Behind The Guitar Chords

1. Tempered Notes

Plucking a string will create a sound that we hear with a certain pitch. This pitch depends on the thickness and material of the string, but for a fix kind of string, it only depends on its length.
Shorter length creates higher pitch.
Half length gives a sound similar of the original full length, in spite of the great pitch difference.
Between this halving, we can use other shortenings that create different pitches and subjective feelings of the jump relative to the original full length's pitch.

The exact fractions $\frac{2}{3}$, $\frac{3}{4}$, $\frac{3}{5}$, $\frac{4}{5}$ give especially pleasant pitch jumps.

Observe that our fractions in increasing order are : $\frac{1}{2} < \frac{3}{5} < \frac{2}{3} < \frac{3}{4} < \frac{4}{5}$ because:

$$\frac{1}{2} = \frac{5}{10} < \frac{6}{10} = \frac{3}{5} = \frac{9}{15} < \frac{10}{15} = \frac{2}{3} = \frac{8}{12} < \frac{9}{12} = \frac{3}{4} = \frac{15}{20} < \frac{16}{20} = \frac{4}{5}$$

These five pitches mean more possible pitch jumps because we can go from any of them to any other.

But for example, to go from $\frac{4}{5}$ to $\frac{3}{4}$ is a shortening of $\frac{4}{5} \bullet \frac{3}{4} = \frac{3}{5}$, so this gives exactly the same subjective pitch jump as from 1 full length to $\frac{3}{5}$. Most other jumps will give new fractions.

If we allow new jumps again between the new pitches, then we get even more new fractions.

In theory, this would create an infinity of pitches or fractions between 1 and $\frac{1}{2}$.

But the human ear (and brain) has a mysterious ability to distort the exact jumps into the basic simplest fractions. When we sing, we only use a few of the theoretically infinite many jumps. The new more complicated fractions are simply cheated by our hearing to approximate them with simpler ones.
On a violin, where the strings can be shortened continually, the exact fractions as jumps, would create an infinity of possible shortenings, that is finger positions corresponding to all possible melodies.
But since our hearing is corrective, we could use fix locations or frets.

Only eleven equal shortenings between 1 and $\frac{1}{2}$ is enough for all possible subjective pitches.

Any jump between these are cheated into exact fractions by our ear.

So these artificial notes are: $1 > m > m\,m = m^2 > m^3 > \ldots > m^{11} > m^{12} = \frac{1}{2}$

Thus, this fix m multiplier as shortening factor is $\frac{1}{\sqrt[12]{2}}$ which is not an exact fraction.

This is the unit note of this equalized or tempered note system, that we use in a piano or on a guitar.

The jumps between these twelve notes are continually cheated by our brain into exact basic fractions.

The only true exact jump in this system is the $\frac{1}{2} = m^{12}$ exact halving that gives identical feel.

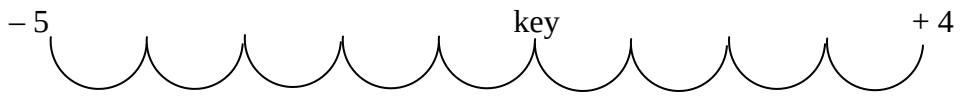
Strangely this perfect jump is called an octave because earlier only eight jumps were used.

The other jump names also reflect the old system, so they make no sense among the twelve notes.

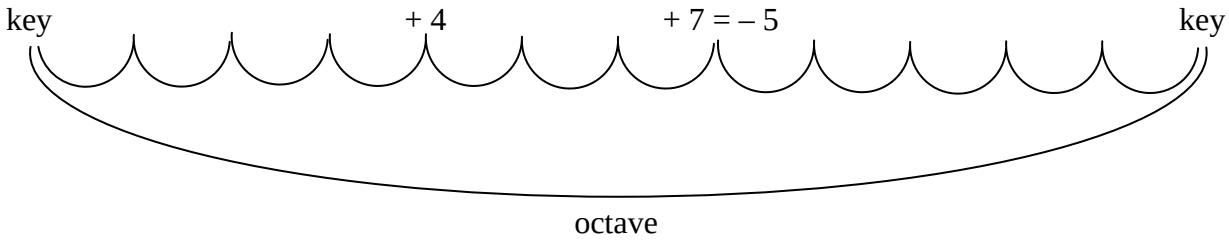
The twelve notes can be repeated between new halvings, which we can see in the many octaves, each containing twelve keys on a piano.

Besides the melodies or scales, using twelve notes, the simultaneously heard notes or chords also fit in this system perfectly. That is, our hearing corrects them to perfect chords. In fact, the more notes we hear, the better the approximation. That's the reason for the fact that the simplest chords are not merely two notes sounding together, rather three.

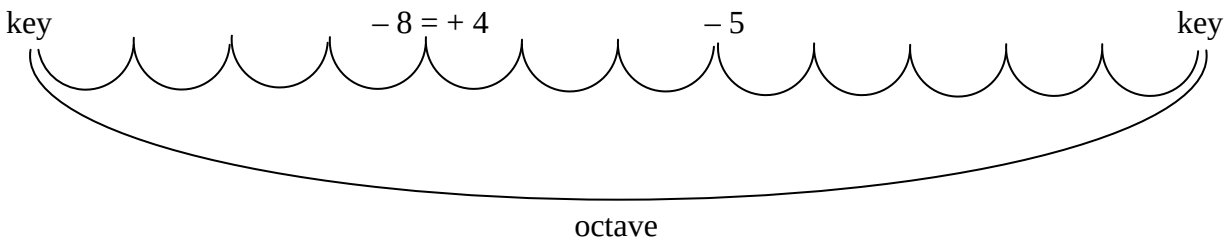
The most neutral chord is heard when a key note is accompanied by one five steps under, and one four steps above:



Since the full $\frac{1}{2}$ or octave jump creates a subjectively similar note, we can replace or add these octave variants to obtain variant chords. They may sound very different on their own, but when we sing a melody behind them, they fit exactly the same way. So, the basic –5+4 chord could also be called as +4+7 if we replace – 5 with its octave:



Or similarly it is a –5–8 chord if we replace the +4 with –8 :



This basic –5+4 = –5+4 = –5–8 chord is called the major and denoted by merely the key note.

In the key notation of our twelve note system, again the old eight step system is used, resulting in using only seven letters A , B , C , D , E , F , G . These are the white keys on a piano.

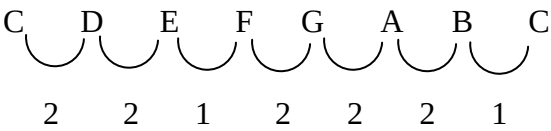
Increment by one note is denoted as # , while decrease denoted as ♭ . These are the black keys.

The old eight note system used single note jumps between B , C and E , F.

These are the white keys that have no black keys between them.

Thus, on a piano or guitar: B # = C , C ♭ = B , E # = F , F ♭ = E

The old eight note system is not old in the sense that it reflects an eternal phase in our individual music developments. Children songs all fit into this simpler system and do, re, mi, fa, so, la, ti, do are the relative names of these increments. They are exactly the alphabetical (white) keys if we start from C :



C D E F G A B C = do re mi fa so la ti do

2 2 1 2 2 2 1

It's amazing that this scale sounds so natural and thus equal in steps, when in fact after the first two double notes, it jumps only half of that between E and F or mi and fa. Then after three double notes we again use only one between B and C or ti and do to return to the octave. This strange subjective evenness of the totally uneven jump sequence is the second mystery in our musical hearing. The first was the automatic correction of false but close to perfect jumps into perfect.

Guitar is an instrument designed for chords. The six strings are : E A D G B E.

These are all in the fundamental five jumps, except between G and B there is only four steps.

The reason for this is that fingerings could be more flexible, allowing fingers under each other.

The one step alterations of the basic or major –5+4 chords are called as:

augmented = + or diminished = – if one step is applied to the – 5 note, while

minor = min = m or suspended = sus = s when applied to the + 4 note.

So A = major, that is –5+4 chord from A as key

A^{+} = augmented, that is –4+4 chord with A as key ,

A^{-} = diminished, that is –6+4 chord with A as key,

Am = minor, that is –5+3 chord with A as key,

As = suspended, that is –5+5 chord with A as key.

And similarly we can combine + , – alterations with m , s alterations.

In addition, to these three note chords, we can add a fourth, fifth, very rarely even sixth note.

These added notes are again numbered in the eight note system, but with some later changes.

Today they are denoted by 4 , 6 , 7 , 7major = $7^{\#}$, 9 , 9minor = 9^{b}.

Except for the 4 they are all the yet unused notes in the basic three notes.
The rarely used 4 is actually the same as sus added to major or minor chords.

So our A , A7 , Am , Am7 , As7 , A6/9 , Am6/9 , notations are pretty clear because they reveal the structure. Letters and signs denote basic notes and numbers as added fourth or fifth notes.
The only confusing exception is that major is not denoted by extra letter at all.
A more consistent way would be to use M for major chords too.
For example AM , AM7 would replace A and A7 .
Then the system were even more perfect:
The A , B , . . , $G^{\#}$ letters are the keys.
These include the –5 notes unless + or – mark the altered –4 or –6 instead.
The letters M , m , s denote the third note of the basic chords.
The numbers are simply added notes.
A quite opposite simplified notation is to leave the M major unmarked and even avoid the minor as m letter by using lower case letters for the key. So Am = a.
To write chords for songs this is the most practical system because minor chords are so frequent.
The sus chords on the other hand are pretty rare.

In the next section I will use this simplified notation system but then in the following I will return to the perfect M , m , s lettering through an invention I made decades ago.

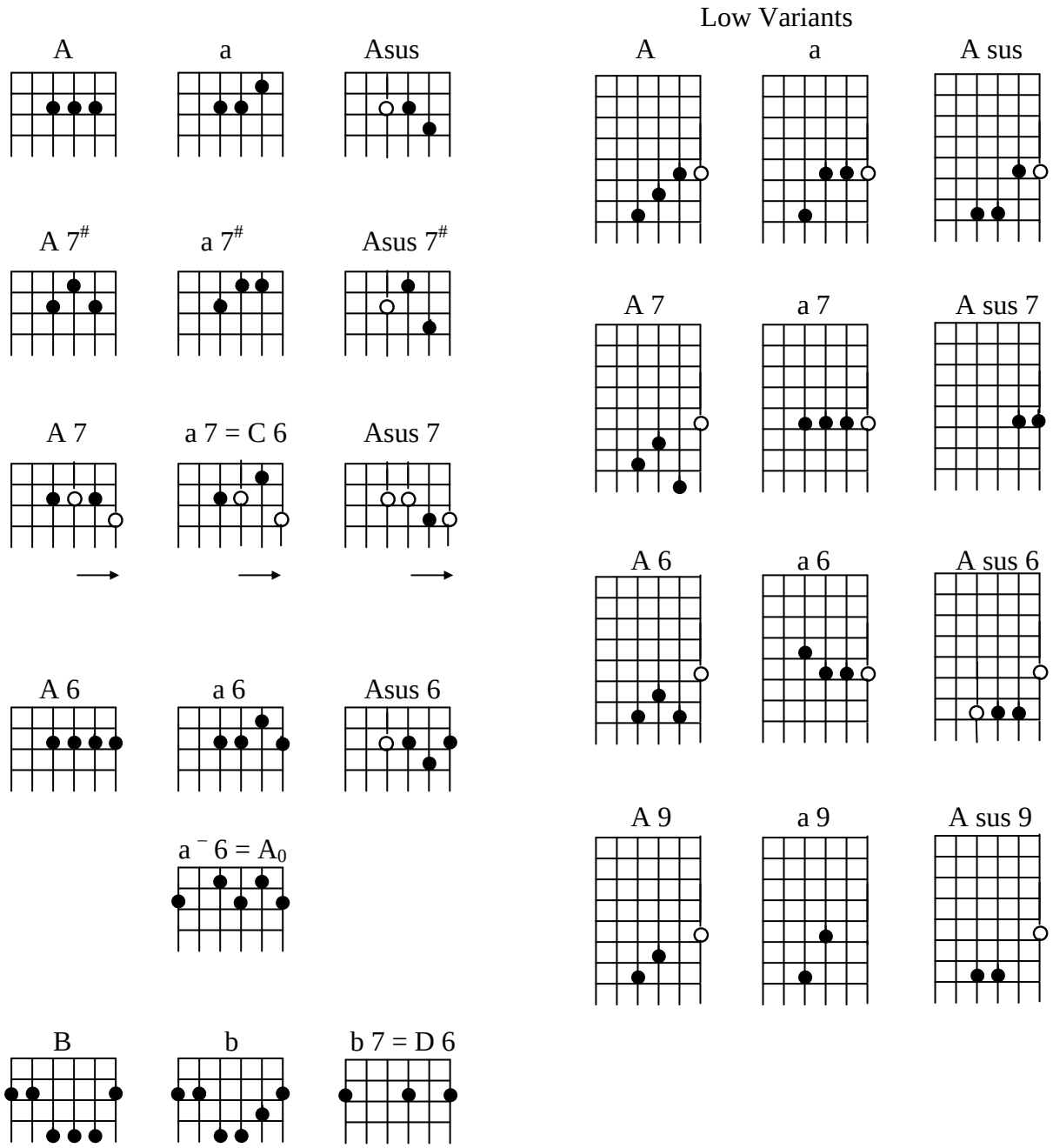
Since the guitar has six strings, if we pluck all of them, this ususally means some repetitions of notes.
Some maybe with octaves replaced.
As I said, these variants in theory can always be used for the same melodies.
In practice, it is not true, because deeper notes have less effective feature in a chord.
So, the chord variants can be crucial in accompanying properly a melody.
The easiest chords are using as many unfingered notes or open strings as possible and most of these easy chords are fingered on the top three frets. But some can be made on lower frets too and the particularly easy ones are above the seventh fret. So, I will give these as “low variants” too.

2. Top Chords And Low Variants

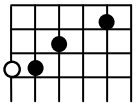
The basic three chords in any key, are the major, minor and suspended. These have three notes.
Capital key letters denote major, lower case ones denote minor and sus denotes suspended.

Only the four important added notes will be used : $7^{\#}$, 7 , 6 , 9. The 4 and 9^{b} are not.

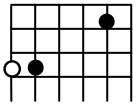
Empty circles mean notes that can be fingered but can be left open too if you wish.
Or these denote alternate fingering instead of the full black.
If more strings have empty circles and one can only be used with an other, then under the strings, we'll mark this with arrows.
A few diminished and augmented chords will be also shown with minus and plus signs.



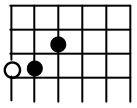
C



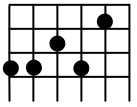
C 9



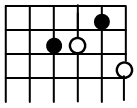
C 7^{m}



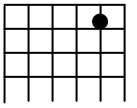
C 7



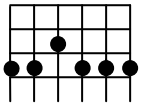
C 6 = a 7



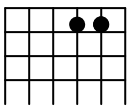
C 6/9



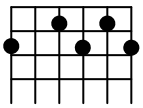
C 7/9



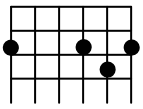
C $^{+}$ 6/9



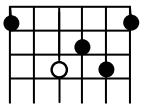
c $^{-}$ 6 = C_0 = A_0



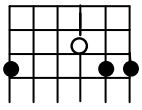
D



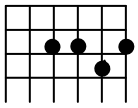
d



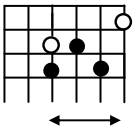
Dsus



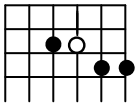
D 9



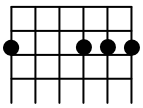
d 9



Dsus 9



D $7^{\#}$



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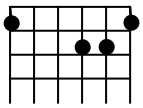
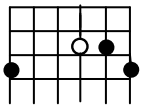
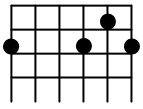


Dsus $7^{\#}$



D 7



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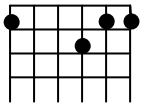
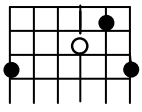


Dsus 7



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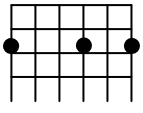
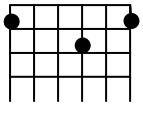


d 6



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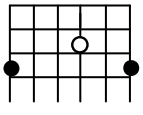
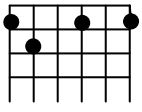
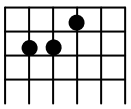


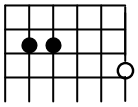
d $^{-}$ 6 = D_0



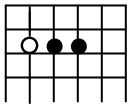
E



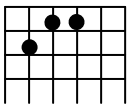
e



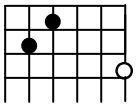
Esus



E $7^{\#}$



e $7^{\#}$



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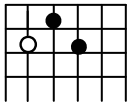
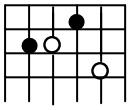
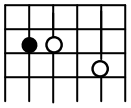


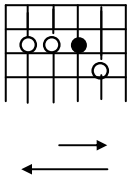
E 7



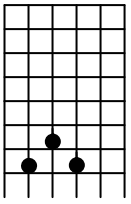
e 7 = G 6



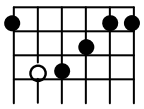
Esus 7



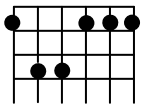
E 7



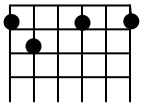
F



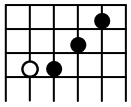
f



f ¯ 6 = F_0 = D_0



F $7^{\#}$



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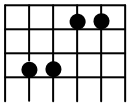

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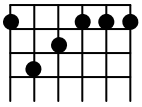

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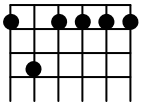

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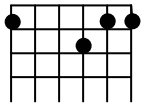

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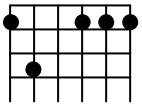

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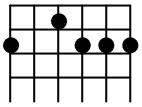

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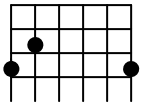

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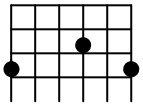

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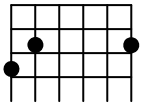

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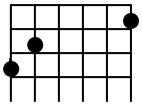

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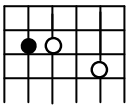

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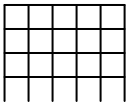

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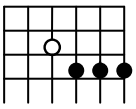
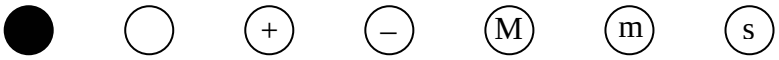


3. My Guitar Chord Slide Rule Invention

The B and b chords above, were using the fourth fret and were merely moved versions of the A and a chords. All chords have such trivial moved versions and one way to achieve these is using our pointing finger as an artificial "nut" or top fret of the guitar. Of course, this way we only have the other three fingers to actually finger strings lower. A useful device to replace our pointing finger is the "capo" a movable nut. This of course brings in new open strings and we might think that just sliding the fingerings is impossible with keeping the original nut and open strings.
Amazingly, the capo can be replaced by a sliding "cape" that combines the logic of chords melting into each other with keeping track of a fix nut position and open string values.
The crucial trick is to mark already the open strings above the nut with their chord values.
This works best with the perfect notation system, that is using letters for all chords as M , m , s.
These are the third notes and the other two could be denoted with black and white circles.
A smart choice is black as the key and white as the –5 because then the augmented and diminished can be white circles with + or – inside. These are the seven basic notes:



The rest of the positions then can be denoted with numbered circles:

The mentioned addition of the sus = s main value as 4 can be obtained by replacing s with s/4.

Placing our imaginary capo or cape anywhere, will create a possible key choice on the guitar.
The rule for basic chords is to use only three kinds from the seven basic notes above.
Namely, having black and a letter choice for sure and a third that then must be empty or a sign.
Having six strings of course means that such basic chords must have three repeats of some of these basic chord values.
Replacing some repeated ones with numbered circles will give four, five or six note chords.
The crucial showing of the chord values of the open strings is achieved by simply having six holes as the bottom window on our cape.
The also crucial key value of the black circles on the neck can also be established on the "cape" !
Either, by using a second window that shows key values printed on the neck further above.
Or using more holes with key values next to them and aligning these with a black circle of the neck.

Decades ago I discovered this system while teaching my daughter the guitar chords.
Then I didn't use M rather three colors. Red for black that is for the key, blue for –5 , and green for M. Of course + and – also being blue and m and s also being green.
Thus the rule is simply to use all three colors.
In Hungary I ended up meeting the same assholes that screwed up the Rubik's cube.
Finally, some famous people got involved but they wanted their unfair share for their names.
When we came to Australia, in Brisbane the Innovation Centre introduced me to Milan Tucek who started to manufacture and promote the invention as the "Mega Chord".
He was well intentioned but when he went to America he didn't want me to be there and that cost our biggest market. He screwed up the same way a fellow Brisbane inventor's invention for a golf ball collecting machine. Nowadays the electronic chord finders are in phones already.
Of course they don't reveal the slidings of the chords. Most importantly, my invention can be used backwards, to find out names of chords that you figure out yourself!