  
inv. 2 

9 fifths 

9 fifths  
inv. 1 

9 fifths  
inv. 2 

2



## 29 Characterizing mode (2)10

### Mode (2)10 (binary key: 0001010)



2

10 sus4

10 sus4  
inv. 1

10 sus4  
inv. 2

10 sus2


10 sus2  
inv. 1


10 sus2  
inv. 2




## 30 Characterizing mode (2)11


### Mode (2)11 (binary key: 0001011)


11 plain 


11 seconds 


11 seconds  
inv. 1 

11 seconds  
inv. 2 

11 thirds 


11 thirds  
inv. 1 

11 thirds  
inv. 2 

11 fourths 

11 fourths  
inv. 1 

11 fourths  
inv. 2 

11 fifths 

11 fifths  
inv. 1 

11 fifths  
inv. 2 

2

11 sus4

11 sus4  
inv. 1

11 sus4  
inv. 2

11 sus2

11 sus2  
inv. 1

11 sus2  
inv. 2

## 31 Characterizing mode (2)12

**Mode (2)12**  
(binary key: 0001100)



2

12 sus4

12 sus4  
inv. 1

12 sus4  
inv. 2

12 sus2


12 sus2  
inv. 1


12 sus2  
inv. 2

## 32 Characterizing mode (2)13


### Mode (2)13 (binary key: 0001101)

13 plain 


13 seconds 


13 seconds  
inv. 1 

13 seconds  
inv. 2 

13 thirds 


13 thirds  
inv. 1 


13 thirds  
inv. 2 


13 fourths 

13 fourths  
inv. 1 

13 fourths  
inv. 2 

13 fifths 

13 fifths  
inv. 1 

13 fifths  
inv. 2 

2

13 sus4

13 sus4  
inv. 1

13 sus4  
inv. 2


13 sus2

13 sus2  
inv. 1

13 sus2  
inv. 2


### 33 Characterizing mode (2)14


#### Mode (2)14 (binary key: 0001110)


14 plain 

14 seconds 

14 seconds  
inv. 1 


14 seconds  
inv. 2 


14 thirds 


14 thirds  
inv. 1 


14 thirds  
inv. 2 


14 fourths 

14 fourths  
inv. 1 

14 fourths  
inv. 2 

14 fifths 

14 fifths  
inv. 1 

14 fifths  
inv. 2 

2

14 sus4

14 sus4  
inv. 1

14 sus4  
inv. 2

14 sus2

14 sus2  
inv. 1

14 sus2  
inv. 2



## 34 Characterizing mode (2)15

### Mode (2)15 (binary key: 0001111)

15 plain 

15 seconds 

15 seconds  
inv. 1 

15 seconds  
inv. 2 

15 thirds 

15 thirds  
inv. 1 

15 thirds  
inv. 2 

15 fourths 

15 fourths  
inv. 1 

15 fourths  
inv. 2 

15 fifths 

15 fifths  
inv. 1 

15 fifths  
inv. 2 

2

15 sus4



15 sus4

inv. 1



15 sus4

inv. 2



15 sus2



15 sus2

inv. 1



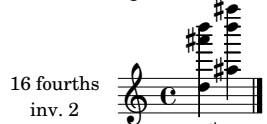
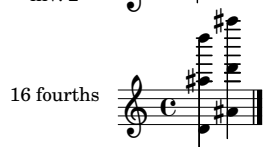
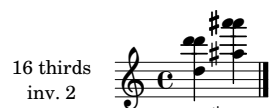
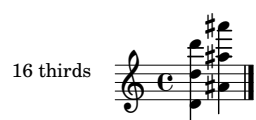
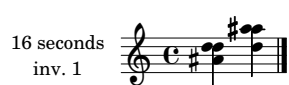
15 sus2

inv. 2

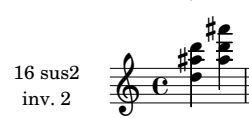
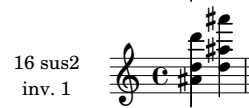
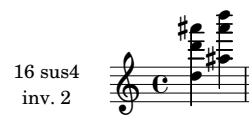
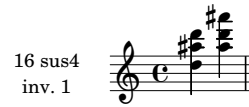
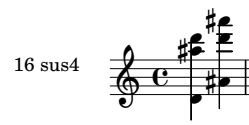
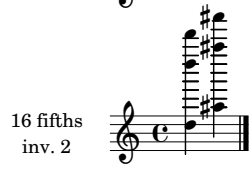
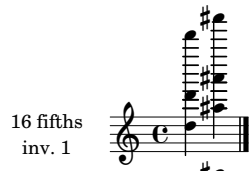


## 35 Characterizing mode (2)16

**Mode (2)16**  
(binary key: 0010000)





2





## 36 Characterizing mode (2)17


**Mode (2)17**  
(binary key: 0010001)


17 plain 


17 seconds 


17 seconds  
inv. 1 


17 seconds  
inv. 2 


17 thirds 

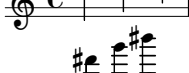
17 thirds  
inv. 1 


17 thirds  
inv. 2 


17 fourths 

17 fourths  
inv. 1 

17 fourths  
inv. 2 

17 fifths 

17 fifths  
inv. 1 

17 fifths  
inv. 2 

2



## 37 Characterizing mode (2)18

### Mode (2)18 (binary key: 0010010)



2  
18 sus4

18 sus4  
inv. 1

18 sus4  
inv. 2

18 sus2

18 sus2  
inv. 1

18 sus2  
inv. 2



## 38 Characterizing mode (2)19

### Mode (2)19 (binary key: 0010011)

19 plain 

19 seconds 

19 seconds  
inv. 1 

19 seconds  
inv. 2 

19 thirds 

19 thirds  
inv. 1 

19 thirds  
inv. 2 

19 fourths 

19 fourths  
inv. 1 

19 fourths  
inv. 2 

19 fifths 

19 fifths  
inv. 1 

19 fifths  
inv. 2 

2

19 sus4

19 sus4  
inv. 1

19 sus4  
inv. 2

19 sus2

19 sus2  
inv. 1

19 sus2  
inv. 2


## 39 Characterizing mode (2)20

### Mode (2)20 (binary key: 0010100)

20 plain 

20 seconds 

20 seconds  
inv. 1 

20 seconds  
inv. 2 

20 thirds 

20 thirds  
inv. 1 

20 thirds  
inv. 2 

20 fourths 

20 fourths  
inv. 1 

20 fourths  
inv. 2 

20 fifths 

20 fifths  
inv. 1 

20 fifths  
inv. 2 

2

20 sus4

20 sus4  
inv. 1

20 sus4  
inv. 2

20 sus2

20 sus2  
inv. 1

20 sus2  
inv. 2

## 40 Characterizing mode (2)21

### Mode (2)21 (binary key: 0010101)

21 plain 

21 seconds 

21 seconds  
inv. 1 

21 seconds  
inv. 2 

21 thirds 

21 thirds  
inv. 1 

21 thirds  
inv. 2 

21 fourths 

21 fourths  
inv. 1 

21 fourths  
inv. 2 

21 fifths 

21 fifths  
inv. 1 

21 fifths  
inv. 2 

2

21 sus4

21 sus4  
inv. 1

21 sus4  
inv. 2


21 sus2


21 sus2  
inv. 1


21 sus2  
inv. 2


## 41 Characterizing mode (2)22


### Mode (2)22 (binary key: 00101110)


22 plain 


22 seconds 


22 seconds  
inv. 1 


22 seconds  
inv. 2 


22 thirds 


22 thirds  
inv. 1 


22 thirds  
inv. 2 


22 fourths 


22 fourths  
inv. 1 

22 fourths  
inv. 2 

22 fifths 

22 fifths  
inv. 1 


22 fifths  
inv. 2 

22 sus4 

2


22 sus4

inv. 1




22 sus4

inv. 2




22 sus2




22 sus2

inv. 1



22 sus2


inv. 2








## 42 Characterizing mode (2)23


### Mode (2)23 (binary key: 0010111)


23 plain 


23 seconds 


23 seconds  
inv. 1 

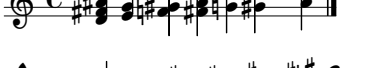
23 seconds  
inv. 2 


23 thirds 


23 thirds  
inv. 1 

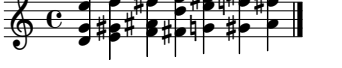
23 thirds  
inv. 2 


23 fourths 


23 fourths  
inv. 1 

23 fourths  
inv. 2 

23 fifths 


23 fifths  
inv. 1 

23 fifths  
inv. 2 


23 sus4 

2


23 sus4  
inv. 1




23 sus4  
inv. 2




23 sus2



23 sus2  
inv. 1





23 sus2  
inv. 2





## 43 Characterizing mode (2)24


### Mode (2)24 (binary key: 0011000)


24 plain 


24 seconds 


24 seconds  
inv. 1 


24 seconds  
inv. 2 


24 thirds 


24 thirds  
inv. 1 


24 thirds  
inv. 2 


24 fourths 

24 fourths  
inv. 1 

24 fourths  
inv. 2 

24 fifths 

24 fifths  
inv. 1 

24 fifths  
inv. 2 

2

24 sus4

24 sus4  
inv. 1

24 sus4  
inv. 2

24 sus2

24 sus2  
inv. 1

24 sus2  
inv. 2

The image displays six musical staves, each representing a different chord and its inversions. The chords are: 24 sus4, 24 sus4 inv. 1, 24 sus4 inv. 2, 24 sus2, 24 sus2 inv. 1, and 24 sus2 inv. 2. Each staff is written in treble clef with a common time signature (C). The notes are represented by black dots on the staff lines, with sharp signs (#) indicating specific pitches. The progressions show how the notes of each chord move from one position to another, typically involving a stepwise motion of the upper voices and a more complex rearrangement of the lower voices to achieve the inversion.

## 44 Characterizing mode (2)25

## Mode (2)25

**(binary key: 0011001)**



2

25 sus4

25 sus4  
inv. 1

25 sus4  
inv. 2


25 sus2


25 sus2  
inv. 1


25 sus2  
inv. 2


## 45 Characterizing mode (2)26


### Mode (2)26 (binary key: 0011010)


26 plain 


26 seconds 

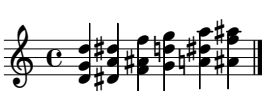
26 seconds  
inv. 1 


26 seconds  
inv. 2 


26 thirds 


26 thirds  
inv. 1 


26 thirds  
inv. 2 


26 fourths 

26 fourths  
inv. 1 

26 fourths  
inv. 2 

26 fifths 

26 fifths  
inv. 1 

26 fifths  
inv. 2 

2

26 sus4

26 sus4  
inv. 1

26 sus4  
inv. 2

26 sus2


26 sus2  
inv. 1


26 sus2  
inv. 2





## 46 Characterizing mode (2)27


### Mode (2)27 (binary key: 0011011)

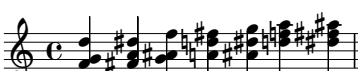
27 plain 


27 seconds 


27 seconds  
inv. 1 


27 seconds  
inv. 2 


27 thirds 


27 thirds  
inv. 1 


27 thirds  
inv. 2 


27 fourths 

27 fourths  
inv. 1 

27 fourths  
inv. 2 

27 fifths 

27 fifths  
inv. 1 

27 fifths  
inv. 2 

2

27 sus4

27 sus4  
inv. 1

27 sus4  
inv. 2


27 sus2


27 sus2  
inv. 1


27 sus2  
inv. 2


## 47 Characterizing mode (2)28


### Mode (2)28 (binary key: 0011100)


28 plain 


28 seconds 


28 seconds  
inv. 1 


28 seconds  
inv. 2 


28 thirds 


28 thirds  
inv. 1 


28 thirds  
inv. 2 


28 fourths 

28 fourths  
inv. 1 

28 fourths  
inv. 2 

28 fifths 

28 fifths  
inv. 1 

28 fifths  
inv. 2 

2

28 sus4

28 sus4  
inv. 1

28 sus4  
inv. 2


28 sus2


28 sus2  
inv. 1


28 sus2  
inv. 2


## 48 Characterizing mode (2)29


### Mode (2)29 (binary key: 0011101)


29 plain 


29 seconds 


29 seconds  
inv. 1 


29 seconds  
inv. 2 


29 thirds 


29 thirds  
inv. 1 


29 thirds  
inv. 2 


29 fourths 

29 fourths  
inv. 1 

29 fourths  
inv. 2 

29 fifths 

29 fifths  
inv. 1 

29 fifths  
inv. 2 

2

29 sus4

29 sus4  
inv. 1

29 sus4  
inv. 2

29 sus2


29 sus2  
inv. 1


29 sus2  
inv. 2


## 49 Characterizing mode (2)30


### Mode (2)30


(binary key: 00111110)


30 plain 


30 seconds 


30 seconds  
inv. 1 


30 seconds  
inv. 2 


30 thirds 

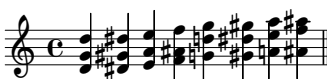
30 thirds  
inv. 1 


30 thirds  
inv. 2 


30 fourths 

30 fourths  
inv. 1 

30 fourths  
inv. 2 

30 fifths 

30 fifths  
inv. 1 

30 fifths  
inv. 2 

2

30 sus4

30 sus4  
inv. 1

30 sus4  
inv. 2

30 sus2

30 sus2  
inv. 1

30 sus2  
inv. 2



## 50 Characterizing mode (2)31

### Mode (2)31 (binary key: 0011111)

31 plain 

31 seconds 

31 seconds  
inv. 1 

31 seconds  
inv. 2 

31 thirds 

31 thirds  
inv. 1 

31 thirds  
inv. 2 

31 fourths 

31 fourths  
inv. 1 

31 fourths  
inv. 2 

31 fifths 

31 fifths  
inv. 1 

31 fifths  
inv. 2 

2

31 sus4

31 sus4  
inv. 1

31 sus4  
inv. 2

31 sus2

31 sus2  
inv. 1

31 sus2  
inv. 2

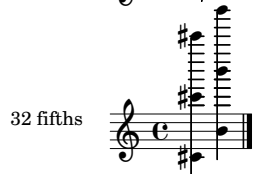
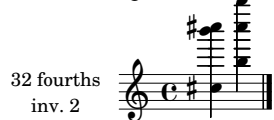
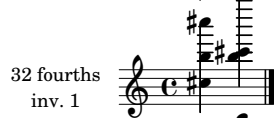
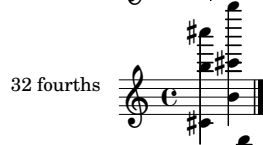
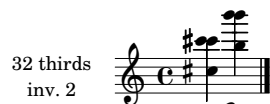
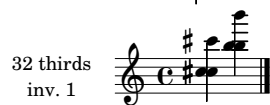
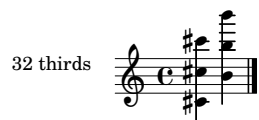
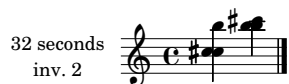
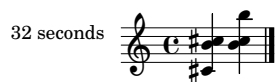
The image displays six musical staves, each representing a different voicing for a 31-note scale in C major. The staves are labeled as follows:

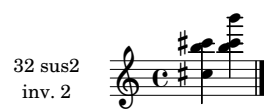
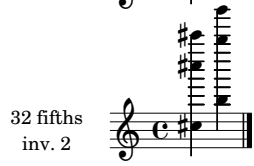
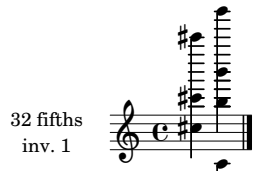
- Staff 1: 31 sus4
- Staff 2: 31 sus4 inv. 1
- Staff 3: 31 sus4 inv. 2
- Staff 4: 31 sus2
- Staff 5: 31 sus2 inv. 1
- Staff 6: 31 sus2 inv. 2

Each staff contains a sequence of chords, primarily triads and dyads, written in a style that suggests a specific voicing or fingering. The notation includes sharp signs for F# and C#.

## 51 Characterizing mode (2)32

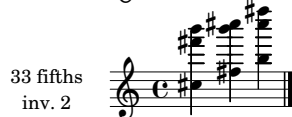
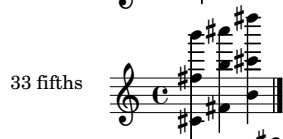
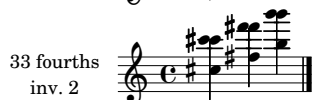
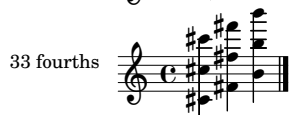
**Mode (2)32**  
(binary key: 0100000)



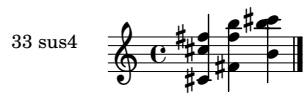


## 52 Characterizing mode (2)33

**Mode (2)33**  
(binary key: 0100001)



2



## 53 Characterizing mode (2)34

**Mode (2)34**  
(binary key: 0100010)



2

34 sus4

34 sus4  
inv. 1

34 sus4  
inv. 2

34 sus2

34 sus2  
inv. 1

34 sus2  
inv. 2



## 54 Characterizing mode (2)35

### Mode (2)35 (binary key: 0100011)


35 plain 

35 seconds 

35 seconds  
inv. 1 


35 seconds  
inv. 2 

35 thirds 


35 thirds  
inv. 1 

35 thirds  
inv. 2 

35 fourths 

35 fourths  
inv. 1 

35 fourths  
inv. 2 

35 fifths 

35 fifths  
inv. 1 

35 fifths  
inv. 2 

2

35 sus4

35 sus4  
inv. 1

35 sus4  
inv. 2

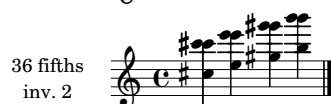
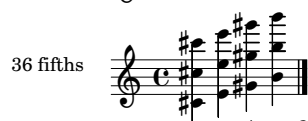
35 sus2

35 sus2  
inv. 1

35 sus2  
inv. 2

## 55 Characterizing mode (2)36

**Mode (2)36**  
(binary key: 0100100)



2

36 sus4

36 sus4  
inv. 1

36 sus4  
inv. 2

36 sus2


36 sus2  
inv. 1


36 sus2  
inv. 2


The image displays six musical staves, each representing a different chord progression in G major (one sharp). The staves are arranged vertically. The first staff is labeled '2' and shows a progression of four chords: G#m (two sharps), G#m (one sharp), G#m (two sharps), and G#m (one sharp). The second staff is labeled '36 sus4' and shows a progression of four chords: G#m (two sharps), G#m (one sharp), G#m (two sharps), and G#m (one sharp). The third staff is labeled '36 sus4 inv. 1' and shows a progression of four chords: G#m (two sharps), G#m (one sharp), G#m (two sharps), and G#m (one sharp). The fourth staff is labeled '36 sus4 inv. 2' and shows a progression of four chords: G#m (two sharps), G#m (one sharp), G#m (two sharps), and G#m (one sharp). The fifth staff is labeled '36 sus2' and shows a progression of four chords: G#m (two sharps), G#m (one sharp), G#m (two sharps), and G#m (one sharp). The sixth staff is labeled '36 sus2 inv. 1' and shows a progression of four chords: G#m (two sharps), G#m (one sharp), G#m (two sharps), and G#m (one sharp). The seventh staff is labeled '36 sus2 inv. 2' and shows a progression of four chords: G#m (two sharps), G#m (one sharp), G#m (two sharps), and G#m (one sharp).


## 56 Characterizing mode (2)37


### Mode (2)37 (binary key: 0100101)


37 plain 


37 seconds 


37 seconds  
inv. 1 


37 seconds  
inv. 2 


37 thirds 


37 thirds  
inv. 1 


37 thirds  
inv. 2 


37 fourths 

37 fourths  
inv. 1 

37 fourths  
inv. 2 

37 fifths 

37 fifths  
inv. 1 

37 fifths  
inv. 2 

2

37 sus4

37 sus4  
inv. 1

37 sus4  
inv. 2


37 sus2


37 sus2  
inv. 1


37 sus2  
inv. 2


## 57 Characterizing mode (2)38


### Mode (2)38 (binary key: 0100110)


38 plain 


38 seconds 


38 seconds  
inv. 1 

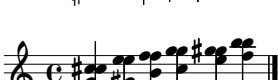
38 seconds  
inv. 2 


38 thirds 


38 thirds  
inv. 1 


38 thirds  
inv. 2 


38 fourths 

38 fourths  
inv. 1 

38 fourths  
inv. 2 

38 fifths 

38 fifths  
inv. 1 

38 fifths  
inv. 2 

2

38 sus4

38 sus4  
inv. 1

38 sus4  
inv. 2

38 sus2


38 sus2  
inv. 1


38 sus2  
inv. 2





## 58 Characterizing mode (2)39


### Mode (2)39 (binary key: 0100111)


39 plain 


39 seconds 


39 seconds  
inv. 1 


39 seconds  
inv. 2 


39 thirds 


39 thirds  
inv. 1 


39 thirds  
inv. 2 


39 fourths 

39 fourths  
inv. 1 

39 fourths  
inv. 2 

39 fifths 

39 fifths  
inv. 1 

39 fifths  
inv. 2 

2

39 sus4



39 sus4

inv. 1



39 sus4

inv. 2



39 sus2



39 sus2

inv. 1




39 sus2

inv. 2





## 59 Characterizing mode (2)40

### Mode (2)40 (binary key: 0101000)


40 plain 


40 seconds 


40 seconds  
inv. 1 

40 seconds  
inv. 2 


40 thirds 

40 thirds  
inv. 1 

40 thirds  
inv. 2 


40 fourths 

40 fourths  
inv. 1 

40 fourths  
inv. 2 

40 fifths 

40 fifths  
inv. 1 

40 fifths  
inv. 2 

2

40 sus4

40 sus4  
inv. 1

40 sus4  
inv. 2


40 sus2


40 sus2  
inv. 1


40 sus2  
inv. 2


## 60 Characterizing mode (2)41


### Mode (2)41 (binary key: 0101001)


41 plain 


41 seconds 


41 seconds  
inv. 1 


41 seconds  
inv. 2 


41 thirds 


41 thirds  
inv. 1 


41 thirds  
inv. 2 


41 fourths 

41 fourths  
inv. 1 

41 fourths  
inv. 2 

41 fifths 

41 fifths  
inv. 1 

41 fifths  
inv. 2 

2

41 sus4

41 sus4  
inv. 1

41 sus4  
inv. 2

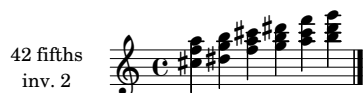
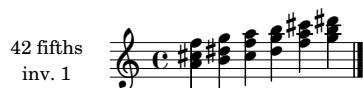
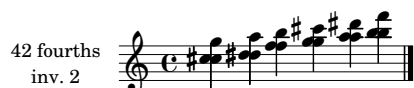
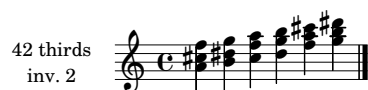
41 sus2

41 sus2  
inv. 1

41 sus2  
inv. 2

## 61 Characterizing mode (2)42

### Mode (2)42 (binary key: 0101010)



2  
42 sus4

42 sus4  
inv. 1

42 sus4  
inv. 2

42 sus2


42 sus2  
inv. 1


42 sus2  
inv. 2





## 62 Characterizing mode (2)43


### Mode (2)43 (binary key: 0101011)


43 plain 


43 seconds 


43 seconds  
inv. 1 


43 seconds  
inv. 2 


43 thirds 


43 thirds  
inv. 1 


43 thirds  
inv. 2 


43 fourths 

43 fourths  
inv. 1 

43 fourths  
inv. 2 

43 fifths 

43 fifths  
inv. 1 

43 fifths  
inv. 2 

2

43 sus4

43 sus4  
inv. 1

43 sus4  
inv. 2


43 sus2


43 sus2  
inv. 1


43 sus2  
inv. 2


## 63 Characterizing mode (2)44


### Mode (2)44 (binary key: 0101100)


44 plain 


44 seconds 


44 seconds  
inv. 1 


44 seconds  
inv. 2 


44 thirds 


44 thirds  
inv. 1 


44 thirds  
inv. 2 


44 fourths 

44 fourths  
inv. 1 

44 fourths  
inv. 2 

44 fifths 

44 fifths  
inv. 1 

44 fifths  
inv. 2 

2

44 sus4

44 sus4  
inv. 1

44 sus4  
inv. 2


44 sus2


44 sus2  
inv. 1


44 sus2  
inv. 2


## 64 Characterizing mode (2)45


### Mode (2)45 (binary key: 0101101)


45 plain 


45 seconds 


45 seconds  
inv. 1 


45 seconds  
inv. 2 


45 thirds 


45 thirds  
inv. 1 


45 thirds  
inv. 2 


45 fourths 

45 fourths  
inv. 1 

45 fourths  
inv. 2 

45 fifths 

45 fifths  
inv. 1 

45 fifths  
inv. 2 

2

45 sus4

45 sus4  
inv. 1

45 sus4  
inv. 2

45 sus2

45 sus2  
inv. 1


45 sus2  
inv. 2


The image displays six musical staves, each representing a different voicing of a 45 sus4 or 45 sus2 chord in C# major. The key signature has two sharps (F# and C#). The time signature is common time (C). The staves are arranged vertically, with the first staff labeled '2' above it. The labels to the left of each staff are: '45 sus4', '45 sus4 inv. 1', '45 sus4 inv. 2', '45 sus2', '45 sus2 inv. 1', and '45 sus2 inv. 2'. The first staff shows a 45 sus4 voicing with notes F#4, C#5, G#4, and D#4. The second and third staves show inversions of 45 sus4. The fourth staff shows a 45 sus2 voicing with notes F#4, C#5, G#4, and D#3. The fifth and sixth staves show inversions of 45 sus2.


## 65 Characterizing mode (2)46


### Mode (2)46


(binary key: 0101110)


46 plain 


46 seconds 


46 seconds  
inv. 1 


46 seconds  
inv. 2 


46 thirds 


46 thirds  
inv. 1 


46 thirds  
inv. 2 


46 fourths 

46 fourths  
inv. 1 

46 fourths  
inv. 2 

46 fifths 

46 fifths  
inv. 1 

46 fifths  
inv. 2 

2

46 sus4

46 sus4  
inv. 1

46 sus4  
inv. 2

46 sus2


46 sus2  
inv. 1


46 sus2  
inv. 2





## 66 Characterizing mode (2)47


### Mode (2)47 (binary key: 0101111)


47 plain 


47 seconds 


47 seconds inv. 1 


47 seconds inv. 2 


47 thirds 


47 thirds inv. 1 


47 thirds inv. 2 


47 fourths 

47 fourths inv. 1 

47 fourths inv. 2 

47 fifths 

47 fifths inv. 1 

47 fifths inv. 2 

2

47 sus4

47 sus4  
inv. 1

47 sus4  
inv. 2

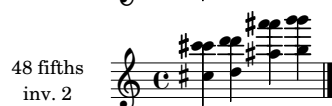
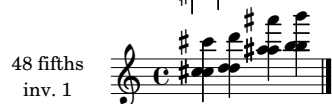
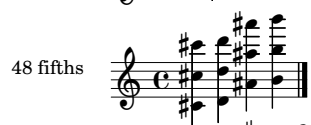
47 sus2

47 sus2  
inv. 1

47 sus2  
inv. 2

## 67 Characterizing mode (2)48

### Mode (2)48 (binary key: 0110000)



2  
48 sus4

48 sus4  
inv. 1

48 sus4  
inv. 2


48 sus2


48 sus2  
inv. 1


48 sus2  
inv. 2


## 68 Characterizing mode (2)49


### Mode (2)49 (binary key: 0110001)


49 plain 


49 seconds 


49 seconds  
inv. 1 


49 seconds  
inv. 2 


49 thirds 


49 thirds  
inv. 1 


49 thirds  
inv. 2 


49 fourths 

49 fourths  
inv. 1 

49 fourths  
inv. 2 

49 fifths 

49 fifths  
inv. 1 

49 fifths  
inv. 2 

2

49 sus4

49 sus4  
inv. 1

49 sus4  
inv. 2


49 sus2


49 sus2  
inv. 1


49 sus2  
inv. 2


## 69 Characterizing mode (2)50


### Mode (2)50 (binary key: 0110010)


50 plain 


50 seconds 


50 seconds  
inv. 1 


50 seconds  
inv. 2 


50 thirds 


50 thirds  
inv. 1 


50 thirds  
inv. 2 


50 fourths 

50 fourths  
inv. 1 

50 fourths  
inv. 2 

50 fifths 

50 fifths  
inv. 1 

50 fifths  
inv. 2 

2

50 sus4

50 sus4  
inv. 1

50 sus4  
inv. 2

50 sus2


50 sus2  
inv. 1


50 sus2  
inv. 2





## 70 Characterizing mode (2)51


### Mode (2)51 (binary key: 0110011)

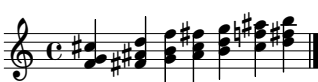
51 plain 


51 seconds 


51 seconds  
inv. 1 


51 seconds  
inv. 2 


51 thirds 


51 thirds  
inv. 1 


51 thirds  
inv. 2 


51 fourths 

51 fourths  
inv. 1 

51 fourths  
inv. 2 

51 fifths 

51 fifths  
inv. 1 

51 fifths  
inv. 2 

2

51 sus4

51 sus4  
inv. 1

51 sus4  
inv. 2


51 sus2


51 sus2  
inv. 1


51 sus2  
inv. 2


## 71 Characterizing mode (2)52


### Mode (2)52 (binary key: 0110100)


52 plain 


52 seconds 


52 seconds  
inv. 1 


52 seconds  
inv. 2 


52 thirds 


52 thirds  
inv. 1 


52 thirds  
inv. 2 


52 fourths 

52 fourths  
inv. 1 

52 fourths  
inv. 2 

52 fifths 

52 fifths  
inv. 1 

52 fifths  
inv. 2 

2

52 sus4

52 sus4  
inv. 1

52 sus4  
inv. 2

52 sus2


52 sus2  
inv. 1


52 sus2  
inv. 2


## 72 Characterizing mode (2)53


### Mode (2)53


(binary key: 0110101)


53 plain 


53 seconds 


53 seconds  
inv. 1 


53 seconds  
inv. 2 


53 thirds 


53 thirds  
inv. 1 

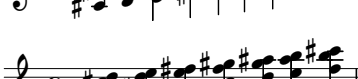
53 thirds  
inv. 2 


53 fourths 

53 fourths  
inv. 1 

53 fourths  
inv. 2 

53 fifths 

53 fifths  
inv. 1 

53 fifths  
inv. 2 

2

53 sus4

53 sus4  
inv. 1

53 sus4  
inv. 2


53 sus2


53 sus2  
inv. 1


53 sus2  
inv. 2


## 73 Characterizing mode (2)54


### Mode (2)54 (binary key: 0110110)


54 plain 


54 seconds 


54 seconds  
inv. 1 


54 seconds  
inv. 2 


54 thirds 


54 thirds  
inv. 1 


54 thirds  
inv. 2 


54 fourths 

54 fourths  
inv. 1 

54 fourths  
inv. 2 

54 fifths 

54 fifths  
inv. 1 

54 fifths  
inv. 2 

2

54 sus4

54 sus4  
inv. 1

54 sus4  
inv. 2

54 sus2

54 sus2  
inv. 1

54 sus2  
inv. 2

The image displays six musical staves, each representing a different chord voicing for a 54-degree interval. The staves are arranged vertically and are all in treble clef with a common time signature (C). The notes are written in a way that shows the interval between the root and the fifth, which is 54 degrees. The staves are labeled as follows:

- Staff 1: 54 sus4
- Staff 2: 54 sus4 inv. 1
- Staff 3: 54 sus4 inv. 2
- Staff 4: 54 sus2
- Staff 5: 54 sus2 inv. 1
- Staff 6: 54 sus2 inv. 2


The notes are written in a way that shows the interval between the root and the fifth, which is 54 degrees. The staves are labeled as follows:





## 74 Characterizing mode (2)55


### Mode (2)55


(binary key: 0110111)

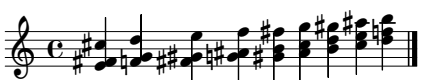
55 plain 


55 seconds 


55 seconds inv. 1 


55 seconds inv. 2 


55 thirds 


55 thirds inv. 1 


55 thirds inv. 2 


55 fourths 

55 fourths inv. 1 

55 fourths inv. 2 

55 fifths 

55 fifths inv. 1 

55 fifths inv. 2 

2

55 sus4

55 sus4  
inv. 1

55 sus4  
inv. 2


55 sus2


55 sus2  
inv. 1


55 sus2  
inv. 2


## 75 Characterizing mode (2)56


### Mode (2)56 (binary key: 0111000)


56 plain 


56 seconds 


56 seconds  
inv. 1 


56 seconds  
inv. 2 

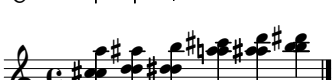
56 thirds 


56 thirds  
inv. 1 


56 thirds  
inv. 2 


56 fourths 

56 fourths  
inv. 1 

56 fourths  
inv. 2 

56 fifths 

56 fifths  
inv. 1 

56 fifths  
inv. 2 

2

56 sus4

56 sus4  
inv. 1

56 sus4  
inv. 2


56 sus2


56 sus2  
inv. 1


56 sus2  
inv. 2


## 76 Characterizing mode (2)57


### Mode (2)57 (binary key: 0111001)


57 plain 


57 seconds 


57 seconds  
inv. 1 


57 seconds  
inv. 2 

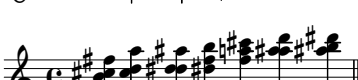
57 thirds 


57 thirds  
inv. 1 


57 thirds  
inv. 2 


57 fourths 

57 fourths  
inv. 1 

57 fourths  
inv. 2 

57 fifths 

57 fifths  
inv. 1 

57 fifths  
inv. 2 

2

57 sus4

57 sus4  
inv. 1

57 sus4  
inv. 2

57 sus2


57 sus2  
inv. 1


57 sus2  
inv. 2


## 77 Characterizing mode (2)58


### Mode (2)58


(binary key: 0111010)


58 plain 


58 seconds 


58 seconds  
inv. 1 


58 seconds  
inv. 2 

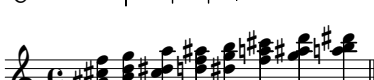
58 thirds 


58 thirds  
inv. 1 

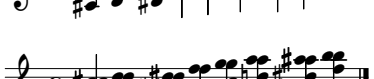
58 thirds  
inv. 2 


58 fourths 

58 fourths  
inv. 1 

58 fourths  
inv. 2 

58 fifths 

58 fifths  
inv. 1 

58 fifths  
inv. 2 

2

58 sus4

58 sus4  
inv. 1

58 sus4  
inv. 2

58 sus2

58 sus2  
inv. 1


58 sus2  
inv. 2





## 78 Characterizing mode (2)59


### Mode (2)59


(binary key: 0111011)


59 plain 


59 seconds 


59 seconds  
inv. 1 


59 seconds  
inv. 2 

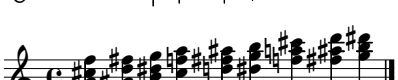
59 thirds 


59 thirds  
inv. 1 


59 thirds  
inv. 2 


59 fourths 

59 fourths  
inv. 1 

59 fourths  
inv. 2 

59 fifths 

59 fifths  
inv. 1 

59 fifths  
inv. 2 

2

59 sus4

59 sus4  
inv. 1

59 sus4  
inv. 2

59 sus2


59 sus2  
inv. 1


59 sus2  
inv. 2


## 79 Characterizing mode (2)60


### Mode (2)60


(binary key: 0111100)


60 plain 


60 seconds 


60 seconds inv. 1 


60 seconds inv. 2 


60 thirds 

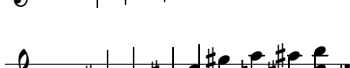
60 thirds inv. 1 

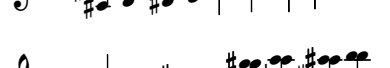
60 thirds inv. 2 


60 fourths 

60 fourths inv. 1 

60 fourths inv. 2 

60 fifths 

60 fifths inv. 1 

60 fifths inv. 2 

2

60 sus4

60 sus4  
inv. 1

60 sus4  
inv. 2


60 sus2


60 sus2  
inv. 1


60 sus2  
inv. 2


## 80 Characterizing mode (2)61


### Mode (2)61 (binary key: 0111101)


61 plain 


61 seconds 


61 seconds  
inv. 1 


61 seconds  
inv. 2 


61 thirds 


61 thirds  
inv. 1 


61 thirds  
inv. 2 


61 fourths 

61 fourths  
inv. 1 

61 fourths  
inv. 2 

61 fifths 

61 fifths  
inv. 1 

61 fifths  
inv. 2 

2

61 sus4

61 sus4  
inv. 1

61 sus4  
inv. 2

61 sus2

61 sus2  
inv. 1

61 sus2  
inv. 2

## 81 Characterizing mode (2)62

### Mode (2)62 (binary key: 0111110)


62 plain



62 seconds



62 seconds  
inv. 1




62 seconds  
inv. 2




62 thirds




62 thirds  
inv. 1



62 thirds  
inv. 2



62 fourths



62 fourths  
inv. 1



62 fourths  
inv. 2



62 fifths



62 fifths  
inv. 1



62 fifths  
inv. 2



2

62 sus4

62 sus4  
inv. 1

62 sus4  
inv. 2

62 sus2


62 sus2  
inv. 1

62 sus2  
inv. 2



## 82 Characterizing mode (2)63

### Mode (2)63 (binary key: 0111111)

63 plain 

63 seconds 

63 seconds inv. 1 


63 seconds inv. 2 

63 thirds 

63 thirds inv. 1 

63 thirds inv. 2 


63 fourths 

63 fourths inv. 1 

63 fourths inv. 2 

63 fifths 

63 fifths inv. 1 

63 fifths inv. 2 

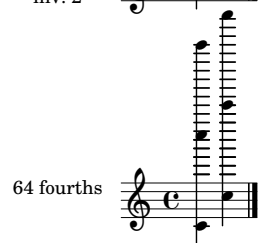
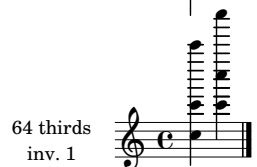
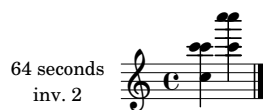
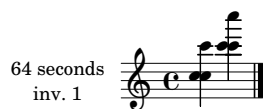
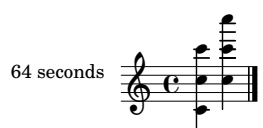
2

63 sus4



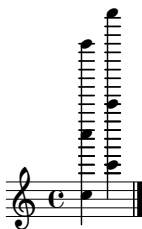
## 83 Characterizing mode (2)64

**Mode (2)64**  
(binary key: 1000000)

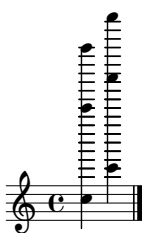


2

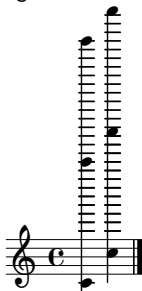
64 fourths  
inv. 1



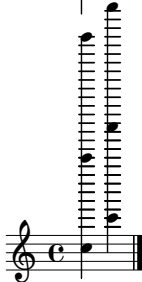
64 fourths  
inv. 2



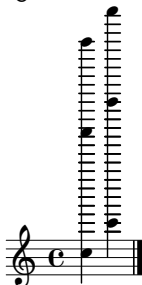
64 fifths

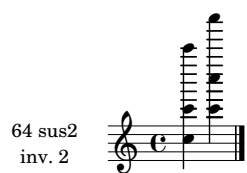
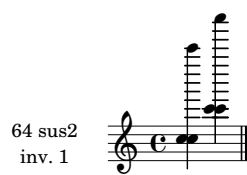
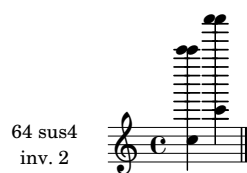
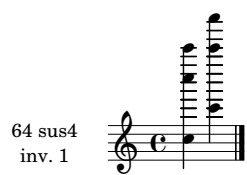


64 fifths  
inv. 1




64 fifths  
inv. 2








## 84 Characterizing mode (2)65


### Mode (2)65 (binary key: 1000001)


65 plain 


65 seconds 


65 seconds  
inv. 1 


65 seconds  
inv. 2 


65 thirds 


65 thirds  
inv. 1 

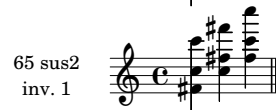
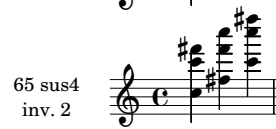
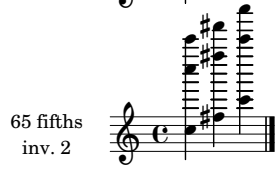
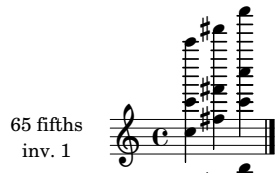
65 thirds  
inv. 2 

65 fourths 

65 fourths  
inv. 1 

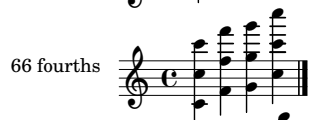
65 fourths  
inv. 2 

65 fifths 



## 85 Characterizing mode (2)66

**Mode (2)66**  
(binary key: 1000010)







2





## 86 Characterizing mode (2)67


### Mode (2)67 (binary key: 1000011)


67 plain 


67 seconds 


67 seconds  
inv. 1 


67 seconds  
inv. 2 


67 thirds 


67 thirds  
inv. 1 


67 thirds  
inv. 2 


67 fourths 

67 fourths  
inv. 1 

67 fourths  
inv. 2 

67 fifths 

67 fifths  
inv. 1 

67 fifths  
inv. 2 

2

67 sus4

67 sus4  
inv. 1

67 sus4  
inv. 2

67 sus2

67 sus2  
inv. 1

67 sus2  
inv. 2

## 87 Characterizing mode (2)68

**Mode (2)68**  
(binary key: 1000100)





2





## 88 Characterizing mode (2)69


**Mode (2)69**  
(binary key: 1000101)


69 plain 


69 seconds 


69 seconds  
inv. 1 


69 seconds  
inv. 2 


69 thirds 


69 thirds  
inv. 1 

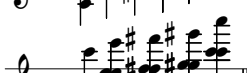
69 thirds  
inv. 2 


69 fourths 

69 fourths  
inv. 1 

69 fourths  
inv. 2 

69 fifths 

69 fifths  
inv. 1 

69 fifths  
inv. 2 

2

69 sus4

69 sus4  
inv. 1

69 sus4  
inv. 2


69 sus2


69 sus2  
inv. 1


69 sus2  
inv. 2


## 89 Characterizing mode (2)70


### Mode (2)70 (binary key: 1000110)

70 plain 


70 seconds 


70 seconds  
inv. 1 


70 seconds  
inv. 2 


70 thirds 


70 thirds  
inv. 1 


70 thirds  
inv. 2 


70 fourths 

70 fourths  
inv. 1 

70 fourths  
inv. 2 

70 fifths 

70 fifths  
inv. 1 

70 fifths  
inv. 2 



2

70 sus4

70 sus4  
inv. 1

70 sus4  
inv. 2


70 sus2


70 sus2  
inv. 1


70 sus2  
inv. 2


## 90 Characterizing mode (2)71


### Mode (2)71 (binary key: 1000111)


71 plain 


71 seconds 


71 seconds  
inv. 1 


71 seconds  
inv. 2 


71 thirds 


71 thirds  
inv. 1 


71 thirds  
inv. 2 


71 fourths 

71 fourths  
inv. 1 

71 fourths  
inv. 2 

71 fifths 

71 fifths  
inv. 1 

71 fifths  
inv. 2 

2

71 sus4

71 sus4  
inv. 1

71 sus4  
inv. 2

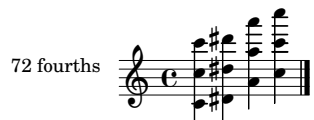
71 sus2

71 sus2  
inv. 1

71 sus2  
inv. 2

## 91 Characterizing mode (2)72

**Mode (2)72**  
(binary key: 1001000)



2

72 fifths  
inv. 2

A musical staff in treble clef with a common time signature 'C'. It contains a sequence of notes: G4, A4, B4, C5, D5, E5, F5, G5, A5, B5, C6, D6, E6, F6, G6, A6, B6, C7, D7, E7, F7, G7, A7, B7, C8, D8, E8, F8, G8, A8, B8, C9, D9, E9, F9, G9, A9, B9, C10, D10, E10, F10, G10, A10, B10, C11, D11, E11, F11, G11, A11, B11, C12, D12, E12, F12, G12, A12, B12, C13, D13, E13, F13, G13, A13, B13, C14, D14, E14, F14, G14, A14, B14, C15, D15, E15, F15, G15, A15, B15, C16, D16, E16, F16, G16, A16, B16, C17, D17, E17, F17, G17, A17, B17, C18, D18, E18, F18, G18, A18, B18, C19, D19, E19, F19, G19, A19, B19, C20, D20, E20, F20, G20, A20, B20, C21, D21, E21, F21, G21, A21, B21, C22, D22, E22, F22, G22, A22, B22, C23, D23, E23, F23, G23, A23, B23, C24, D24, E24, F24, G24, A24, B24, C25, D25, E25, F25, G25, A25, B25, C26, D26, E26, F26, G26, A26, B26, C27, D27, E27, F27, G27, A27, B27, C28, D28, E28, F28, G28, A28, B28, C29, D29, E29, F29, G29, A29, B29, C30, D30, E30, F30, G30, A30, B30, C31, D31, E31, F31, G31, A31, B31, C32, D32, E32, F32, G32, A32, B32, C33, D33, E33, F33, G33, A33, B33, C34, D34, E34, F34, G34, A34, B34, C35, D35, E35, F35, G35, A35, B35, C36, D36, E36, F36, G36, A36, B36, C37, D37, E37, F37, G37, A37, B37, C38, D38, E38, F38, G38, A38, B38, C39, D39, E39, F39, G39, A39, B39, C40, D40, E40, F40, G40, A40, B40, C41, D41, E41, F41, G41, A41, B41, C42, D42, E42, F42, G42, A42, B42, C43, D43, E43, F43, G43, A43, B43, C44, D44, E44, F44, G44, A44, B44, C45, D45, E45, F45, G45, A45, B45, C46, D46, E46, F46, G46, A46, B46, C47, D47, E47, F47, G47, A47, B47, C48, D48, E48, F48, G48, A48, B48, C49, D49, E49, F49, G49, A49, B49, C50, D50, E50, F50, G50, A50, B50, C51, D51, E51, F51, G51, A51, B51, C52, D52, E52, F52, G52, A52, B52, C53, D53, E53, F53, G53, A53, B53, C54, D54, E54, F54, G54, A54, B54, C55, D55, E55, F55, G55, A55, B55, C56, D56, E56, F56, G56, A56, B56, C57, D57, E57, F57, G57, A57, B57, C58, D58, E58, F58, G58, A58, B58, C59, D59, E59, F59, G59, A59, B59, C60, D60, E60, F60, G60, A60, B60, C61, D61, E61, F61, G61, A61, B61, C62, D62, E62, F62, G62, A62, B62, C63, D63, E63, F63, G63, A63, B63, C64, D64, E64, F64, G64, A64, B64, C65, D65, E65, F65, G65, A65, B65, C66, D66, E66, F66, G66, A66, B66, C67, D67, E67, F67, G67, A67, B67, C68, D68, E68, F68, G68, A68, B68, C69, D69, E69, F69, G69, A69, B69, C70, D70, E70, F70, G70, A70, B70, C71, D71, E71, F71, G71, A71, B71, C72, D72, E72, F72, G72, A72, B72, C73, D73, E73, F73, G73, A73, B73, C74, D74, E74, F74, G74, A74, B74, C75, D75, E75, F75, G75, A75, B75, C76, D76, E76, F76, G76, A76, B76, C77, D77, E77, F77, G77, A77, B77, C78, D78, E78, F78, G78, A78, B78, C79, D79, E79, F79, G79, A79, B79, C80, D80, E80, F80, G80, A80, B80, C81, D81, E81, F81, G81, A81, B81, C82, D82, E82, F82, G82, A82, B82, C83, D83, E83, F83, G83, A83, B83, C84, D84, E84, F84, G84, A84, B84, C85, D85, E85, F85, G85, A85, B85, C86, D86, E86, F86, G86, A86, B86, C87, D87, E87, F87, G87, A87, B87, C88, D88, E88, F88, G88, A88, B88, C89, D89, E89, F89, G89, A89, B89, C90, D90, E90, F90, G90, A90, B90, C91, D91, E91, F91, G91, A91, B91, C92, D92, E92, F92, G92, A92, B92, C93, D93, E93, F93, G93, A93, B93, C94, D94, E94, F94, G94, A94, B94, C95, D95, E95, F95, G95, A95, B95, C96, D96, E96, F96, G96, A96, B96, C97, D97, E97, F97, G97, A97, B97, C98, D98, E98, F98, G98, A98, B98, C99, D99, E99, F99, G99, A99, B99, C100, D100, E100, F100, G100, A100, B100, C101, D101, E101, F101, G101, A101, B101, C102, D102, E102, F102, G102, A102, B102, C103, D103, E103, F103, G103, A103, B103, C104, D104, E104, F104, G104, A104, B104, C105, D105, E105, F105, G105, A105, B105, C106, D106, E106, F106, G106, A106, B106, C107, D107, E107, F107, G107, A107, B107, C108, D108, E108, F108, G108, A108, B108, C109, D109, E109, F109, G109, A109, B109, C110, D110, E110, F110, G110, A110, B110, C111, D111, E111, F111, G111, A111, B111, C112, D112, E112, F112, G112, A112, B112, C113, D113, E113, F113, G113, A113, B113, C114, D114, E114, F114, G114, A114, B114, C115, D115, E115, F115, G115, A115, B115, C116, D116, E116, F116, G116, A116, B116, C117, D117, E117, F117, G117, A117, B117, C118, D118, E118, F118, G118, A118, B118, C119, D119, E119, F119, G119, A119, B119, C120, D120, E120, F120, G120, A120, B120, C121, D121, E121, F121, G121, A121, B121, C122, D122, E122, F122, G122, A122, B122, C123, D123, E123, F123, G123, A123, B123, C124, D124, E124, F124, G124, A124, B124, C125, D125, E125, F125, G125, A125, B125, C126, D126, E126, F126, G126, A126, B126, C127, D127, E127, F127, G127, A127, B127, C128, D128, E128, F128, G128, A128, B128, C129, D129, E129, F129, G129, A129, B129, C130, D130, E130, F130, G130, A130, B130, C131, D131, E131, F131, G131, A131, B131, C132, D132, E132, F132, G132, A132, B132, C133, D133, E133, F133, G133, A133, B133, C134, D134, E134, F134, G134, A134, B134, C135, D135, E135, F135, G135, A135, B135, C136, D136, E136, F136, G136, A136, B136, C137, D137, E137, F137, G137, A137, B137, C138, D138, E138, F138, G138, A138, B138, C139, D139, E139, F139, G

72 sus4



72 sus4  
inv. 1



72 sus4  
inv. 2




72 sus2 


[illegible]

72 sus2  
inv. 2

## 92 Characterizing mode (2)73

### Mode (2)73 (binary key: 1001001)

73 plain 

73 seconds 

73 seconds  
inv. 1 

73 seconds  
inv. 2 

73 thirds 

73 thirds  
inv. 1 

73 thirds  
inv. 2 


73 fourths 

73 fourths  
inv. 1 

73 fourths  
inv. 2 

73 fifths 

73 fifths  
inv. 1 

73 fifths  
inv. 2 

2

73 sus4

73 sus4  
inv. 1

73 sus4  
inv. 2


73 sus2


73 sus2  
inv. 1


73 sus2  
inv. 2


## 93 Characterizing mode (2)74


### Mode (2)74 (binary key: 1001010)


74 plain 


74 seconds 


74 seconds  
inv. 1 


74 seconds  
inv. 2 


74 thirds 


74 thirds  
inv. 1 


74 thirds  
inv. 2 


74 fourths 

74 fourths  
inv. 1 

74 fourths  
inv. 2 

74 fifths 

74 fifths  
inv. 1 

74 fifths  
inv. 2 



2

74 sus4

74 sus4  
inv. 1

74 sus4  
inv. 2


74 sus2


74 sus2  
inv. 1


74 sus2  
inv. 2


## 94 Characterizing mode (2)75


### Mode (2)75 (binary key: 1001011)

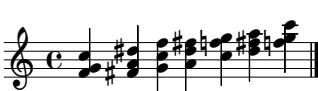
75 plain 


75 seconds 


75 seconds  
inv. 1 


75 seconds  
inv. 2 


75 thirds 


75 thirds  
inv. 1 


75 thirds  
inv. 2 


75 fourths 

75 fourths  
inv. 1 

75 fourths  
inv. 2 

75 fifths 

75 fifths  
inv. 1 

75 fifths  
inv. 2 

2

75 sus4



75 sus4

inv. 1

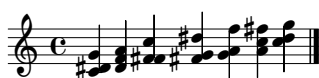


75 sus4

inv. 2



75 sus2



75 sus2

inv. 1




75 sus2


inv. 2





## 95 Characterizing mode (2)76


### Mode (2)76 (binary key: 1001100)


76 plain 


76 seconds 


76 seconds  
inv. 1 


76 seconds  
inv. 2 


76 thirds 


76 thirds  
inv. 1 

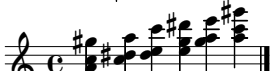
76 thirds  
inv. 2 


76 fourths 

76 fourths  
inv. 1 

76 fourths  
inv. 2 

76 fifths 

76 fifths  
inv. 1 

76 fifths  
inv. 2 

2

76 sus4

76 sus4  
inv. 1

76 sus4  
inv. 2


76 sus2


76 sus2  
inv. 1


76 sus2  
inv. 2


## 96 Characterizing mode (2)77


### Mode (2)77 (binary key: 1001101)


77 plain 


77 seconds 


77 seconds  
inv. 1 


77 seconds  
inv. 2 


77 thirds 


77 thirds  
inv. 1 


77 thirds  
inv. 2 


77 fourths 

77 fourths  
inv. 1 

77 fourths  
inv. 2 

77 fifths 

77 fifths  
inv. 1 

77 fifths  
inv. 2 


2





## 97 Characterizing mode (2)78


### Mode (2)78


(binary key: 1001110)


78 plain 


78 seconds 


78 seconds  
inv. 1 


78 seconds  
inv. 2 


78 thirds 


78 thirds  
inv. 1 


78 thirds  
inv. 2 


78 fourths 

78 fourths  
inv. 1 

78 fourths  
inv. 2 

78 fifths 

78 fifths  
inv. 1 

78 fifths  
inv. 2 



2

78 sus4

78 sus4  
inv. 1

78 sus4  
inv. 2

78 sus2


78 sus2  
inv. 1


78 sus2  
inv. 2


The image displays six musical staves, each representing a different voicing of a 78sus4 or 78sus2 chord. The first staff shows a 78sus4 chord in its basic form. The second and third staves show the first and second inversions of the 78sus4 chord, respectively. The fourth staff shows a 78sus2 chord in its basic form. The fifth and sixth staves show the first and second inversions of the 78sus2 chord, respectively. All staves are in C major and 4/4 time.


## 98 Characterizing mode (2)79


### Mode (2)79 (binary key: 1001111)


79 plain 


79 seconds 


79 seconds  
inv. 1 


79 seconds  
inv. 2 


79 thirds 


79 thirds  
inv. 1 


79 thirds  
inv. 2 


79 fourths 

79 fourths  
inv. 1 

79 fourths  
inv. 2 

79 fifths 

79 fifths  
inv. 1 

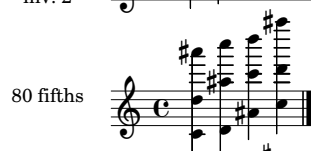
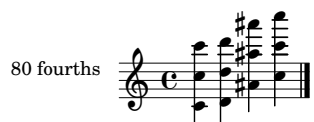
79 fifths  
inv. 2 

2



## 99 Characterizing mode (2)80

**Mode (2)80**  
(binary key: 1010000)





2





## 100 Characterizing mode (2)81


### Mode (2)81 (binary key: 1010001)


81 plain 


81 seconds 


81 seconds  
inv. 1 


81 seconds  
inv. 2 


81 thirds 


81 thirds  
inv. 1 


81 thirds  
inv. 2 


81 fourths 

81 fourths  
inv. 1 

81 fourths  
inv. 2 

81 fifths 

81 fifths  
inv. 1 

81 fifths  
inv. 2 

2

81 sus4

81 sus4  
inv. 1

81 sus4  
inv. 2


81 sus2


81 sus2  
inv. 1


81 sus2  
inv. 2


## 101 Characterizing mode (2)82


### Mode (2)82 (binary key: 1010010)


82 plain 


82 seconds 


82 seconds  
inv. 1 


82 seconds  
inv. 2 

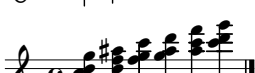
82 thirds 


82 thirds  
inv. 1 

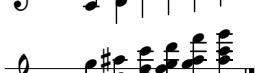
82 thirds  
inv. 2 

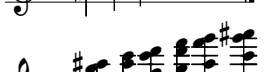
82 fourths 

82 fourths  
inv. 1 

82 fourths  
inv. 2 

82 fifths 

82 fifths  
inv. 1 

82 fifths  
inv. 2 



2

82 sus4

82 sus4  
inv. 1

82 sus4  
inv. 2


82 sus2


82 sus2  
inv. 1


82 sus2  
inv. 2


## 102 Characterizing mode (2)83


### Mode (2)83 (binary key: 1010011)


83 plain 


83 seconds 


83 seconds  
inv. 1 


83 seconds  
inv. 2 


83 thirds 


83 thirds  
inv. 1 


83 thirds  
inv. 2 


83 fourths 


83 fourths  
inv. 1 

83 fourths  
inv. 2 

83 fifths 

83 fifths  
inv. 1 

83 fifths  
inv. 2 

83 sus4 

2

83 sus4  
inv. 1

83 sus4  
inv. 2


83 sus2

83 sus2  
inv. 1


83 sus2  
inv. 2


## 103 Characterizing mode (2)84


### Mode (2)84 (binary key: 1010100)


84 plain 

84 seconds 


84 seconds  
inv. 1 


84 seconds  
inv. 2 


84 thirds 


84 thirds  
inv. 1 


84 thirds  
inv. 2 


84 fourths 

84 fourths  
inv. 1 

84 fourths  
inv. 2 

84 fifths 

84 fifths  
inv. 1 


84 fifths  
inv. 2 


2





## 104 Characterizing mode (2)85


### Mode (2)85 (binary key: 1010101)


85 plain 


85 seconds 


85 seconds inv. 1 


85 seconds inv. 2 


85 thirds 


85 thirds inv. 1 


85 thirds inv. 2 


85 fourths 

85 fourths inv. 1 

85 fourths inv. 2 

85 fifths 

85 fifths inv. 1 

85 fifths inv. 2 

2

85 sus4

85 sus4  
inv. 1

85 sus4  
inv. 2

85 sus2


85 sus2  
inv. 1


85 sus2  
inv. 2


## 105 Characterizing mode (2)86


### Mode (2)86


(binary key: 1010110)


86 plain 


86 seconds 


86 seconds inv. 1 


86 seconds inv. 2 


86 thirds 


86 thirds inv. 1 


86 thirds inv. 2 


86 fourths 

86 fourths inv. 1 

86 fourths inv. 2 

86 fifths 

86 fifths inv. 1 

86 fifths inv. 2 



2

86 sus4

86 sus4  
inv. 1

86 sus4  
inv. 2


86 sus2


86 sus2  
inv. 1


86 sus2  
inv. 2


## 106 Characterizing mode (2)87


### Mode (2)87 (binary key: 1010111)


87 plain 


87 seconds 


87 seconds inv. 1 


87 seconds inv. 2 


87 thirds 


87 thirds inv. 1 


87 thirds inv. 2 


87 fourths 

87 fourths inv. 1 

87 fourths inv. 2 

87 fifths 

87 fifths inv. 1 

87 fifths inv. 2 

2

87 sus4

87 sus4  
inv. 1

87 sus4  
inv. 2


87 sus2


87 sus2  
inv. 1


87 sus2  
inv. 2


## 107 Characterizing mode (2)88


### Mode (2)88 (binary key: 1011000)


88 plain 


88 seconds 


88 seconds  
inv. 1 


88 seconds  
inv. 2 

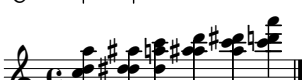
88 thirds 


88 thirds  
inv. 1 


88 thirds  
inv. 2 


88 fourths 

88 fourths  
inv. 1 

88 fourths  
inv. 2 

88 fifths 

88 fifths  
inv. 1 


88 fifths  
inv. 2 


2





## 108 Characterizing mode (2)89


### Mode (2)89 (binary key: 1011001)


89 plain 


89 seconds 


89 seconds  
inv. 1 


89 seconds  
inv. 2 


89 thirds 


89 thirds  
inv. 1 


89 thirds  
inv. 2 


89 fourths 

89 fourths  
inv. 1 

89 fourths  
inv. 2 

89 fifths 

89 fifths  
inv. 1 

89 fifths  
inv. 2 

2

89 sus4

89 sus4  
inv. 1

89 sus4  
inv. 2


89 sus2


89 sus2  
inv. 1


89 sus2  
inv. 2


## 109 Characterizing mode (2)90


### Mode (2)90 (binary key: 1011010)


90 plain 


90 seconds 


90 seconds  
inv. 1 


90 seconds  
inv. 2 


90 thirds 


90 thirds  
inv. 1 


90 thirds  
inv. 2 


90 fourths 

90 fourths  
inv. 1 

90 fourths  
inv. 2 

90 fifths 

90 fifths  
inv. 1 

90 fifths  
inv. 2 



2

90 sus4

90 sus4  
inv. 1

90 sus4  
inv. 2


90 sus2


90 sus2  
inv. 1


90 sus2  
inv. 2


## 110 Characterizing mode (2)91


### Mode (2)91 (binary key: 1011011)

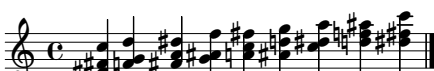
91 plain 


91 seconds 


91 seconds inv. 1 


91 seconds inv. 2 

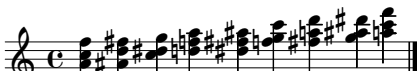
91 thirds 


91 thirds inv. 1 


91 thirds inv. 2 


91 fourths 

91 fourths inv. 1 

91 fourths inv. 2 

91 fifths 

91 fifths inv. 1 

91 fifths inv. 2 

2

91 sus4

91 sus4  
inv. 1

91 sus4  
inv. 2


91 sus2


91 sus2  
inv. 1


91 sus2  
inv. 2


# 111 Characterizing mode (2)92


## Mode (2)92 (binary key: 1011100)


92 plain 


92 seconds 


92 seconds inv. 1 


92 seconds inv. 2 


92 thirds 

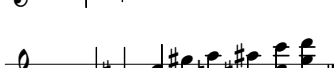
92 thirds inv. 1 


92 thirds inv. 2 

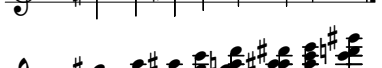
92 fourths 

92 fourths inv. 1 

92 fourths inv. 2 

92 fifths 

92 fifths inv. 1 

92 fifths inv. 2 

2

92 sus4

92 sus4  
inv. 1

92 sus4  
inv. 2

92 sus2


92 sus2  
inv. 1


92 sus2  
inv. 2


## 112 Characterizing mode (2)93


### Mode (2)93


(binary key: 1011101)


93 plain 


93 seconds 


93 seconds inv. 1 


93 seconds inv. 2 

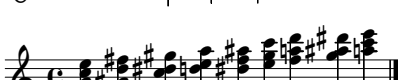
93 thirds 

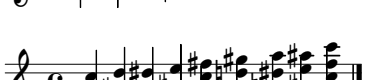
93 thirds inv. 1 


93 thirds inv. 2 


93 fourths 

93 fourths inv. 1 

93 fourths inv. 2 

93 fifths 

93 fifths inv. 1 

93 fifths inv. 2 

2

93 sus4

93 sus4  
inv. 1

93 sus4  
inv. 2


93 sus2


93 sus2  
inv. 1


93 sus2  
inv. 2


# 113 Characterizing mode (2)94


## Mode (2)94 (binary key: 1011110)


94 plain 


94 seconds 


94 seconds inv. 1 


94 seconds inv. 2 


94 thirds 


94 thirds inv. 1 


94 thirds inv. 2 


94 fourths 

94 fourths inv. 1 

94 fourths inv. 2 

94 fifths 

94 fifths inv. 1 

94 fifths inv. 2 




2

94 sus4




# 114 Characterizing mode (2)95

## Mode (2)95 (binary key: 1011111)


95 plain 


95 seconds 

95 seconds inv. 1 


95 seconds inv. 2 


95 thirds 

95 thirds inv. 1 

95 thirds inv. 2 


95 fourths 

95 fourths inv. 1 

95 fourths inv. 2 

95 fifths 

95 fifths inv. 1 

95 fifths inv. 2 

2

95 sus4



95 sus4

inv. 1



95 sus4

inv. 2



95 sus2



95 sus2

inv. 1



95 sus2

inv. 2



# 115 Characterizing mode (2)96

## Mode (2)96 (binary key: 1100000)

96 plain 

96 seconds 

96 seconds  
inv. 1 

96 seconds  
inv. 2 

96 thirds 

96 thirds  
inv. 1 

96 thirds  
inv. 2 

96 fourths 

96 fourths  
inv. 1 


96 fourths  
inv. 2 

96 fifths 


96 fifths  
inv. 1 

2


96 fifths  
inv. 2




96 sus4




96 sus4  
inv. 1




96 sus4  
inv. 2




96 sus2



96 sus2  
inv. 1





96 sus2  
inv. 2





## 116 Characterizing mode (2)97

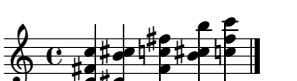
### Mode (2)97 (binary key: 1100001)


97 plain 


97 seconds 


97 seconds  
inv. 1 

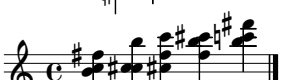
97 seconds  
inv. 2 


97 thirds 


97 thirds  
inv. 1 


97 thirds  
inv. 2 


97 fourths 

97 fourths  
inv. 1 

97 fourths  
inv. 2 

97 fifths 

97 fifths  
inv. 1 


97 fifths  
inv. 2 


2





# 117 Characterizing mode (2)98


## Mode (2)98 (binary key: 1100010)


98 plain 


98 seconds 


98 seconds  
inv. 1 


98 seconds  
inv. 2 


98 thirds 


98 thirds  
inv. 1 


98 thirds  
inv. 2 


98 fourths 

98 fourths  
inv. 1 

98 fourths  
inv. 2 

98 fifths 

98 fifths  
inv. 1 

98 fifths  
inv. 2 



2

98 sus4

98 sus4  
inv. 1

98 sus4  
inv. 2


98 sus2


98 sus2  
inv. 1


98 sus2  
inv. 2


## 118 Characterizing mode (2)99


### Mode (2)99 (binary key: 1100011)


99 plain 


99 seconds 


99 seconds  
inv. 1 


99 seconds  
inv. 2 


99 thirds 


99 thirds  
inv. 1 

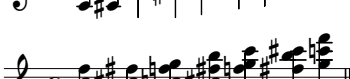
99 thirds  
inv. 2 


99 fourths 

99 fourths  
inv. 1 

99 fourths  
inv. 2 

99 fifths 

99 fifths  
inv. 1 

99 fifths  
inv. 2 

2

99 sus4

99 sus4  
inv. 1

99 sus4  
inv. 2


99 sus2


99 sus2  
inv. 1


99 sus2  
inv. 2


## 119 Characterizing mode (2)100


### Mode (2)100 (binary key: 1100100)


100 plain 


100 seconds 


100 seconds  
inv. 1 


100 seconds  
inv. 2 


100 thirds 


100 thirds  
inv. 1 


100 thirds  
inv. 2 


100 fourths 

100 fourths  
inv. 1 

100 fourths  
inv. 2 

100 fifths 

100 fifths  
inv. 1 

100 fifths  
inv. 2 

2

100 sus4

100 sus4  
inv. 1

100 sus4  
inv. 2

100 sus2


100 sus2  
inv. 1


100 sus2  
inv. 2


## 120 Characterizing mode (2)101


### Mode (2)101


(binary key: 1100101)


101 plain 


101 seconds 


101 seconds  
inv. 1 


101 seconds  
inv. 2 


101 thirds 


101 thirds  
inv. 1 


101 thirds  
inv. 2 


101 fourths 

101 fourths  
inv. 1 

101 fourths  
inv. 2 

101 fifths 

101 fifths  
inv. 1 

101 fifths  
inv. 2 

2

101 sus4

101 sus4  
inv. 1

101 sus4  
inv. 2

101 sus2


101 sus2  
inv. 1


101 sus2  
inv. 2


## 121 Characterizing mode (2)102


### Mode (2)102


(binary key: 1100110)


102 plain 


102 seconds 


102 seconds  
inv. 1 


102 seconds  
inv. 2 


102 thirds 


102 thirds  
inv. 1 


102 thirds  
inv. 2 


102 fourths 

102 fourths  
inv. 1 

102 fourths  
inv. 2 

102 fifths 

102 fifths  
inv. 1 

102 fifths  
inv. 2 



2

102 sus4

102 sus4  
inv. 1

102 sus4  
inv. 2

102 sus2


102 sus2  
inv. 1


102 sus2  
inv. 2


## 122 Characterizing mode (2)103


### Mode (2)103


(binary key: 1100111)


103 plain 


103 seconds 


103 seconds inv. 1 


103 seconds inv. 2 


103 thirds 


103 thirds inv. 1 


103 thirds inv. 2 

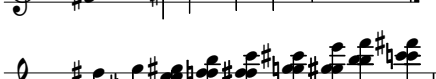
103 fourths 

103 fourths inv. 1 

103 fourths inv. 2 

103 fifths 

103 fifths inv. 1 

103 fifths inv. 2 

2

103 sus4

103 sus4  
inv. 1

103 sus4  
inv. 2

103 sus2


103 sus2  
inv. 1


103 sus2  
inv. 2


## 123 Characterizing mode (2)104


### Mode (2)104


(binary key: 1101000)


104 plain 


104 seconds 


104 seconds inv. 1 


104 seconds inv. 2 


104 thirds 


104 thirds inv. 1 


104 thirds inv. 2 


104 fourths 

104 fourths inv. 1 

104 fourths inv. 2 

104 fifths 

104 fifths inv. 1 

104 fifths inv. 2 


2  
104 sus4





## 124 Characterizing mode (2)105


### Mode (2)105


(binary key: 1101001)


105 plain 


105 seconds 


105 seconds  
inv. 1 


105 seconds  
inv. 2 


105 thirds 


105 thirds  
inv. 1 


105 thirds  
inv. 2 


105 fourths 

105 fourths  
inv. 1 

105 fourths  
inv. 2 

105 fifths 

105 fifths  
inv. 1 

105 fifths  
inv. 2 

2

105 sus4

105 sus4  
inv. 1

105 sus4  
inv. 2

105 sus2


105 sus2  
inv. 1


105 sus2  
inv. 2


## 125 Characterizing mode (2)106


### Mode (2)106


(binary key: 1101010)


106 plain 


106 seconds 


106 seconds inv. 1 


106 seconds inv. 2 

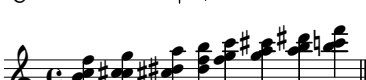
106 thirds 


106 thirds inv. 1 


106 thirds inv. 2 

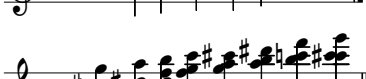
106 fourths 

106 fourths inv. 1 

106 fourths inv. 2 

106 fifths 

106 fifths inv. 1 

106 fifths inv. 2 



2

106 sus4

106 sus4  
inv. 1

106 sus4  
inv. 2

106 sus2


106 sus2  
inv. 1


106 sus2  
inv. 2


## 126 Characterizing mode (2)107


### Mode (2)107


(binary key: 1101011)


107 plain 


107 seconds 


107 seconds  
inv. 1 


107 seconds  
inv. 2 

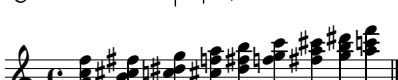
107 thirds 


107 thirds  
inv. 1 


107 thirds  
inv. 2 

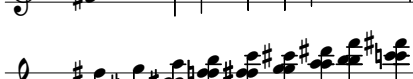
107 fourths 

107 fourths  
inv. 1 

107 fourths  
inv. 2 

107 fifths 

107 fifths  
inv. 1 

107 fifths  
inv. 2 

2

107 sus4

107 sus4  
inv. 1

107 sus4  
inv. 2

107 sus2

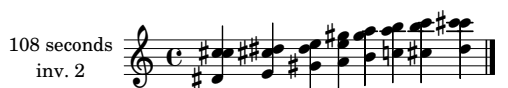
107 sus2  
inv. 1

107 sus2  
inv. 2

## 127 Characterizing mode (2)108

### Mode (2)108

(binary key: 1101100)



2

108 sus4



108 sus4  
inv. 1



108 sus4  
inv. 2



108 sus2



108 sus2  
inv. 1




108 sus2  
inv. 2





## 128 Characterizing mode (2)109


### Mode (2)109


(binary key: 1101101)


109 plain 


109 seconds 


109 seconds inv. 1 


109 seconds inv. 2 


109 thirds 

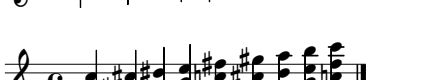
109 thirds inv. 1 

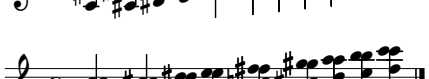
109 thirds inv. 2 


109 fourths 

109 fourths inv. 1 

109 fourths inv. 2 

109 fifths 

109 fifths inv. 1 

109 fifths inv. 2 

2

109 sus4

109 sus4  
inv. 1

109 sus4  
inv. 2

109 sus2


109 sus2  
inv. 1


109 sus2  
inv. 2


## 129 Characterizing mode (2)110


### Mode (2)110


(binary key: 1101110)


110 plain 


110 seconds 


110 seconds inv. 1 


110 seconds inv. 2 


110 thirds 

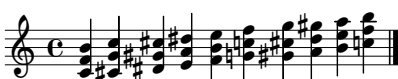
110 thirds inv. 1 


110 thirds inv. 2 


110 fourths 

110 fourths inv. 1 

110 fourths inv. 2 

110 fifths 

110 fifths inv. 1 

110 fifths inv. 2 




2





## 130 Characterizing mode (2)111


### Mode (2)111


(binary key: 1101111)


111 plain 


111 seconds 


111 seconds inv. 1 


111 seconds inv. 2 


111 thirds 


111 thirds inv. 1 


111 thirds inv. 2 


111 fourths 

111 fourths inv. 1 

111 fourths inv. 2 

111 fifths 


111 fifths inv. 1 


111 fifths inv. 2 





## 131 Characterizing mode (2)112


### Mode (2)112 (binary key: 1110000)


112 plain 


112 seconds 


112 seconds  
inv. 1 


112 seconds  
inv. 2 


112 thirds 


112 thirds  
inv. 1 


112 thirds  
inv. 2 


112 fourths 

112 fourths  
inv. 1 

112 fourths  
inv. 2 

112 fifths 

112 fifths  
inv. 1 

112 fifths  
inv. 2 

2

112 sus4

112 sus4  
inv. 1

112 sus4  
inv. 2

112 sus2

112 sus2  
inv. 1


112 sus2  
inv. 2


The image displays six musical staves, each representing a different voicing of a triad. The first staff is labeled '112 sus4' and shows a treble clef with a C major triad in suspension (F#, A, C) in a 1-1-2 voicing. The second staff is labeled '112 sus4 inv. 1' and shows the first inversion of the same triad (A, C, F#) in a 1-1-2 voicing. The third staff is labeled '112 sus4 inv. 2' and shows the second inversion (C, F#, A) in a 1-1-2 voicing. The fourth staff is labeled '112 sus2' and shows the C major triad in suspension (F#, A, C) in a 1-1-2 voicing. The fifth staff is labeled '112 sus2 inv. 1' and shows the first inversion (A, C, F#) in a 1-1-2 voicing. The sixth staff is labeled '112 sus2 inv. 2' and shows the second inversion (C, F#, A) in a 1-1-2 voicing. Each staff ends with a double bar line.


## 132 Characterizing mode (2)113


### Mode (2)113


(binary key: 1110001)


113 plain 


113 seconds 


113 seconds  
inv. 1 


113 seconds  
inv. 2 


113 thirds 


113 thirds  
inv. 1 


113 thirds  
inv. 2 


113 fourths 

113 fourths  
inv. 1 

113 fourths  
inv. 2 


113 fifths 

113 fifths  
inv. 1 


113 fifths  
inv. 2 

2


113 sus4




113 sus4  
inv. 1




113 sus4  
inv. 2




113 sus2



113 sus2  
inv. 1



113 sus2  
inv. 2



The image displays six musical staves, each representing a different voicing of a triad. The first staff is labeled '113 sus4' and shows a treble clef with a C major triad in suspension (F#, A, C). The second staff is labeled '113 sus4 inv. 1' and shows the first inversion (F#, C, A). The third staff is labeled '113 sus4 inv. 2' and shows the second inversion (A, C, F#). The fourth staff is labeled '113 sus2' and shows a C major triad in suspension (F#, C, E). The fifth staff is labeled '113 sus2 inv. 1' and shows the first inversion (F#, E, C). The sixth staff is labeled '113 sus2 inv. 2' and shows the second inversion (C, E, F#). All staves are in common time (C) and end with a double bar line.

## 133 Characterizing mode (2)114

### Mode (2)114

(binary key: 1110010)





114 sus4




## 134 Characterizing mode (2)115


### Mode (2)115

(binary key: 1110011)

115 plain 

115 seconds 

115 seconds inv. 1 


115 seconds inv. 2 

115 thirds 

115 thirds inv. 1 

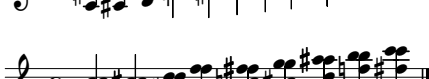
115 thirds inv. 2 


115 fourths 

115 fourths inv. 1 

115 fourths inv. 2 

115 fifths 

115 fifths inv. 1 

115 fifths inv. 2 

2



## 135 Characterizing mode (2)116

### Mode (2)116

(binary key: 1110100)



2

116 sus4

116 sus4  
inv. 1

116 sus4  
inv. 2

116 sus2


116 sus2  
inv. 1


116 sus2  
inv. 2


## 136 Characterizing mode (2)117


### Mode (2)117


(binary key: 1110101)


117 plain 


117 seconds 


117 seconds inv. 1 


117 seconds inv. 2 


117 thirds 


117 thirds inv. 1 


117 thirds inv. 2 


117 fourths 

117 fourths inv. 1 

117 fourths inv. 2 

117 fifths 

117 fifths inv. 1 

117 fifths inv. 2 

2

117 sus4

117 sus4  
inv. 1

117 sus4  
inv. 2

117 sus2


117 sus2  
inv. 1


117 sus2  
inv. 2

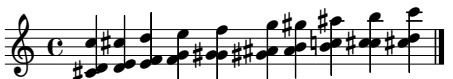
## 137 Characterizing mode (2)118


### Mode (2)118


(binary key: 1110110)


118 plain 


118 seconds 


118 seconds inv. 1 


118 seconds inv. 2 


118 thirds 


118 thirds inv. 1 


118 thirds inv. 2 


118 fourths 

118 fourths inv. 1 

118 fourths inv. 2 

118 fifths 

118 fifths inv. 1 

118 fifths inv. 2 



2



## 138 Characterizing mode (2)119

### Mode (2)119


(binary key: 1110111)

119 plain 

119 seconds 

119 seconds inv. 1 

119 seconds inv. 2 

119 thirds 


119 thirds inv. 1 


119 thirds inv. 2 

119 fourths 

119 fourths inv. 1 

119 fourths inv. 2 

119 fifths 

119 fifths inv. 1 

119 fifths inv. 2 


2





## 139 Characterizing mode (2)120


### Mode (2)120


(binary key: 1111000)


120 plain 


120 seconds 


120 seconds inv. 1 


120 seconds inv. 2 


120 thirds 


120 thirds inv. 1 

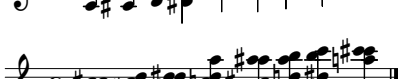
120 thirds inv. 2 


120 fourths 

120 fourths inv. 1 

120 fourths inv. 2 

120 fifths 

120 fifths inv. 1 

120 fifths inv. 2 

2

120 sus4

120 sus4  
inv. 1

120 sus4  
inv. 2

120 sus2


120 sus2  
inv. 1


120 sus2  
inv. 2


## 140 Characterizing mode (2)121


### Mode (2)121


(binary key: 1111001)


121 plain 


121 seconds 


121 seconds inv. 1 


121 seconds inv. 2 


121 thirds 


121 thirds inv. 1 


121 thirds inv. 2 


121 fourths 

121 fourths inv. 1 

121 fourths inv. 2 

121 fifths 

121 fifths inv. 1 

121 fifths inv. 2 



## 141 Characterizing mode (2)122

### Mode (2)122

(binary key: 1111010)

122 plain 

122 seconds 

122 seconds inv. 1 

122 seconds inv. 2 

122 thirds 

122 thirds inv. 1 

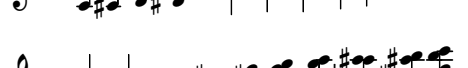
122 thirds inv. 2 

122 fourths 

122 fourths inv. 1 

122 fourths inv. 2 

122 fifths 

122 fifths inv. 1 

122 fifths inv. 2 



2



## 142 Characterizing mode (2)123

### Mode (2)123

(binary key: 1111011)

123 plain 

123 seconds 

123 seconds inv. 1 

123 seconds inv. 2 

123 thirds 

123 thirds inv. 1 

123 thirds inv. 2 

123 fourths 

123 fourths inv. 1 

123 fourths inv. 2 

123 fifths 

123 fifths inv. 1 

123 fifths inv. 2 

2

123 sus4

123 sus4  
inv. 1

123 sus4  
inv. 2

123 sus2


123 sus2  
inv. 1


123 sus2  
inv. 2


## 143 Characterizing mode (2)124


### Mode (2)124


(binary key: 1111100)


124 plain 


124 seconds 


124 seconds inv. 1 


124 seconds inv. 2 


124 thirds 


124 thirds inv. 1 


124 thirds inv. 2 


124 fourths 

124 fourths inv. 1 

124 fourths inv. 2 

124 fifths 

124 fifths inv. 1 

124 fifths inv. 2 

2

124 sus4



124 sus4  
inv. 1



124 sus4  
inv. 2



124 sus2



124 sus2  
inv. 1



124 sus2  
inv. 2




## 144 Characterizing mode (2)125


### Mode (2)125


(binary key: 1111101)


125 plain 

125 seconds 

125 seconds inv. 1 


125 seconds inv. 2 


125 thirds 

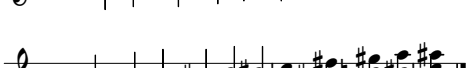
125 thirds inv. 1 

125 thirds inv. 2 


125 fourths 

125 fourths inv. 1 

125 fourths inv. 2 

125 fifths 

125 fifths inv. 1 

125 fifths inv. 2 

2

125 sus4



125 sus4  
inv. 1



125 sus4  
inv. 2



125 sus2



125 sus2  
inv. 1



125 sus2  
inv. 2



## 145 Characterizing mode (2)126

### Mode (2)126

(binary key: 1111110)

126 plain 

126 seconds 

126 seconds inv. 1 

126 seconds inv. 2 

126 thirds 

126 thirds inv. 1 

126 thirds inv. 2 

126 fourths 

126 fourths inv. 1 

126 fourths inv. 2 

126 fifths 

126 fifths inv. 1 

126 fifths inv. 2 





## 146 Characterizing mode (2)127

## Mode (2)127

**(binary key: 1111111)**

127 plain



127 seconds



127 seconds  
inv. 1



127 seconds  
inv. 2



127 thirds



127 thirds  
inv. 1



127 thirds  
inv. 2



127 fourths



127 fourths  
inv. 1



127 fourths  
inv. 2



127 fifts



127 fifths  
inv. 1



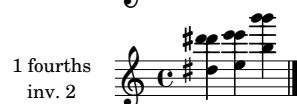
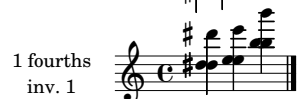
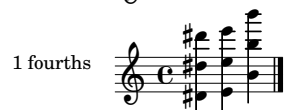
127 fifths  
inv. 2



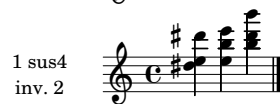


## 147 Characterizing mode (3)1

### Mode (3)1 (binary key: 0001)

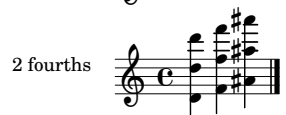


2



## 148 Characterizing mode (3)2

### Mode (3)2 (binary key: 0010)



2

2 sus4

2 sus4  
inv. 1

2 sus4  
inv. 2


2 sus2


2 sus2  
inv. 1


2 sus2  
inv. 2


## 149 Characterizing mode (3)3


### Mode (3)3 (binary key: 0011)


3 plain 


3 seconds 


3 seconds  
inv. 1 


3 seconds  
inv. 2 


3 thirds 


3 thirds  
inv. 1 


3 thirds  
inv. 2 


3 fourths 

3 fourths  
inv. 1 

3 fourths  
inv. 2 

3 fifths 

3 fifths  
inv. 1 

3 fifths  
inv. 2 



2

3 sus4

3 sus4  
inv. 1

3 sus4  
inv. 2


3 sus2


3 sus2  
inv. 1


3 sus2  
inv. 2


## 150 Characterizing mode (3)4


### Mode (3)4 (binary key: 0100)


4 plain 


4 seconds 


4 seconds  
inv. 1 


4 seconds  
inv. 2 

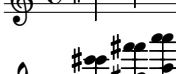
4 thirds 

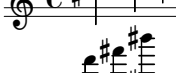
4 thirds  
inv. 1 

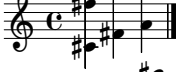
4 thirds  
inv. 2 


4 fourths 

4 fourths  
inv. 1 

4 fourths  
inv. 2 

4 fifths 

4 fifths  
inv. 1 


4 fifths  
inv. 2 


2





## 151 Characterizing mode (3)5


### Mode (3)5 (binary key: 0101)


5 plain 


5 seconds 


5 seconds  
inv. 1 


5 seconds  
inv. 2 


5 thirds 


5 thirds  
inv. 1 


5 thirds  
inv. 2 


5 fourths 

5 fourths  
inv. 1 

5 fourths  
inv. 2 

5 fifths 

5 fifths  
inv. 1 


5 fifths  
inv. 2 


2


5 sus4


## 152 Characterizing mode (3)6


### Mode (3)6 (binary key: 0110)


6 plain 


6 seconds 


6 seconds  
inv. 1 


6 seconds  
inv. 2 


6 thirds 


6 thirds  
inv. 1 


6 thirds  
inv. 2 


6 fourths 

6 fourths  
inv. 1 

6 fourths  
inv. 2 

6 fifths 

6 fifths  
inv. 1 

6 fifths  
inv. 2 

2

6 sus4

6 sus4  
inv. 1

6 sus4  
inv. 2


6 sus2


6 sus2  
inv. 1


6 sus2  
inv. 2


## 153 Characterizing mode (3)7


### Mode (3)7 (binary key: 0111)


7 plain 


7 seconds 


7 seconds  
inv. 1 


7 seconds  
inv. 2 


7 thirds 


7 thirds  
inv. 1 


7 thirds  
inv. 2 


7 fourths 

7 fourths  
inv. 1 

7 fourths  
inv. 2 

7 fifths 

7 fifths  
inv. 1 

7 fifths  
inv. 2 



2

7 sus4

7 sus4  
inv. 1

7 sus4  
inv. 2


7 sus2


7 sus2  
inv. 1


7 sus2  
inv. 2


## 154 Characterizing mode (3)8

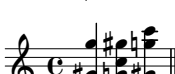
### Mode (3)8 (binary key: 1000)


8 plain 


8 seconds 


8 seconds  
inv. 1 

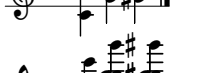
8 seconds  
inv. 2 


8 thirds 


8 thirds  
inv. 1 


8 thirds  
inv. 2 


8 fourths 

8 fourths  
inv. 1 

8 fourths  
inv. 2 

8 fifths 

8 fifths  
inv. 1 

8 fifths  
inv. 2 

2

8 sus4

8 sus4  
inv. 1

8 sus4  
inv. 2


8 sus2


8 sus2  
inv. 1


8 sus2  
inv. 2


## 155 Characterizing mode (3)9


### Mode (3)9 (binary key: 1001)


9 plain 


9 seconds 


9 seconds  
inv. 1 


9 seconds  
inv. 2 


9 thirds 


9 thirds  
inv. 1 


9 thirds  
inv. 2 


9 fourths 

9 fourths  
inv. 1 

9 fourths  
inv. 2 

9 fifths 

9 fifths  
inv. 1 

9 fifths  
inv. 2 

2  
9 sus4

9 sus4  
inv. 1

9 sus4  
inv. 2


9 sus2


9 sus2  
inv. 1


9 sus2  
inv. 2


## 156 Characterizing mode (3)10


### Mode (3)10 (binary key: 1010)


10 plain 


10 seconds 


10 seconds  
inv. 1 


10 seconds  
inv. 2 


10 thirds 


10 thirds  
inv. 1 


10 thirds  
inv. 2 


10 fourths 

10 fourths  
inv. 1 

10 fourths  
inv. 2 

10 fifths 

10 fifths  
inv. 1 

10 fifths  
inv. 2 

2

10 sus4

10 sus4  
inv. 1

10 sus4  
inv. 2


10 sus2


10 sus2  
inv. 1


10 sus2  
inv. 2


## 157 Characterizing mode (3)11


### Mode (3)11 (binary key: 1011)


11 plain 


11 seconds 


11 seconds  
inv. 1 


11 seconds  
inv. 2 


11 thirds 


11 thirds  
inv. 1 


11 thirds  
inv. 2 


11 fourths 

11 fourths  
inv. 1 

11 fourths  
inv. 2 

11 fifths 

11 fifths  
inv. 1 

11 fifths  
inv. 2 



2

11 sus4

11 sus4  
inv. 1

11 sus4  
inv. 2

11 sus2


11 sus2  
inv. 1


11 sus2  
inv. 2

# 158 Characterizing mode (3)12

## Mode (3)12 (binary key: 1100)

12 plain 


12 seconds 


12 seconds  
inv. 1 


12 seconds  
inv. 2 

12 thirds 

12 thirds  
inv. 1 

12 thirds  
inv. 2 

12 fourths 

12 fourths  
inv. 1 

12 fourths  
inv. 2 

12 fifths 

12 fifths  
inv. 1 

12 fifths  
inv. 2 

2

12 sus4

12 sus4  
inv. 1

12 sus4  
inv. 2


12 sus2


12 sus2  
inv. 1


12 sus2  
inv. 2


## 159 Characterizing mode (3)13


### Mode (3)13 (binary key: 1101)


13 plain 


13 seconds 


13 seconds  
inv. 1 


13 seconds  
inv. 2 

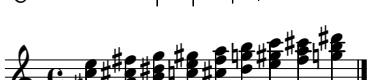
13 thirds 


13 thirds  
inv. 1 

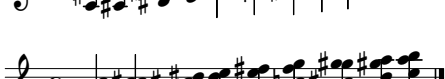
13 thirds  
inv. 2 


13 fourths 

13 fourths  
inv. 1 

13 fourths  
inv. 2 

13 fifths 

13 fifths  
inv. 1 

13 fifths  
inv. 2 

2

13 sus4

13 sus4  
inv. 1

13 sus4  
inv. 2


13 sus2


13 sus2  
inv. 1


13 sus2  
inv. 2

## 160 Characterizing mode (3)14


### Mode (3)14 (binary key: 1110)


14 plain 

14 seconds 


14 seconds  
inv. 1 


14 seconds  
inv. 2 

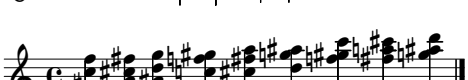
14 thirds 

14 thirds  
inv. 1 


14 thirds  
inv. 2 


14 fourths 

14 fourths  
inv. 1 

14 fourths  
inv. 2 

14 fifths 

14 fifths  
inv. 1 

14 fifths  
inv. 2 

2

14 sus4

14 sus4  
inv. 1

14 sus4  
inv. 2

14 sus2

14 sus2  
inv. 1

14 sus2  
inv. 2

## 161 Characterizing mode (3)15

### Mode (3)15 (binary key: 1111)

15 plain 

15 seconds 

15 seconds inv. 1 

15 seconds inv. 2 

15 thirds 

15 thirds inv. 1 

15 thirds inv. 2 

15 fourths 

15 fourths inv. 1 

15 fourths inv. 2 

15 fifths 

15 fifths inv. 1 

15 fifths inv. 2 



2

15 sus4

15 sus4  
inv. 1

15 sus4  
inv. 2

15 sus2

15 sus2  
inv. 1

15 sus2  
inv. 2