

The 32 Modes

The following is a study of the 32 modes based off of the Hindustani musicologist Pandit Bhatkhande's system of 32 thaats. I haven't seen many western theorists exploring this concept, other than W A Mathieu who will be mentioned again later on, so I wanted to present this system in a way that might be easier for musicians trained in western theory to relate to. There are a lot of little nuances that make Indian music so unique, but most of the main concepts are similar or can be related to a lot of the concepts in western music theory. I have been interested in and studying Indian music theory for a number of years now though I am no expert and I don't have much experience playing it. There are plenty of online resources that teach Indian music and theory and some of them will be mentioned throughout this document. There are also plenty of other modes available in music, in fact the Carnatic (South Indian) recognizes 72 modes that include the 32 thaats of Hindustani (North Indian) music, but I believe that the 32 modes of Bhatkhande's thaata system include most of the essential 7-note modes a western musician might want to study without going too far out of their comfort zone.

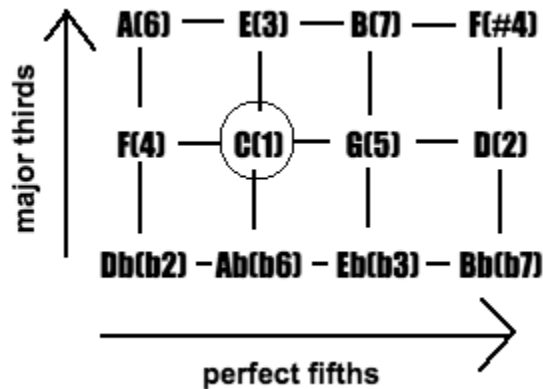
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Requirements of the System:

The system of 32 thaats is basically all of the possible scales out of [1, (b2 or 2), (b3 or 3), (4 or #4), 5, (b6 or 6), and (b7 or 7)]. The scale must be only 7 notes long and must be in order from 1 to 7. The 1 and 5 are fixed so that the tonic triad is either major or minor, but every other note has a chromatic pair to choose from. The 2, 3, 6, and 7, can be lowered a semitone, and the 4 can be raised a semitone. One or the other notes has to be chosen, for example there can't be a b2 and a 2 in the same mode.

This system might seem arbitrary but there are good reasons for its use. As stated before, the 1 and 5 are fixed so that every tonic chord is either major or minor. Specifically, there are 8 modes with a major seventh tonic (I Δ 7), 8 with a dominant seventh tonic (I7), 8 with a minor major seventh tonic (I- Δ 7), and 8 with a minor seventh

tonic (1-7). Because every mode has either a major or minor tonic, each mode is more stable than a mode that doesn't (for this reason, the locrian mode is not included in the 32 thaat system). In addition to this, the 12 notes that we have to pick from are chosen because of their harmonic proximity to the tonic note as you can see in the lattice below. All of the 32 modes can be graphed on this lattice. (learn more about the lattice [here](#))



Tuning:

It is important to discuss tuning because of the differences between Indian and modern western music, but I will try to keep it brief. In Bhatkhande's system, although he didn't specify tuning, theoretically speaking it is assumed that the notes are tuned approximately to the system of just intonation based on the note relationships seen in the lattice above. In just intonation, the notes are tuned based on the mathematical ratios between the frequencies of notes. The ratio of 2:1 is an octave, 3:2 is a perfect fifth, and 5:4 is a major third. With these ratios alone we can create a lattice of 12 notes which is referred to as a 12 note 5-limit lattice. (5-limit because it is limited by not using any ratios with a greater prime number than 5) I won't explain just intonation in any more detail so if you want to learn more there are plenty of online resources and I could also recommend the beginning of the book *Harmonic Experience* by W A Mathieu or *The Arithmetic of Listening* by Kyle Gann.

The ratios of each of the 12 notes and their deviation from equal temperament in cents are as follows:

- 1:** 1/1; no deviation
- b2:** 16/15; +12 cents
- 2:** 9/8; +4 cents
- b3:** 6/5; +16 cents
- 3:** 5/4; +14 cents
- 4:** 4/3; -2 cents
- #4:** 45/32; -10 cents
- 5:** 3/2; +2 cents

b6: 8/5; +14 cents
6: 5/3; -16 cents
b7: 9/5; +18 cents
7: 15/8; -12 cents

The just intonation tuning system described above is applied to all of the 32 thaats, but remember that when these thaats are utilized in singing or playing ragas, the notes are not fixed to a certain pitch and can be sharpened, flattened, and otherwise embellished in a number of different ways.

I think it is important to be familiar with this concept of note relationships and their ratios, but for all of our purposes, we can use the western equal tempered tuning system without having to worry about any major discrepancies. The equal tempered tuning system has been the main system used for almost all western music of the past century. Classical composers such as Bach, Beethoven, Mozart, Chopin, and many more experimented with different tuning systems such as well temperament, meantone temperaments, equal temperaments and just intonation tunings. *The Arithmetic of Listening* by Kyle Gann explains the math behind all of these tunings.

Difference Between Modes, Keys, Scales, and Thaats:

The terms mode, key, and scale get thrown around a lot when talking about music, and a lot of the time their definitions seem to overlap. There is no single certified definition for any of these words and they are all used to describe a number of different things in music, so it will be hard to try and set some distinctions, but I will explain how I like to differentiate them.

Let's start with the difference between modes and scales. The word 'scale' is used to describe a collection of notes that start on one note and then end on the same note an octave higher. Theoretically, a scale can be any number of notes up to 12, where all 12 notes would be an octave. Usually the smallest scale talked about is a pentatonic scale (5 notes) but technically something like an arpeggiated major chord (C,E,G,C) could also be considered a scale. Most scales are 7 notes (not including the octave note), scales like the whole tone or minor blues scale have 6 notes and scales like the diminished or bebop scale have 8.

The term 'mode' is often used to describe a collection of scales that are related to each other by their interval patterns. For example, the dorian scale (w h w w w h w) has the same whole/half step pattern as the major scale (w w h w w w h) so they are said to be modes of each other. Any 7-note scale has 7 modes, any 6-note scale has 6 modes, etc. The major scale (or natural minor scale) therefore has 7 modes (Lydian, Ionian, Mixolydian, Dorian, Aeolian, Phrygian, and Locrian) and these are commonly referred to as the 7 church modes.

This way of talking about modes is very helpful when relating scales to each other, but the way I like to see modes is as a scale that can stand on its own with a clear tonic, that carries its own unique emotion or energy about it. When playing in a mode, the sense of the tonic note should never be lost. The 32 'modes' that we are discussing in this document all follow this sentiment. You will notice that, although the locrian scale is a 'mode' of the major scale and one of the 7 church modes, it is not included in the list of 32 modes because it is not very stable on its own. Without a perfect 5th in the scale or mode, it is hard to relate to or keep track of the tonic note. In this sense, while I wouldn't consider the locrian scale to be a suitable mode on its own, it is useful to know as a scale when, for example, you are playing a VII-7b5 chord in a major key. So if you are improvising in the key of C major and playing a B-7b5 chord, it can be helpful to think of the B locrian 'scale' when soloing over that chord.

A 'key' is also used to refer to a few different things but the best way I have heard it described is that there are only two keys, major and minor. Now the lines between what is major and what is minor are blurred and some of the time a song will blend both major and minor keys, but generally if a song gravitates towards a major tonic it is in a major key, and if the song suggests a minor tonic then it is in a minor key. Songs that use the lydian, ionian, mixolydian, and harmonic major scales for example are all in a major key. Songs that use dorian, aeolian, phrygian, and melodic minor scales for example are all in a minor key. Half of the 32 modes are in a major key while the other half is in a minor key.

The Hindustani term 'thaat', although can be related to the terms 'mode', 'scale', or 'key', doesn't translate exactly into western music terms. I would say that the term 'mode' best represents the concept of thaats, but remember that we also use the word mode to describe scales that share the same interval pattern as we discussed earlier. Thaats are used as a foundation for ragas and are named after the raga that uses that particular thaat, but there are many things that distinguish thaats and ragas. A raga is basically a song or tune that usually approximates one of the thaats, but ragas go way deeper than just the notes. Each raga has specific ways of embellishing these thaats that go beyond just using the notes. Again, it really doesn't translate the best to western music concepts, but in each raga there is a certain way to ascend the scale, descend the scale, certain notes to highlight, certain notes to embellish in different ways, accidentals, specific ways to move around the thaat and more. If you want to learn more about ragas I would suggest visiting George Howlett's website ragajunglism.org or reading *The ragas of North Indian Music* by N A Jairazbhoy.

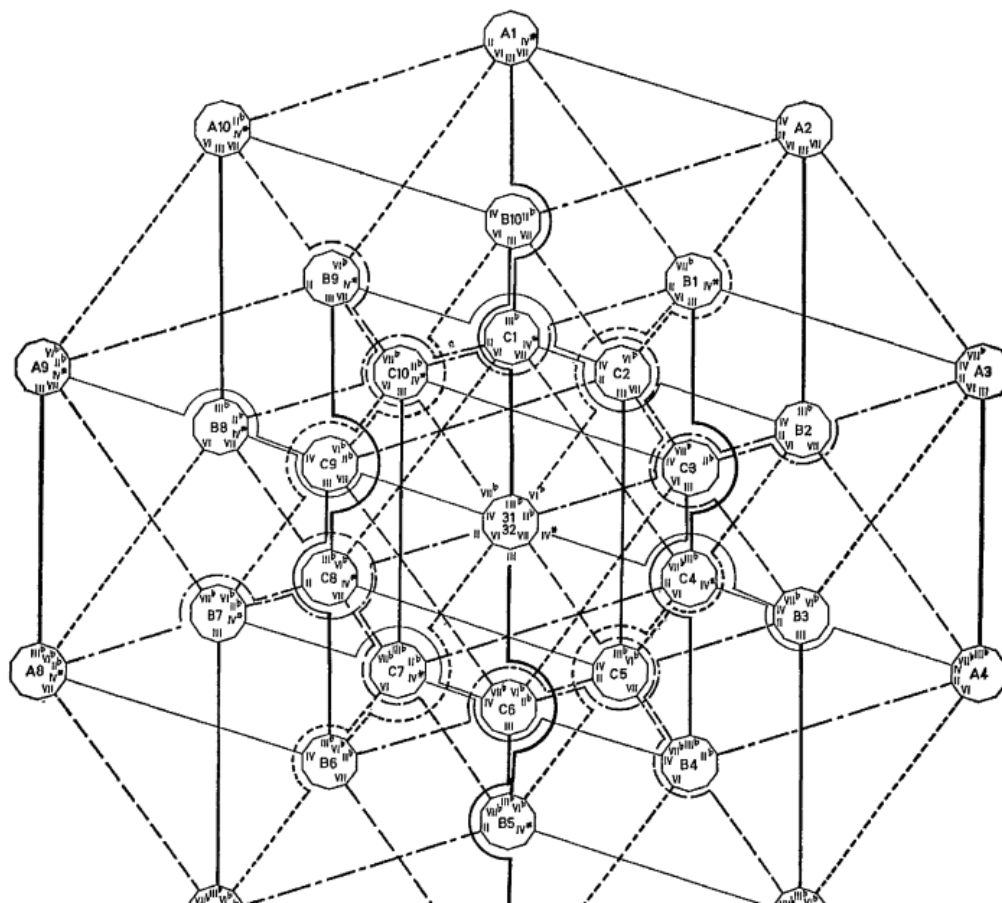
As you can see a lot of these definitions are pretty loose and they overlap each other in one way or another. Classical Indian musicians conceptualized and organized music in a different way than classical western musicians did, and although there are many similarities and relations, the two systems are very unique ways that can't always be translated to the other system. The Indian system is more focused on melody and the

only harmony that occurs is between the melody note and the drone, which is sometimes 2 notes, the tonic and usually a fifth or sometimes a fourth. Traditionally, the harmonies don't move together in the same way they would in western counterpoint.

Because of this, there also really isn't an equivalent concept of chords. And if there were it would be more complicated because of the just intonation tuning system. The western equal temperament tuning system allows for certain chords to exist that wouldn't sound in tune in just intonation. For example the II- chord is either the relative minor of the IV chord, or its the V- of the V chord which in just intonation would imply two different tunings for each of the II- chords. As another example, in equal temperament the lydian mode allows for the major II chord to exist, where the 6 is the fifth of the 2 and not the major third of the 4. If playing chords in a fixed 12 note 5-limit just intonation system, the 6 would be tuned as the major third of the 4 and therefore wouldn't be in tune as the perfect fifth of the 2. Since ragas are mostly sung with just intonation in mind, these tuning discrepancies are taken into account and often adjusted for by either sharpening or flattening the note to be in tune with a different note.

N A Jairazbhoy's Numbering System:

The numbering system that N A Jairazbhoy introduces in his book includes the numbers A1-A10, B1-B10, C1-C10, and then D1 and D2. I couldn't find this numbering system anywhere else but I like the way it is organized to show which of the thaats are related to other ones by one note. Since each thaat has a total of 5 possible notes that can be 2 different options, each thaat relates to 5 other thaats by the difference of 1 note.



An is related to An+1, An-1, Bn, Cn, and Bn-2.

Bn is related to An, An +2, Cn-1, Cn+3, D1 if n is odd and D2 if n is even.

Cn is related to An, Bn+1, Bn-3, Cn+3 and Cn-3.

D1 is related to all odd B's and D2 is related to all even B's.

The diagram above is a wonderful representation from Jairazbhoy's book showing how each thaat is related to 5 other thaats.

This way of organizing thaats also shows that all of the 10 'A' scales can form a circle of scales that all relate to each other by the difference of by 1 note as you can see in the following diagram, also from Jairazbhoy's book.



The book *A Geometry of Music* by Dmitri Tymoczko explores a lot of the ways that scales can relate to each other and also how they relate to the whole tone and diminished scales.

32 Modes Chart:

The following chart includes all 32 thaats in order by Jairazbhoy's numbering system including the western scale name and the thaat name. Jairazbhoy's book only gives the name for the 10 main thaats, all of the A's except for A7, and then C9. The additional names here are from the musician Chaitanya Kunte. The chart also shows which pitches are used in the mode and the pattern of intervals between the pitches. There are only three different steps possible between two adjacent pitches in the 32 modes, the half step (h), whole step (w), and augmented second (a). The augmented second steps are highlighted orange so they are easier to spot. Two adjacent pitches that are 3 semitones apart always represent an augmented second interval, not a minor third. Every half step here represents a minor second interval, never an augmented first. The whole step always represents a major second interval. This will all be explored more later on. Lastly, the far left column shows what the tonic seventh chord of the mode is. There are 8 $\Delta 7$'s, 8 $\bar{7}$'s, 8 $\bar{7}$'s and 8 $\bar{\Delta 7}$'s.

Additionally, each of the modes are grouped together vertically with the other modes whose scales are modes of each other. For example the first 6 modes below, the church modes minus locrian, are all modes of each other. A7 or the Phrygian #4 mode has no other modes that fit into this system.

#	Scale	Thaat	Pitches	Steps	Tonic
A1	Lydian	Kalyan	1 2 3 #4 5 6 7	w w w h w w h	$\Delta 7$
A2	Ionian (Major)	Bilival	1 2 3 4 5 6 7	w w h w w w h	$\Delta 7$
A3	Mixolydian	Khamaj	1 2 3 4 5 6 b7	w w h w w h w	$\bar{7}$
A4	Dorian	Kafi	1 2 b3 4 5 6 b7	w h w w w h w	$\bar{7}$
A5	Aeolian (Minor)	Asavari	1 2 b3 4 5 b6 b7	w h w w h w w	$\bar{7}$
A6	Phrygian	Bhairavi	1 b2 b3 4 5 b6 b7	h w w w h w w	$\bar{7}$
A7	Phrygian #4	Bhavpirya	1 b2 b3 #4 5 b6 b7	h w a h h w w	$\bar{7}$
A8	Todi	Todi (Tori)	1 b2 b3 #4 5 b6 7	h w a h h a h	$\bar{\Delta 7}$
A9	Composite	Purvi (Pooravi)	1 b2 3 #4 5 b6 7	h a w h h a h	$\Delta 7$

A10	Lydian b2	Marva	1 b2 3 #4 5 6 7	h a w h w w h	IΔ7
B1	Lydian Dominant	Vachaspati	1 2 3 #4 5 6 b7	w w w h w h w	I7
B2	Melodic Minor	Gauri Manohari	1 2 b3 4 5 6 7	w h w w w w h	I-Δ7
B3	Hindu	Charukeshi	1 2 3 4 5 b6 b7	w w h w h w w	I7
B4	Javanese	Natakpirya	1 b2 b3 4 5 6 b7	h w w w w h w	I-7
B5	Hungarian Gypsy	Shanmukhpirya	1 2 b3 #4 5 b6 b7	w h a h h w w	I-7
B6	Neapolitan Minor	Dhenuka	1 b2 b3 4 5 b6 7	h w w w h a h	I-Δ7
B7	Phrygian Major #4	Namnarayani	1 b2 3 #4 5 b6 b7	h a w h h w w	I7
B8	Lydian b2 b3	Swaranangi	1 b2 b3 #4 5 6 7	h w a h w w h	I-Δ7
B9	Lydian b6	Latangi	1 2 3 #4 5 b6 7	w w w h h a h	IΔ7
B10	Ionian b2	Suryakant	1 b2 3 4 5 6 7	h a h w w w h	IΔ7
C1	Lydian b3	Dharamvati	1 2 b3 #4 5 6 7	w h a h w w h	I-Δ7
C2	Harmonic Major	Sarsangi	1 2 3 4 5 b6 7	w w h w h a h	IΔ7
C3	Mixolydian b2	Chakarvak	1 b2 3 4 5 6 b7	h a h w w h w	I7
C4	Romanian Minor	Hemvati	1 2 b3 #4 5 6 b7	w h a h w h w	I-7
C5	Harmonic Minor	Kirvani	1 2 b3 4 5 b6 7	w h w w h a h	I-Δ7
C6	Phrygian Major	Bakulabharan	1 b2 3 4 5 b6 b7	h a h w h w w	I7
C7	Dorian b2 #4	Shadvidhmargani	1 b2 b3 #4 5 6 b7	h w a h w h w	I-7

C8	Hungarian Minor	Sahinder Madhyam	1 2 b3 #4 5 b6 7	w h a h h a h	I-Δ7
C9	Double Harmonic	Bhairav	1 b2 3 4 5 b6 7	h a h w h a h	IΔ7
C10	Romanian Major	Rampirya	1 b2 3 #4 5 6 b7	h a w h w h w	I7
D1	Neapolitan Major	Kakilpirya	1 b2 b3 4 5 6 7	h w w w w h	I-Δ7
D2	Lydian Minor	Rishavpirya	1 2 3 #4 5 b6 b7	w w w w h h w	I7

The following is the same chart of 32 thaats, this time organized by the scales that have the most modes that fit into the guidelines of the 32 thaats. I feel that this way is a bit more intuitive, maybe especially to the western musician because the first three groups of modes are from the major(minor) scale, the melodic minor scale, and the harmonic minor scale, plus their modes, which are the most popular scales in western music. The last 9 thaats are all scales that have no other modes. They also are all the scales with a b2 and a #4, the augmented third interval.

#	Scale	Thaat	Pitches	Steps	Tonic
A1	Lydian	Kalyan	1 2 3 #4 5 6 7	w w w h w w h	IΔ7
A2	Ionian (Major)	Bilival	1 2 3 4 5 6 7	w w h w w w h	IΔ7
A3	Mixolydian	Khamaj	1 2 3 4 5 6 b7	w w h w w h w	I7
A4	Dorian	Kafi	1 2 b3 4 5 6 b7	w h w w w h w	I-7
A5	Aeolian (Minor)	Asavari	1 2 b3 4 5 b6 b7	w h w w h w w	I-7
A6	Phrygian	Bhairavi	1 b2 b3 4 5 b6 b7	h w w w h w w	I-7
B1	Lydian Dominant	Vachaspati	1 2 3 #4 5 6 b7	w w w h w h w	I7
B2	Melodic Minor	Gauri Manohari	1 2 b3 4 5 6 7	w h w w w w h	I-Δ7
B3	Hindu	Charukeshi	1 2 3 4 5 b6 b7	w w h w h w w	I7
B4	Javanese	Natakpirya	1 b2 b3 4 5 6 b7	h w w w w h w	I-7

C1	Lydian b3	Dharamvati	1 2 b3 #4 5 6 7	w h a h w w h	I-Δ7
C2	Harmonic Major	Sarsangi	1 2 3 4 5 b6 7	w w h w h a h	IΔ7
C3	Mixolydian b2	Chakarvak	1 b2 3 4 5 6 b7	h a h w w h w	I7
C4	Romanian Minor	Hemvati	1 2 b3 #4 5 6 b7	w h a h w h w	I-7
C5	Harmonic Minor	Kirvani	1 2 b3 4 5 b6 7	w h w w h a h	I-Δ7
C6	Phrygian Major	Bakulabharan	1 b2 3 4 5 b6 b7	h a h w h w w	I7
D1	Neapolitan Major	Kakilpirya	1 b2 b3 4 5 6 7	h w w w w w h	I-Δ7
D2	Lydian Minor	Rishavpirya	1 2 3 #4 5 b6 b7	w w w w h h w	I7
B5	Hungarian Gypsy	Shanmukhpirya	1 2 b3 #4 5 b6 b7	w h a h h w w	I-7
B6	Neapolitan Minor	Dhenuka	1 b2 b3 4 5 b6 7	h w w w h a h	I-Δ7
C8	Hungarian Minor	Sahinder Madhyam	1 2 b3 #4 5 b6 7	w h a h h a h	I-Δ7
C9	Double Harmonic	Bhairav	1 b2 3 4 5 b6 7	h a h w h a h	IΔ7
B9	Lydian b6	Latangi	1 2 3 #4 5 b6 7	w w w h h a h	IΔ7
B10	Ionian b2	Suryakant	1 b2 3 4 5 6 7	h a h w w w h	IΔ7
A7	Phrygian #4	Bhavpirya	1 b2 b3 #4 5 b6 b7	h w a h h w w	I-7
A8	Todi	Todi (Tori)	1 b2 b3 #4 5 b6 7	h w a h h a h	I-Δ7
A9	Composite	Purvi (Pooravi)	1 b2 3 #4 5 b6 7	h a w h h a h	IΔ7

A10	Lydian b2	Marva	1 b2 3 #4 5 6 7	h a w h w w h	1Δ7
B7	Phrygian Major #4	Namnarayani	1 b2 3 #4 5 b6 b7	h a w h h w w	17
B8	Lydian b2 b3	Swaranangi	1 b2 b3 #4 5 6 7	h w a h w w h	1-Δ7
C7	Dorian b2 #4	Shadvidhmargani	1 b2 b3 #4 5 6 b7	h w a h w h w	1-7
C10	Romanian Major	Rampirya	1 b2 3 #4 5 6 b7	h a w h w h w	17

Patterns and Symmetries:

There are a lot of patterns found within and between the 32 modes, and a lot of different ways of categorizing them. Each of the modes on its own can be analyzed for different symmetries and repeating patterns. To provide a few different examples, for instance the intervals of the double harmonic scale are [(h a h) w (h a h)], which is the same pattern (h, a, h) repeated twice, separated by a whole step between the 4 and 5, or [(1 b2 3 4) (5 b6 7 1)]. Other modes like mixolydian, [(1 2 3 (4) 5 6 b7)] or [(w w h) (w w h) w], repeat the same pattern twice with an interval separating them between the b7 and the 1 instead of the 4 and 5. Two adjacent intervals can also form a repeating pattern like in the Lydian Dominant b2 mode [h] a (w h) (w h) (w) for example. Here is a list of all of the repeating patterns found in the 32 modes:

A1 Lydian:	[w (w w h) (w w h)]	or	[w] w (w h w) (w h)	or	[w w] w (h w w) (h)
A2 Ionian:	[(w w h) w (w w h)]	or	[w] (w h w) w (w h)	or	[w w] (h w w) w (h)
A3 Mixolydian:	[(w w h) (w w h) w]	or	[w (w h w) (w h w)]	or	[w] w (h w w) (h w)
A4 Dorian:	[w h) w (w w h) (w]	or	[(w h w) w (w h w)]	or	[w] (h w w) w (h w)
A5 Aeolian:	[w h) (w w h) w (w]	or	[(w h w) (w h w) w]	or	[w (h w w) (h w w)]
A6 Phrygian:	[h) w (w w h) (w w]	or	[h w) w (w h w) (w]	or	[(h w w) w (h w w)]
A8 Todi:	[h) w (a h h) (a h]				
A9 Composite:	[h a) w (h h a) (h]				
C7 Dorian b2 #4:	[(h w) a (h w) (h w)]				
C8: Hungarian Minor:	[w (h a h) (h a h)]				
C9: Double Harmonic:	[(h a h) w (h a h)]				
C10 Romanian Major:	[h) a (w h) (w h) (w]				

Similar to repeated patterns, modes like the hindu scale [(w w h) w (h w w)] can be symmetrical across the middle of the octave, this type of symmetry is also reflected

across the tonic note. There are only four modes that are symmetrical in this way and two of them, A4 and C9, also have repeating patterns. The 4 symmetrical modes are:

A4 Dorian: [(w h w) w (w h w)]
 B3 Hindu: [(w w h) w (h w w)]
 C9 Double Harmonic: [(h a h) w (h a h)]
 D1 Neapolitan Major: [(h w w) w (w w h)]

There are a lot of different patterns and symmetries to explore so I won't attempt to go through and analyze all of them. I'm also not sure how applicable this is to making music but I do think it is interesting to view some different perspectives on the patterns found within scales. One thing you might have noticed is that all of the modes that are symmetrical have a natural 4 and not a #4. Also, the double harmonic scale is the only symmetrical mode with an augmented second interval, in this case there are two. Both Jairazbhoy's book and ragajunglism.org explore these symmetries and more in a bit better detail than I have above. Mathieu's *Harmonic Experience* groups each scale into two tetrachords to help in naming the modes. For example, the melodic minor scale [1 2 b3 4 5 6 7] would be grouped as [(1 2 b3 4) (5 6 7 8)] where the first tetrachord (1 2 b3 4) is the beginning of the minor scale, and the second tetrachord (5 6 7 8) is the end of the major scale. Since the first half is minor and the second half is major, Mathieu refers to this as the major over minor (major/minor) scale. For another example, the lydian dominant scale [(1 2 3 #4) (5 6 b7 8)] would be mixolydian/lydian.

32 Modes Categorized by Tonic Chord:

#	Scale	Tonic		#	Scale	Tonic
A1	Lydian	IΔ7		A3	Mixolydian	I7
A2	Ionian (Major)	IΔ7		B1	Lydian Dominant	I7
A9	Composite	IΔ7		B3	Hindu	I7
A10	Lydian b2	IΔ7		B7	Phrygian Major #4	I7
B9	Lydian b6	IΔ7		C3	Mixolydian b2	I7
B10	Ionian b2	IΔ7		C6	Phrygian Major	I7
C2	Harmonic Major	IΔ7		C10	Romanian Major	I7
C9	Double Harmonic	IΔ7		D2	Lydian Minor	I7

#	Scale	Tonic		#	Scale	Tonic
A4	Dorian	I-7		A8	Todi	I-Δ7
A5	Aeolian (Minor)	I-7		B2	Melodic Minor	I-Δ7
A6	Phrygian	I-7		B6	Neapolitan Minor	I-Δ7
A7	Phrygian #4	I-7		B8	Lydian b2 b3	I-Δ7
B4	Javanese	I-7		C1	Lydian b3	I-Δ7
B5	Hungarian Gypsy	I-7		C5	Harmonic Minor	I-Δ7
C4	Romanian Minor	I-7		C8	Hungarian Minor	I-Δ7
C7	Dorian b2 #4	I-7		D1	Neapolitan Major	I-Δ7

32 Modes Categorized by Interval Steps:

Another way to categorize the 32 modes is by the interval steps used in the scale. As we saw in the chart above, the only intervals that can exist between two adjacent notes are the half step (h), the whole step (w), and the augmented second (a). Each of the modes has to have 7 interval steps and these 7 steps have to add up to equal an octave. There are three different interval patterns that achieve this while fitting into our system. One with 5 whole steps, and 2 half steps, one with 3 whole steps, 3 half steps, and 1 augmented second, and one with 1 whole step, 4 half steps, and 2 augmented seconds. Once grouped into one of those three categories, the modes can be further classified by how those intervals are distributed. Scales that are modes of each other share the same interval pattern only with different starting points.

Modes with 5 whole steps and 2 half steps:

A1-A6 where the 2 half steps are separated by 2 whole steps

B1-B4 where the two half steps are separated by 1 whole step

D1 and D2 where the 2 half steps are right next to each other

- 2 half step intervals in a row creates 3 semitones in a row. These two scales also have 5 whole steps in a row which makes them really close to a whole tone scale. In fact they are the whole tone scale with one note added in between two of the whole tones.

Modes with 3 whole steps 3 half steps and 1 augmented second:

A7, A10 and B5-B10 with 1 instance of 3 semitones in a row (2 half steps in a row)

C1-C7 and C10 with no instances of 3 semitones in a row

Modes with 1 whole step 4 half steps and 2 augmented seconds:

A8 and A9 with 2 instances of 3 semitones in a row

- There are only two places in the scale where 3 semitones in a row can occur. This is with the #4, 5 and b6, and again with the 7, 1, and b2. The modes A8 and A9 each have both of these groups of 3 semitones in a row.

C8 and C9 with 1 instance of 3 semitones in a row

Other Intervals Found in the 32 Modes:

To explain a few things real quick, the second, third, sixth, and seventh intervals all have a major and a minor version. When one of these intervals is augmented, it means the major version is augmented by a half step, when one of these intervals is diminished, it means the minor interval is diminished by a half step. The fourth and fifth intervals are perfect, meaning they do not have a major or minor version, just one perfect interval. If it is augmented then it moves up a half step, and when diminished moves down a half step. The same amount of semitones between two notes can be represented by two different intervals, for example a major third and a diminished fourth interval both have 4 semitones in between their two pitches. In fact, every interval here has another interval with the same amount of semitones between, except for 1 semitone (minor seconds) and 11 semitones (major sevenths) as you will see in the chart below. Theoretically diminished seconds, augmented sevenths, diminished unisons, and augmented unisons exist, but they are not possible in our system of 32 modes.

There are a lot of interval relationships (20 in total) hidden within the 32 modes that are worth noting. We've already mentioned the 3 that can occur between two adjacent notes. There's a minor second interval between 1 and b2 for example, a major second interval between 2 and 3 for example, and an augmented second interval between b3 and #4 for example. Augmented seconds can only occur between b2 and 3, b3 and #4, or b6 and 7.

All of the possible 12 notes also create their own interval with the tonic note, for example the 1 and b6 give us a minor sixth interval, the 1 and 3 give us the major third interval

and so on. Disregarding the unison interval between the 1 and itself, and incorporating the interval of an augmented second, this gives us a total of 11 intervals. Each interval also has an inverse interval. For example, the inverse of a perfect fifth interval (C to G) is a perfect fourth (G to C), or the inverse of a major second interval (C to D) is a minor seventh (D to C). Every inversed major interval is a minor interval and vice versa. Augmented intervals and diminished intervals are inverses of each other, and the inverse of a perfect interval is another perfect interval. Of the 12 intervals we have discussed, all of them except for the augmented fourth and augmented second have an inverse interval that is also within these 12 intervals. The inverse of an augmented fourth interval (C to F#) is a diminished fifth interval (F# to C). The inverse of an augmented second interval (Ab to B) is a diminished seventh (B to Ab). This brings our total to 14, so where are the last 6?

Examining all of the note relationships between the 12 notes of the 32 thaat system, we can see there is another unique interval between 3 and b6, #4 and b7, 6 and b2, and again between 7 and b3. This might look like a major third interval but the relationship between these pairs of pitches actually create the interval of a diminished fourth. The inverse of a diminished fourth interval is an augmented fifth. The next interval can be found between #4 and 6, and again between 7 and b2. This is the diminished third interval and the inverse is the augmented sixth interval. Lastly, the interval between b2 and #4 is that of an augmented third. The inverse of this is the diminished sixth. Every scale above that has both a b2 and a #4 has no other modes that fit into this system, that is because the only place an augmented third interval can exist in this system is between the b2 and the #4.

Since we use equal temperament it may not seem like these distinctions are necessary. However, though represented by the same pitches in equal temperament, an augmented second can be used to invoke an entirely different emotion than a minor third can. It's not so much the space between the notes as it is the relationship between the notes in respect to the tonic. Two notes can be perceived as different intervals depending on the context of the surrounding notes. We see this in the difference between an augmented sixth and a minor seventh interval when discussing dominant seventh vs. augmented sixth chords. For example, in the key of C, the notes Ab (b6) and F# (#4) make an augmented sixth interval while in the key of Db, these same notes would be an Ab (5) and a Gb (4) and create a minor seventh interval. However arbitrary it may seem, understanding the difference I believe can help musicians to expand their composition skills and certainly further familiarize themselves with their mental map of music theory.

The following chart shows all 20 of the intervals we've just discussed, the semitones between the intervals, and the inverse of that interval.

Interval	Semitones	Inverse
minor second	1	major seventh
major second	2	minor seventh
augmented second	3	diminished seventh
diminished third	2	augmented sixth
minor third	3	major sixth
major third	4	minor sixth
augmented third	5	diminished sixth
diminished fourth	4	augmented fifth
perfect fourth	5	perfect fifth
augmented fourth	6	diminished fifth
diminished fifth	6	augmented fourth
perfect fifth	7	perfect fourth
augmented fifth	8	diminished fourth
diminished sixth	7	augmented third
minor sixth	8	major third
major sixth	9	minor third
augmented sixth	10	diminished third
diminished seventh	9	augmented second
minor seventh	10	major second
major seventh	11	minor second

Flipped Modes:

Another way of differentiating the modes is by looking at how many of the natural notes (1,2,3,4,5,6,7) are altered. Since 1 and 5 can't be altered, that only leaves 5 possible notes to be altered. There is only one mode, ionian (1,2,3,4,5,6,7), with no altered notes,

and only one mode, phrygian #4 (1,b2,b3,#4,5,b6,b7) where all 5 moveable notes are altered. In between this, there are 5 modes with 1 altered note, 10 with 2 altered notes, 10 with 3 altered notes, and 5 with 4 altered notes.

There are some theorists who talk about 'flipped' versions of thaats, where each of the 5 moveable notes 'flips' to create its flipped pair. The two modes we just mentioned, ionian and phrygian #4, are flipped versions of each other. For another example, D1 (1,b2,b3,4,5,6,7) and D2 (1,2,3,#4,5,b6,b7) are also flipped versions of each other. I think this characteristic is interesting to point out, but I'm not sure if it is helpful in classifying or understanding the modes.

Chords in the 32 modes:

As I said earlier, the concept of chords in western music theory doesn't really have a counterpart in classical Indian theory. The 32 thaats were theorized with melodic movement in mind, not thinking about triads or seventh chords or anything like that. As we explored a little bit earlier, the just intonation tuning system doesn't accommodate the concept of chords as well as a tempered tuning system does because each chord has a particular tuning in respect to the tonic note, and when the chords move around then the tuning would have to change as well. Because of this, it can be hard to incorporate the concept of chords in some of the 32 modes, especially the more complicated scales that don't have any other modes.

The easiest scales to use chords in are the 7 church modes, melodic minor and its modes, and harmonic minor and its modes. Which makes sense why those are the most popular scales to use in western music, they provide the most harmonic opportunity. The other scales are hard to use chords in, not because the chords can't be found within the scales, but because the intervals between some of the notes are not what they seem as we explored just before. For example, in C harmonic major, the 3, b6, and 7 might look like an E major chord, but as we know already, the interval between 3 and b6 is that of an augmented second and not a major third. Because of this slight discrepancy, even when playing in equal temperament, it can be hard to fool the brain that you are playing a III major chord while staying put in the mode of harmonic major. What appears as a E major chord (E, G#, B) is really what I will call a "faux" E major chord (E, Ab, B). This is one example of many that you might run into when trying to play chords with all of these modes. It might not seem like this difference is a big deal, but the way we listen to and register harmony in our brains is by relating all the different notes that we hear. If our brain has already established a major third relationship between the b6 (Ab) and the 1 (C), and another major third between the 1 (C) and the 3 (E), then in our brain, the relationship between the b6 (Ab) and the 3 (E) is already established as two major thirds away from each other. When you try to pass off the b6 (Ab) as a #5 (G#) in order to play an E major chord, the brain will notice that something is up between the relationships of the notes. Even in equal temperament where the pitches of Ab and G# are exactly the

same, it's the note relationships we are mapping in our brain that discern how we interpret harmony and harmonic movement.

With all of that being said, the following is a list of all the main possible 4-note chords (not including suspended chords) that can be found in at least 1 of the 32 modes. All of the “faux” chords that can be made are found in **green** with their technical names in brackets. The V and bVII root notes have the most chord options with 8 possible “real” chords and 3 “faux” chords, #IV has the least with 2 “real” chords and 5 “faux” chords. Every pitch can create a diminished seventh chord, there is no agreement as to what intervals actually make up a diminished seventh chord, they can be any mixture between minor third intervals and augmented second intervals. The symmetry of fully diminished and augmented chords in equal temperament can be tricky to apply to the system of just intonation. For these purposes, a ‘real’ augmented chord is (1, 3, #5) and a ‘real’ diminished seventh chord is (1, b3, b5, bb7). Most of the chords in black can be found in one of the seven church modes.

I: no real diminished fifth, no real augmented fifth, no real diminished seventh

IΔ7

I7

I6

I-Δ7

I-7

I-6

I+Δ7 [IΔ7(b13)no5 or inverted bVI+(#9)]

I+7 [I7(b13)no5 or inverted bVI+(9)]

I°Δ7 [I-Δ7(#11)no5]

I-7b5 [I-7(#11)no5]

I°7 [I-6(#11)no5 or inverted #IV°7]

bII: no real minor third, no real minor seventh, no real diminished fifth, no real diminished seventh, no real minor seventh

bIIΔ7

bII7 [bII(#6)]

bII6

bII-Δ7 [bIIΔ7(#9)no3 or inverted bVI+(11)]

bII-7 [bII(#6,#9)no3]

bII-6 [bII6(#9)no3]

bII+Δ7

bII+7 [bII+(#6)]

bII°Δ7 [bIIΔ7(#9,#11)no3no5 or inverted I(b9)]

bII-7b5 [bII(#6,#9,#11)no3no5 or inverted III-(bb7)]
bII°7 [bII6(#9,#11)no3no5 or inverted III°7]

II: no real augmented fifth, no real diminished seventh, no major seventh

II7
II6
II-7
II-6
II+7 [II7(b13)no5 or inverted bVII+(9)]
II-7b5
II°7 [II°(13) or inverted VII°7]

bIII: no real minor third, no real diminished fifth, no real diminished seventh

bIIIΔ7
bIII7
bIII6
bIII-Δ7 [bIIIΔ7(#9)no3 or inverted bVII+(11)]
bIII-7 [bIII7(#9)no3]
bIII-6 [bIII6(#9)no3]
bIII+Δ7
bIII+7
bIII°Δ7 [bIIΔ7(#9,#11)no3no5 or inverted II(b9)]
bIII-7b5 [bIII7(#9,#11)no3no5]
bIII°7 [bIII6(#9,#11)no3no5 or inverted #IV°7]

III: no real major third, no real augmented fifth, no real major sixth, no major seventh

III7 [III7(b13)no3]
III6 [III(b9,b11)no3]
III-7
III-6 [III-(bb7)]
III+7 [III7(b11,b13)no3no5 or inverted bVI+(#11)]
III-7b5
III°7

IV: no real diminished fifth, no real augmented fifth, no real diminished seventh

IV Δ 7

IV7

IV6

IV- Δ 7

IV-7

IV-6

IV+ Δ 7 [IV Δ 7(b13)no5 or inverted bII+(#9)]

IV+7 [IV7(b13)no5 or inverted bII+(9)]

IV $^{\circ}$ Δ 7 [IV- Δ 7(#11)no5]

IV-7b5 [IV-7(#11)no5]

IV $^{\circ}$ 7 [IV-6(#11)no5 or inverted VII $^{\circ}$ 7]

#IV: no real major third, no real perfect fifth, no real augmented fifth, no real major sixth, no major seventh

#IV7 [#IV7(b11,bb13)no3no5]

#IV6 [#IV(bb7,b11,bb13)no3no5]

#IV-7 [#IV-7(bb13)no5]

#IV-6 [#IV-(bb7,bb13)no5]

#IV+7 [#IV7(b11,b13)no3no5 or inverted bVII+(#11)]

#IV-7b5

#IV $^{\circ}$ 7

V: no real augmented fifth, no real diminished seventh

V Δ 7

V7

V6

V- Δ 7

V-7

V-6

V+ Δ 7 [V Δ 7(b13)no5 or inverted bIII+(#9)]

V+7 [V7(b13)no5 or inverted bIII+(9)]

V $^{\circ}$ Δ 7

V-7b5

V $^{\circ}$ 7 [V $^{\circ}$ (13) or inverted III $^{\circ}$ 7]

bVI: no real minor third, no real diminished fifth, no real diminished seventh, no real minor seventh

bVIΔ7

bVI7 [bVI(#6)]

bVI6

bVI-Δ7 [bVIΔ7(#9)no3 or inverted bIII+(11)]

bVI-7 [bVI(#6,#9)no3]

bVI-6 [bVI6(#9)no3]

bVI+Δ7

bVI+7 [bVI+(#6)]

bVI°Δ7 [bVIΔ7(#9,#11)no3no5 or inverted V(b9)]

bVI-7b5 [bVI(#6,#9,#11)no3no5 or inverted VII-(bb7)]

bVI°7 [bVI6(#9,#11)no3no5 or inverted VII°7]

VI: no real major third, no real augmented fifth, no real diminished seventh, no major seventh

VI7 [VI7(b11)no3]

VI6 [VI6(b11)no3]

VI-7

VI-6

VI+7 [VI7(b11,b13)no3no5 or inverted bII+(#11)]

VI-7b5

VI°7 [VI°(13) or inverted #IV°7]

bVII: no real diminished fifth, no real diminished seventh

bVIIΔ7

bVII7

bVII6

bVII-Δ7

bVII-7

bVII-6

bVII+Δ7

bVII+7

bVII°Δ7 [bVII-Δ7(#11)no5]

bVII-7b5 [bVII-7(#11)no5]

bVII°7 [bVII-6(#11)no5 or inverted III°7]

VII: no real major third, no real augmented fifth, no real major sixth, no major seventh

VII7 [VII7(b11)no3]

VII6 [VII(bb7,b11)no3]

VII-7

VII-6 [VII-(bb7)]

VII+7 [VII7(b11,b13)no3no5 or inverted bIII+(#11)]

VII-7b5

VII°7

Conclusions:

In conclusion, here are a few additional thoughts on Even though I am doing a lot of comparison between Indian and western music, these are two very different systems that use different approaches and musical concepts to create and analyze music. Both western and Indian music has changed a lot over the years. For one, there are a lot of new ragas being played based on different systems and thaats. But also there is a lot of Indian/western fusion, especially in jazz music, and a lot of modern Indian music has adopted the equal tempered tuning system. Jairazbhoy mentions in his book, originally published in 1971, that around 20 of the 32 thaats are actually in use today though he said that number is growing. Today, North Indian raga uses about 29 of the 32 thaats, though only about half of these are in widespread use. In Carnatic music, all 32 of the thaats, or melakarta, have been in use for several hundred years.

Although this has covered a lot of territory, this in no way has exhausted the list of all possible places to explore harmonically within a 12-tone equal tempered system. This is only a limited system between 12 notes on 5-limit lattice. The lattice can keep extending in any direction and can also begin to include other interval relationships such as ones from the seventh or eleventh harmonics. Additional harmonics are trickier to explore in equal temperament because the seventh harmonic is 31 cents flatter than an equal tempered b7, and the eleventh harmonic is 49 cents flatter than an equal tempered #4, almost exactly halfway between the 4 and #4. Other tuning systems, even equal tempered ones such as 19TET or 31TET, can accommodate different frequency ratios better than 12TET, though they are usually less accessible and I think 12TET does a fine job accommodating for a majority of important frequency relationships.

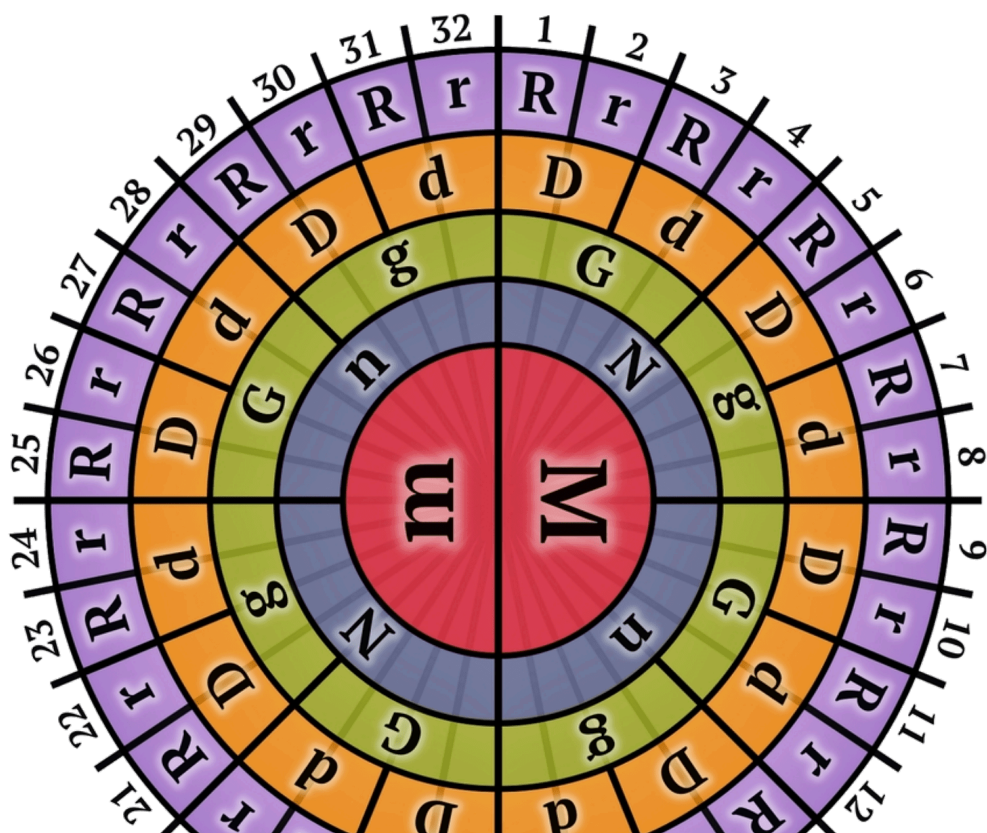
Don't let this system of 32 modes limit your creativity in any way, there is still plenty to explore outside of this system. For example, this system doesn't include a #5 note which is very handy as the major third of the 3 in a III7 or V7/VI chord, and this is only one example. The #1 note, b5, or #2 are a few other interesting pitches worth exploring. Again, I'm not sure how relevant any of this information is to different musicians. For me personally it has definitely deepened my understanding of how pitches relate to each

other and work together to create different musical statements. A lot of this information, however pedantic it may seem, has aided me in finding new areas to explore in music without making me feel like I'm too lost in formalities or technicalities. I would encourage you to look through all of the 32 modes and see if any patterns or unique characteristics stick out to you. Spend as little or as much time as you want and don't get too hung up on anything that might not make sense. Just introduce yourself to some new ideas and let them build on their own time, eventually a lot of gaps in your mental map of music will be filled whether or not you realize it consciously.

Below are two additional diagrams from ragajunglism.com. The first shows the note names from the Indian system of sargam, which is basically the equivalent of western solfege (do re mi). It also includes the Carnatic system which has three versions of the pitches 2, 3, 6, and 7 instead of only two versions.

Generic	Sa	Re		Ga		Ma		Pa	Dha		Ni		Sa
Specific	S	r	R	g	G	m	M	P	d	D	n	N	S
Semitones	0	1	2	3	4	5	6	7	8	9	10	11	12
Intervals	1	b2	2	b3	3	4	#4	5	b6	6	b7	7	8
Carnatic	S	R ₁	R ₂	R ₃		M ₁	M ₂	P	D ₁	D ₂	D ₃		S
			G ₁	G ₂	G ₃					N ₁	N ₂	N ₃	

The next diagram shows a cool way of organizing the 32 thaats that allows you to conceptualize all of them at once.



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Dmitri Tymoczko

Additional [documents](#) from me