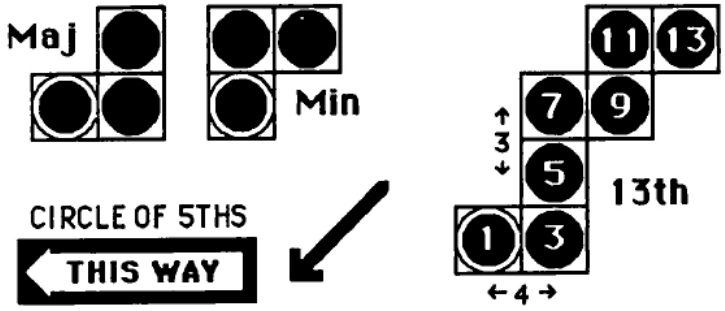
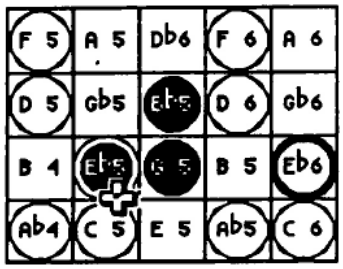


Harmony Grid

Users' Guide

Programming: Ethan Joffe
Production: Kate Temby
Documentation: David Levitt



Eb Major

Table of Contents

1. What is Harmony Grid?

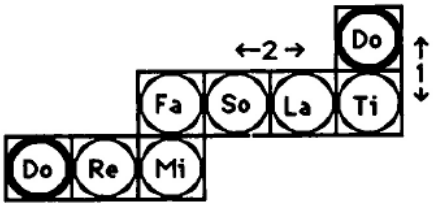
Harmony Grid is a software instrument that lets you explore basic harmony theory while making music. It presents a few simple concepts of harmony and 12-tone theory graphically, while you play the screen with the mouse. Harmony Grid documents contain bits of harmony theory, helping non-musicians improvise by keeping them effortlessly in key, and on the beat.

Harmony Grid is a simple program that can be used in a variety of ways. The basics -- the grid, clavier (the piano-style keyboard on the screen), chords, modes, metronome, and optional MIDI -- can be used as an instrument or a music learning tool.

Harmony Grid lets you:

- improvise in key before knowing any instrument
- play diatonic melodies, block chords, blues, and more
- learn voicings on traditional music keyboards
- learn music theory concepts
- see chord patterns from your MIDI instrument
- configure original instruments to improvise on

You don't have to know music theory to make music with Harmony Grid. If you want to learn or think about harmony, it offers an exciting way to play.



1.1. See Musical Spaces and Shapes

Musicians often think in terms of distances and shapes. A musician has many ideas of how one pitch might be 'near' another one, ideas that are usually mysterious to the non-musician. What note would follow this one on a particular scale? What chord root would typically follow the current one in a chord progression? Most musical instruments give hardly a clue of what the musician might think is 'nearby'.

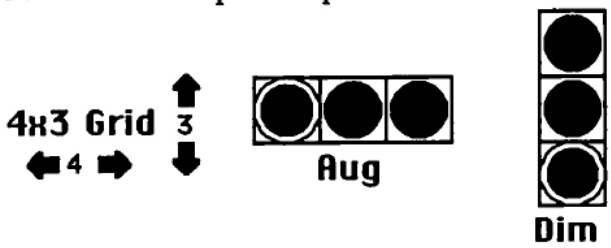
Harmony Grid provides a way to see several ideas of 'nearby' at once, using a two-dimensional *grid* and a traditional piano-style keyboard, called the *clavier*, at the bottom of the screen. In a grid, a pitch can be next to as many as eight others -- vertically, horizontally, or on a diagonal. So, each grid can capture a few ideas of 'nearness' in traditional melodic and harmonic motion. You can explore traditional ideas by playing the documents, or add new ones to explore personal, funky ideas of musical space.

Every musical interval, chord, or mode has a characteristic shape on a particular harmony grid, regardless of what key it is played in. So, in addition to capturing notions of 'nearby', Harmony Grid lets you picture chords and modes as simple shapes. Harmony Grid provides a simpler way to think of basic concepts like Major and Minor, since the shapes don't change when you change key, the way they do on a piano. The Reference Cards show the shapes for the many common chords and modes as they appear on the grid. Most chords and modes appear as simple, connected shapes on at least one grid.

Major and Minor triads always look this way on the 4x3 grid. With help from Harmony Grid and its Reference

Cards, you can learn harmony concepts like these, without attending to the special cases that come up when you change keys on most instruments.

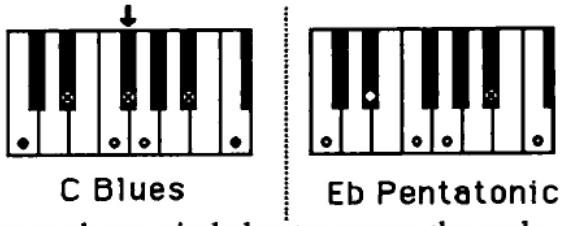
Shape patterns in Harmony Grid can show subtler properties of chords and scales, such as how they overlap and whether they are ambiguous. Harmony Grid presents many 'unstable' structures in traditional music theory as symmetric shapes that have multiple interpretations.



Augmented and Diminished triads, shown here on the 4x3 grid, are inherently unstable. Ideas like these are discussed further in the "Seeing Harmony Theory" chapters of the Users' Guide.

1.2. Learn Piano Keyboard Patterns

If you want to learn traditional musical keyboard patterns, the piano-style *clavier* on Harmony Grid's screen lets you quickly see all 12 shape patterns made by an interval, chord, or mode on a traditional keyboard instrument.

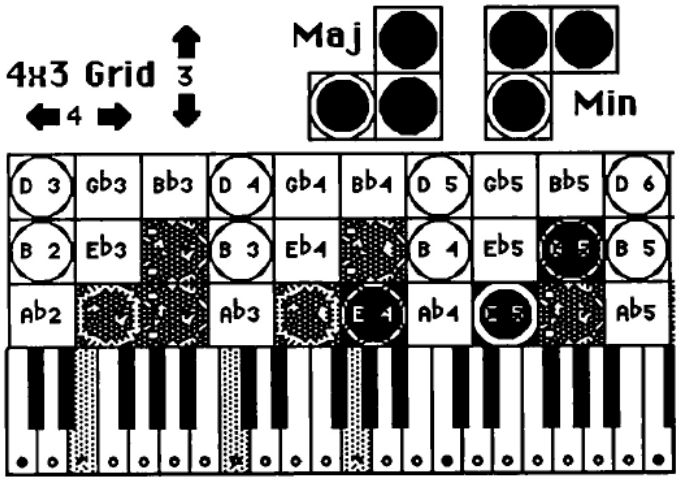


In the figure above, circled notes are on the scale, while the filled one indicates the root. We have drawn an arrow to show how the set of tones in the C Blues scale and the Eb Pentatonic scale differ by only one tone. You can play the clavier on the screen, much as you play the grid. Execute

graceful runs by checking '**Smooth Clavier**' in the **Options** menu, and clicking or dragging the mouse over the clavier.

1.3. Recognize MIDI Harmonies Visually

If you have a MIDI synthesizer, Harmony Grid can also help you recognize harmonic material played on your MIDI instrument. Here again, the simple shapes on the Reference Cards reveal the harmonic character as a grid shape.



In the figure, the speckled keys on the clavier show the wide voicing we're playing from our MIDI instrument. On the grid, the pitches appear in black, while in dark gray they've been translated into *all* the other octaves to demonstrate the concept of 'octave equivalence'. We see from its characteristic shape that we're clearly playing some inversion of Maj, the Major triad, rather than Min.

1.4. Create Original Instruments

Harmony Grid lets you create new chords, modes, and combinations of them under the keys 0 thru 9 on the Mac keyboard, and save every setting in a Harmony Grid document. This lets users create custom instruments that convey original musical ideas.

Because we're HIP, we don't think music learning is a transfer of fixed information from a teacher or textbook to a student. Harmony Grid lets you *play* with intervals, chords, and modes. We encourage musicians and teachers to create new curricula, by inventing documents and sharing their discoveries. The examples in the Users' Guide provide only a glimpse of Harmony Grid's potential as a learning laboratory. Write, call, or send us your documents! We're dying to know what you'll do with Harmony Grid.

1.5. Using this Guide

Like other Mac applications, you can figure out a lot about Harmony Grid on your own by exploring the menus and by using the on–line Help screen via the menu. Reference Cards also help you use the program without referring to the Help Screen or manual.

This guide is organized to let you play a bit with Harmony Grid and then learn how it works.

- **Getting Started** explains how to 'jam' with Harmony Grid and presents a few documents.
- **How Harmony Grid Works** summarizes exactly what happens when you move the mouse around the grid, and how to change the chord, mode, and scale root with the Mac keyboard.
- **Reference Manual** describes everything Harmony Grid can do in more detail.
- **Seeing Harmony Theory** explains the underlying concepts, and what the different grids mean musically.

The Reference Manual section and on-line Help screen let you explore the program in any order you wish.

To begin making your own documents immediately, read sections 4.9 and 4.10, "Create Chords and Modes" and "Design Instruments with Copy and Paste."

To avoid confusion, we've adopted the following conventions throughout this manual: the *clavier* is the

musical keyboard on the screen; the Mac's alphanumeric keyboard is always the *Mac Keyboard*; MIDI input, which may or may not be a keyboard, will be the *MIDI synthesizer*; and we'll reserve *keyboard* for piano-style keyboards in general.

To avoid confusing the 7-tone diatonic Major *mode* from the 3-tone Major *triad*, we'll spell out the 7-tone mode as 'Major mode' or 'Major', while we'll call the triad 'Major triad' or abbreviate it 'Maj'. So C Major means the scale, while C Maj means the triadic chord. We'll use the same conventions to distinguish 'Minor', the ascending melodic minor mode, from 'Min' the triad. A three-letter abbreviation means the triad.

2. Getting Started: Jamming on Harmony Grid

Here's a quick check-list for using Harmony Grid.

Disk

Protect your Harmony Grid master disk. Copy Harmony Grid onto your hard disk, or make a copy on floppy, and keep the locked master for backup.

Sound

If you are using a MIDI synthesizer, make sure **MIDI** is checked in the **Options** menu, and that your synthesizer is properly connected to the modem port and amplified.

Otherwise, make sure **Internal Sound** is checked., and set the sound volume by opening the Control Panel desk accessory in your menu.

Mouse

In your Mac's Control Panel, set your mouse to "Slow" but not "Very Slow" or "Very Fast".

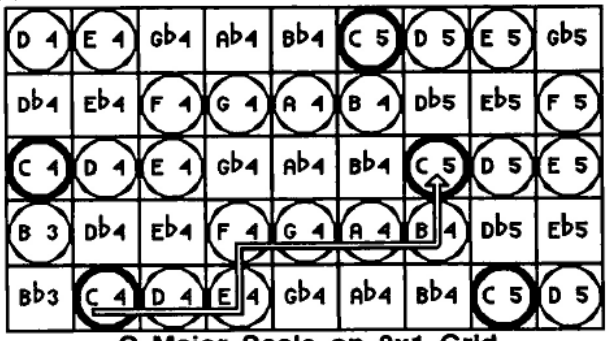
Mac Keyboard

Make sure `caps lock` on your Mac keyboard isn't depressed. Holding `shift` or `caps lock` lets you change the *mode*, the pattern of fixed circles on the screen. In a moment we'll be changing the *chord*, the dark pattern we drag around, so we'll stay unshifted.

2.1. Play the Try Me document

Double-click Harmony Grid to play with the 'Try Me' document. If you only have internal sound, click or open the 'Try Me (Internal Sound)' document instead.

Move the mouse over the grid, and you're playing it. Find one of the darkened circles labeled "C4" and move the mouse into it. Play a traditional *major scale* -- "Do Re Mi Fa So La Ti Do" -- by dragging the mouse *in the circles* from C4 to C5 as shown below:



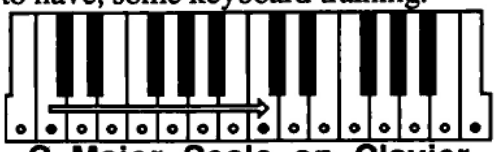
C Major Scale on 2x1 Grid

Simply turn upward or to the right where necessary to remain in the circles. Retrace your steps to go back down.

See how each note waits for a metronome pulse, before it jumps into the circle to play? Next time you go up and down, feel that pulse underneath, and be ready when the next pulse comes around. The pulses come pretty fast, so don't jerk, gesture. Glide into it. After each note, move the mouse into a nearby circle in time for the next tick.

It's OK if you fall behind or overshoot, or even if you hit outside the circles. Only the pitches in the circles will play. Try playing a rhythmically even scale anyway.

You can achieve the same effect by dragging the mouse from C4 to C5 on the white keys of the *clavier*, the piano-style keyboard below the grid. When you play a pitch anywhere on the grid or clavier, the other appearances of it also light up. The clavier will be helpful to users who have had, or would like to have, some keyboard training.



C Major Scale on Clavier

Play chord patterns
Press the numeric key 2, for the 'counterpoint' chord, and repeat the scale. Hear the backup voices underneath?

Press any of the keys 0 thru 9, on your Mac keyboard or numeric keypad, and repeat. The names of the patterns give hints to their behavior when played with an Ionian scale.

Most of the effects below work best if you stay within the scale. Some sound interesting if you move outside, since other notes in the chord still may sound.

1. **solo**. Play only the pitch under the mouse,which we call the *lead pitch*. Chord 1 is always solo, in every document.
2. **counterpoint**. As you move on the grid or clavier, a second voice chimes in below the lead pitch. Except, listen: when you're one square right of a dark circle (scale degree 2), the lower voice disappears and the lead pitch plays alone. If you're in C Ionian, you're playing D. This is discussed in greater detail later, in section 5.9.
3. **min ctrpt**. Like counterpoint, this creates a second voice on the scale, but in a generally minor tonality. It uses minor 3rds where 'counterpoint' uses Major 3rds. *Now* when you're on scale degree 2, a *third* voice is *added*. This too is discussed in chapter section 5.9.
4. **block chords**. Plays 4-note clusters, with 6ths and 2nds.

5. **Mm triad (1).** Plays a major or a minor triad as needed to stay in the current scale. You're dragging the chord around by its root. But listen: when you get to the left turn on the grid, the top voice disappears. (Musicians: if the root is C and you're on B, you'll be playing a minor 3rd, B and D.)

6. **-Mm triad (1).** Now we're dragging the top pitch of the Major/minor chord, though it's still the harmonic root.

Change Key

To change key, move over any note without a dark circle, and simply click the mouse button. See how the Scale (the circle pattern) shifts, so the dark circle is now under the mouse? You've moved the scale Root. Keep playing on circles, which now show a new scale.

Metronome

Glance at the blinking metronome squares in the lower left. See how every new note waits for that Metronome tick to happen? Select Harmony Grid Help from the menu for documentation on the metronome controls and other command keys.

Move up, around, diagonally, or however you like. Hear how arriving early creates a rhythmic suspense, a syncopation? Move through a *root* tone, one of the pitches in dark circles. Hear how moving into one resolves harmonic suspense, while moving below it or to the right creates new suspense? Plan your motions so you return to the root at what feels rhythmically like the end of a phrase. If you arrive early, or late, continue the phrase and try again next time. Jamming yet?

2.2. Blues document

Open or double-click on the 'Blues' document. This one works best if you play the piano-style clavier below the grid. If you know Blues piano, you can see that every note in a traditional C Blues scale has been marked with a circle. Those circled notes are the only notes you can play.

Bring the mouse cursor over to the clavier and press the mouse button. The cursor disappears, and you can see the notes you're playing as they darken. Drag right and left across the clavier. You're playing on a C Blues scale, with **Smooth Clavier** set (see the Reference section for details).

In the Blues document the Metronome is off, so the sound begins as soon as you touch a new note. This lets you be playful with timing. Hang out around a Gb, an unstable pitch, and return to the dark circles C, to resolve the suspense. (You can find Gb, or any other note we name, by looking for one of its appearances in a grid square. When you click on it, the corresponding note on the clavier lights up, along with every other occurence of it on the grid.)

Blues Roots

You can play standard blues progressions, where the root simply moves between C, F, and G, by changing the scale Root.

If you have a MIDI instrument or controller, you can set the scale Root easily by playing it in, over MIDI. **MIDI Set Root** is checked in the MIDI version of the Blues document. Now if you play a C, F, G, or any other note on your MIDI synthesizer, the scale Root (dark circle) will move and the rest of the scale (light circles) will be transposed accordingly. A typical 12–bar blues progression goes:

C F C _ F _ C _ G F C _

where "_" means a continuation of the previous root.

If you only have internal sound, you can still select a new root with the mouse and set it by typing `tab`, the root key on

the Mac keyboard. To set the root to F, move into an F on the clavier (or grid) and type `tab` on the Mac keyboard. Now we're in the F Blues scale. To move to G Blues, play G on the clavier and type `tab` again. To get back to F or C Blues, type `tab` while the mouse is playing that root. When changing roots this way, you may find you have to improvise slower. Still, the improvisation works best if you don't hesitate long over the new root during the transitions to the C, F, and G.

Since the clavier is currently in relative mode, you can only switch roots to other pitches in the current scale. So, if you accidentally move to a root which does not allow you to get to the next root that you want, you will have to release the mouse button, click on the desired new root, and hit tab.

2.3. Minor Classic document

Open the Minor Classic document and jam on the clavier, following the same basic instructions as for the Blues document, above. Click the mouse button on the clavier at the bottom of the screen, and drag it back and forth horizontally.

The metronome is fast, and you can't see the cursor when using the **Smooth Clavier**, so don't worry about positioning the mouse precisely. Try wiggling the mouse rapidly, and moving gradually from one area of the clavier to another. Think of the way the melody sometimes alternates up and down in a baroque or classical piece. Hear the strong underlying sense of sinister 'minor' tonality, offset by the rapid pace.

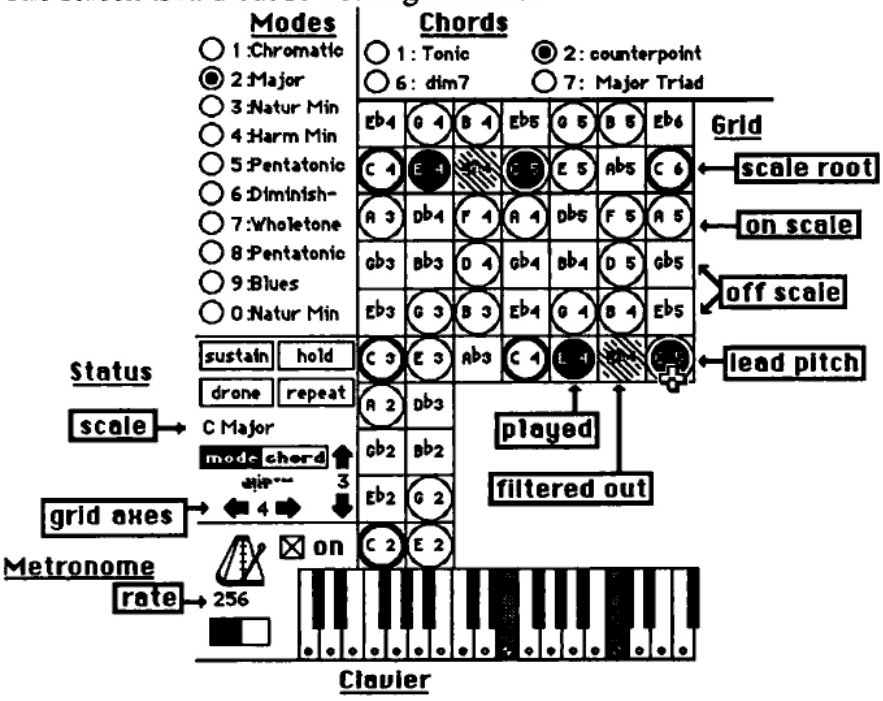
Change the root as you did in the Blues document -- by playing it in from MIDI, or by typing `tab`. Try the other chords in the document by typing different numbers and dragging new shapes around. Hear how the harmonic suspense builds, and then resolves when you stop on a dark circle?

3. How Harmony Grid Works

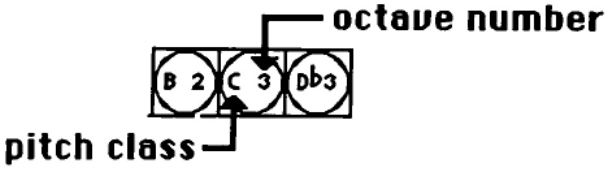
Before proceeding with the Harmony Grid reference manual, we'll summarize its behavior. When you play on the grid or clavier, Harmony Grid:

- determines what pitch the mouse is over, the *lead pitch*;
- transposes the current *chord* by that pitch;
- removes any pitch not in the current *scale*; and
- plays the resulting set of pitches.

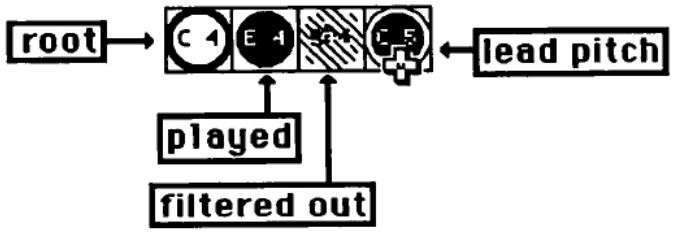
The screen is laid out something like this:



Pitches on the Harmony Grid are labeled with both their pitch-class and octave number. The octave increments as we ascend from B to C.



The grid behaves as though you're pulling a fixed shape around it with the mouse. The chord shape defines the set of musical intervals, the current *chord*[1]. You drag the chord around by one of its pitches, which we'll call the *lead pitch.* As you move the lead pitch, the rest of the chord follows it and is musically *transposed* along with it. The circled pitches are the *scale*, a kind of mask the chord intersects with. When a pitch in a chord peeks through a circle (a scale tone), the circle blackens and a note plays. If there's no circle there, the chord pitch peeks through silently, showing a faint striped pattern.

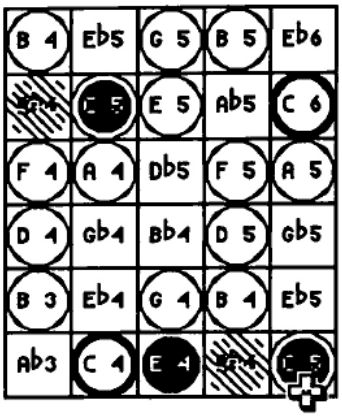


In the figure above two pitches are playing. The third pitch between them is being suppressed because it was not circled: it lies outside the C Major scale.

When you play a chord pattern with the mouse, it appears in more than one place on the grid, and on the piano clavier as well. In the figure below, the pitch C5 appears in multiple places on the same grid. Moving up and right on the grid

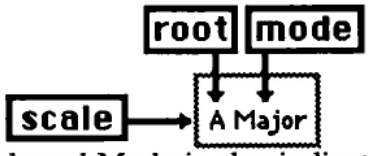
[1]In Harmony Grid, a chord is simply a set of intervals. This includes chord types like Maj triads and 7ths, as well as any other cluster of intervals.

increases the pitch while moving down and left decrease the pitch. So if the axes of the grid are set to 2x1, for instance, moving up 2 grid squares increases the pitch by 2 chromatic steps, and moving left 1 grid square decreases the pitch by 2 chromatic steps (since the horizontal axis increments by 2 chromatic steps per square). This results in the exact same pitch being in a position 2 squares up and 1 square left of a given pitch.



The pitches of the scale are defined as the current *mode*, transposed by the current scale *root*. The root is the pitch class in the dark circles on the grid (filled circles on the clavier).

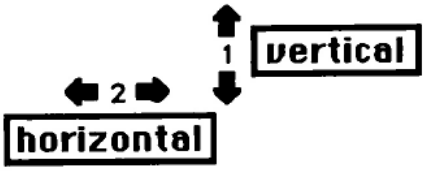
The name of the scale (root and mode) appears in the grid/status area on the left of the screen.



The currently selected Mode is also indicated by the active radio button among the Modes on the left. Likewise, the selected Chord is shown at the top of the screen. Typing a number between 0 and 9 will change the current chord or mode, depending on the state of the `shift` and `caps lock` keys.

The mode/chord icon in the Status area shows which is currently active as a black rectangle with white lettering. Also, a heavy line highlights the radio buttons for chords *or* modes, indicating which is active. The highlights in the figure above show that if we type a digit on the Mac keyboard, it will effect the *mode*, not the chord.

The grid axes indicate the intervals that correspond to the horizontal and vertical axes, in semitones. These large arrows are the only displays in the Status area that are also controls.



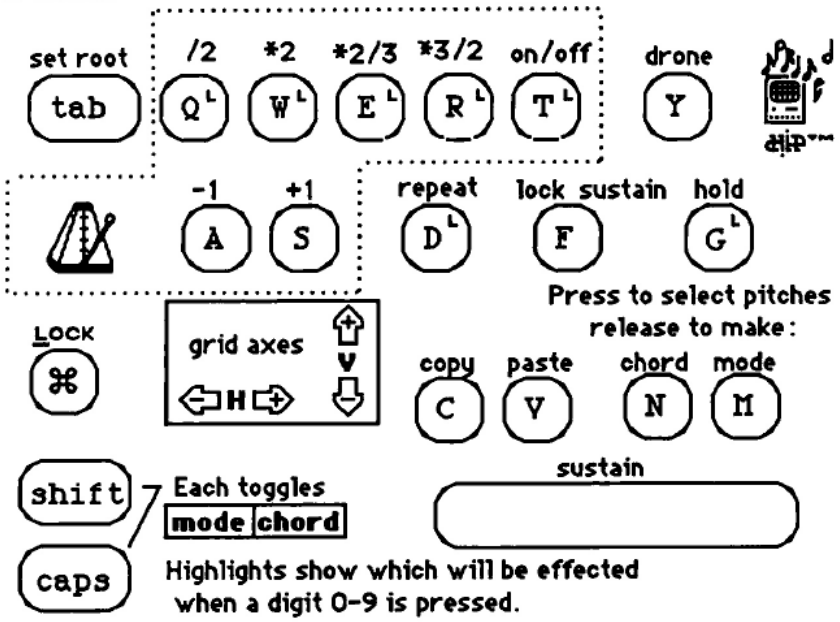
Click on them to change the interval corresponding to the vertical or horizontal, and make a new grid.

The ability to represent a pair of intervals by setting the grid axes is central to Harmony Grid's representation of musical structure. Several different settings for the grid axes are explored in chapter 5, Seeing Harmony Theory.

4. Harmony Grid Reference Manual

4.1. Help Screen

Most of the capabilities of Harmony Grid are summarized in the Help Screen, available under Harmony Grid Help in the menu.



4.2. Auto Button

First we describe **Auto Button** in the **Options** menu, because, when checked, it produces a significant global change in the way the mouse works.

- You don't have to press the mouse button to make music; moving the mouse over a pitch is sufficient.
- When you *do* press the mouse button, the scale root changes to the pitch you clicked on.

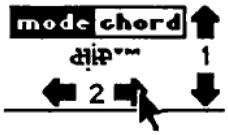
This is true of both the grid and the clavier (unless you're in **Smooth Clavier**, described in section 4.11.2 which always requires a mouse click to play). You can move freely

between the grid and the clavier. You can at once play easily, and change keys just by clicking, without needing to type the `tab` key or set it from **MIDI** with the **Sets Root** option. Instead of a pointing arrow, a cross-hair cursor shows that you don't have to press the mouse button to play.

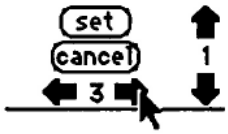
The **Auto Button** option simplifies real-time improvisation. If you want to move the mouse over the grid without making music -- for example, to select pitches to make a new chord or mode -- you'll probably want to turn **Auto Button** off.

4.3. Grid Axes

The grid controls are the large arrows in the status and control area, on the left side of the screen.



The numbers show the intervals, in semitones, spanned by independent horizontal and vertical motions on the grid. The intervals must be between 1 (a semitone or minor 2nd) and 12 (an octave), inclusive. To change either interval, click on an arrow to increment or decrement the interval. When you first click an arrow, set and cancel buttons appear beside them, where the Scale and mode/chord status displays used to be.



Increment and decrement the intervals until you've found the grid settings you want, and click the set button; otherwise click cancel to keep the old grid. The new grid is then set and drawn, and the status displays reappear.

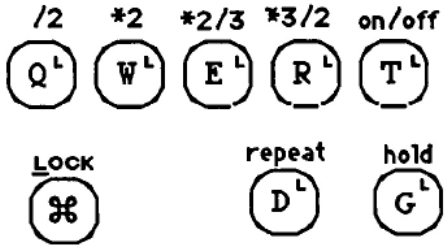
4.3.1. Mac Keyboard commands

Since Harmony Grid is a musical instrument as well as a visualization tool, the Mac keyboard commands have been

organized to make it easier to 'play' harmony grid than the Macintosh interface guidelines would ordinarily allow. For example, a typical operation doesn't require the Mac command key; just type the character. In fact, Harmony Grid makes special use of the command key: to lock a key command that is ordinarily intermittent.

4.3.2. Lock Intermittent Keys with 'command'

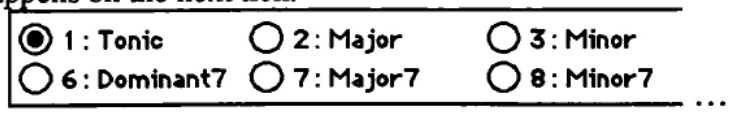
Several of Harmony Grid's Mac keyboard commands are *intermittent*: they work only while you're holding them down, and they revert to their previous state when you release them. This includes the hold (G) key and the metronome control keys (except for -1 and +1). These keys are marked with a tiny 'L' on the Harmony Grid Help screen.



Whenever you don't want to hold down an intermittent key, you can *lock* it down by holding the command key as you press the intermittent key. Of course, the key can't physically lock down like caps lock, but the effect is similar: the key will keep its new state after it is released.

4.4. Set the Chord

To change chords, simply type a digit from 0 to 9, on the Mac keyboard or numeric keypad. The corresponding chord replaces the current chord, as indicated in the radio buttons at the top of the screen. You may also click the radio buttons with the mouse. If the metronome is on, the chord change happens on the next tick.

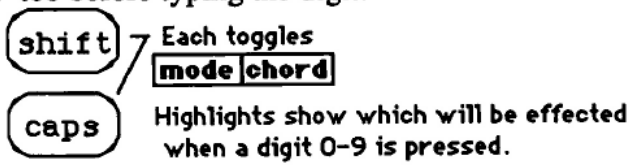


4.5. Set the Mode

Changing modes is just like changing chords, except the `shift` or `caps lock` key must be down. Type a digit between 0 and 9 on the Mac keyboard or numeric keypad, to select one of the 10 corresponding modes on the left side of the screen.

4.6. Toggle Chord/Mode with 'shift' and 'caps'

While `shift` or `caps lock` is down, chord and mode switch roles with respect to the digit keys and the shift keys. If `caps lock` is down, the player can change modes with one finger, by typing a digit. When they're both down, `shift` and `caps lock` negate each other's effect, and typing a digit will change the chord, not the mode. That's the meaning of XOR in the icon -- we change from chords to modes if `shift` *or* `caps lock` is down, but not if both are down. To change *chords* while `caps lock` is down, hold `shift` too before typing the digit.



Also, you can always click on the radio buttons to change the chord or mode.

The `shift` and `caps lock` keys are used only for chord/mode control; all other commands ignore these keys. We depict Mac keys in lower case throughout the documentation.

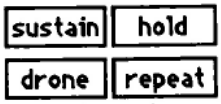
4.7. Set Scale Root

Change the scale root to the currently playing pitch by typing `tab`, the root key shown in the Help screen.

There are two other ways to set the scale root. When **Auto Button** is checked in the **Options** menu, clicking the mouse button on the grid or clavier will set the root. When **Sets Root** is checked in the **MIDI** menu, any MIDI input will set the root.

4.8. Status area

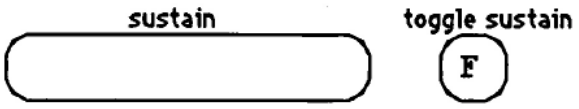
The status of four real-time switches is indicated in the Status area on the left side of the screen.



When the switch is active (pressed or locked) the corresponding rectangle inverts to show white text on black. The next four sections describe each of these keys.

4.8.1. Sustain keys

The sustain key is the `space bar`. It works like the sustain pedal on a piano: while you're pressing it, the notes you play stay on until you release the sustain key. Unlike a piano, Harmony Grid sustains a limited number of notes (specified in the **Hold Number** of the **Settings...** dialog). If you try to exceed that number, notes are released in the order they arrived, one at a time.



Harmony Grid also provides a way to lock the sustain on with a single key. Type 'F' to lock the sustain on, and type it again to unlock it.

As explained below, the keys N and M also do a Sustain. (N and M are also found as **Make Mode** and **Make Chord** in the **Operations** menu.) If any of `space bar`, F, N, or M imposes a sustain, the sustain is active and is reflected in the sustain rectangle of the Status area.

4.8.2. Hold key

The hold key is G.

Hold is a single-event version of sustain. While hold is pressed or locked, after the mouse button does not cause the current chord to be released. It continues playing until the hold key is released, or until the next new chord on the grid or clavier. The chord turns *off* the previously held chord and replaces it with a new one. The result is *legato*; there is no silence between clicks of the mouse in contrast to *staccato*, an abrupt release after the attack.

The current status of the hold key is shown as inverted text in the hold rectangle in the Status area.

4.8.3. Drone key

The drone key is Y.

It lets you hold down one set of notes and keep playing others,without sustaining the notes that follow. Hold the key while playing, and whatever notes are playing will be

locked down. To release the droning notes, press the key again. The drone in the Status area shows whether the drone is holding down pitches.

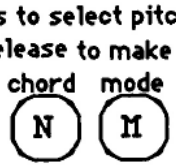
4.8.4. Repeat key

The repeat key is D.

Ordinarily, the grid plays only when you've either clicked or entered into a new circle. You can repeat a pitch or chord any number of times, at each metronome tick, by holding the repeat key.Hold down 'D' and the chord will play again on every metronome pulse until you release it. It acts as a kind of gate for the metronome trigger.

4.9. Create Chords and Modes

You can customize Harmony Grid, putting your own chord and mode patterns on your preferred numeric Mac keys. To create a new chord or mode, press sustain to collect notes by clicking on the grid or keyboard, and then type N (**Make Chord**) or M (**Make Mode**).



N and M are both *cluster* keys. A cluster key is like sustain, except when it is pressed:

- the chord is temporarily changed to 1, Solo, and
- the mode is temporarily changed to 1, Chromatic.

This lets you easily select any combination of pitches, independent of the current Chord and Mode settings. When the key is released, a dialog appears so you can number and name the new mode or chord. (If no pitches are selected, the Mac beeps and the dialog does not appear.) Thus, using **Make Chord** and **Make Mode**, a new chord or mode can be collected in a single keystroke.

When you release the key and the **Make Chord** or **Make Mode** dialog appears, select the new chord or mode number from the Mac Keyboard or numeric keypad. The Solo chord and Chromatic mode cannot be replaced, so 1 is not a valid number for a new mode or chord. Then press `tab` to enter the chord or mode name. To fit on the screen, the name should be fewer than 10 characters.

Make Chord and **Make Mode** are smart if, after pressing one, but before releasing it, you realize you wanted to press the other. For instance, if you pressed N for **Make Chord** but you really want a Mode, press M before releasing N and no chord will be created. Then when you release M, you'll have your new mode.

If you're not sure just what chord or mode you want to make, hold down notes you think you want with the Sustain key (`space bar`) before pressing and releasing **Make Chord** or **Make Mode.** That way, to cancel an unwanted collection of pitches, you can simply release Sustain. To cancel **Make Chord** or **Make Mode**, you must release the key and click Cancel in the subsequent dialog.

When collecting pitches for a mode or chord, the first pitch you select is important, since all the intervals are computed with respect to it. If you're making a chord, it will become the *lead pitch*, the origin of the pattern you drag around. If you're making a mode, it will be treated as the *root*. Often, you'll click the lowest or highest note of a chord first, so later you can drag the pattern around by its lowest or highest note.

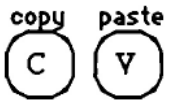
When creating a chord or mode, the **Hold Number,** in the **Settings** dialog of the **Options** menu, must be at least as large as the cluster you want to collect. If you're using Mac Internal Sound, which is limited to 4 voices, you can still collect a mode with 7 or more tones; you'll see them on the screen, but you just won't hear them all at once.

If you're using the grid to select pitches for a new chord or mode, you probably do *not* want **Auto Button** checked in the **Options** menu. This would cause every pitch you passed over to be added to the new mode or chord.

Experiment with original chord and mode patterns to discover new uses for the Harmony Grid. The 'Seeing Harmony Theory' chapter covers just a few of the traditional relationships musicians use.

4.10. Design Instruments with Copy and Paste

Once you've created a chord or mode and assigned it to a digit, you can move it to any other key (except 1) without rebuilding it from scratch. C and V are the copy and paste keys, which can be used with or without the `command` key. For Copy, the currently selected item is copied; for Paste, a previously copied item is Pasted to replace the item at the currently selected digit.



As with the digit keys, the status of `shift` and `caps lock` -- indicated in the mode/chord status display and highlights -- determine whether the Copy or Paste operation applies to the currently selected mode, or to the current chord. Once again, if *neither* is pressed (or if both are depressed) we are copying or pasting a *chord*. If *one* of `shift` or `caps lock` is depressed, we are copying or pasting a *mode*. Harmony Grid does not allow the user to paste a chord into a mode, or vice versa. Neither does it allow a Paste of a mode or chord before there has been a prior Copy of the same. Also, you can not replace mode 1 (Chromatic) or chord 1 (Solo).

Copy and Paste let you create individualized instruments with your Harmony Grid chords and modes. When you find two chords or modes you'd like to alternate between, lay them out so they're on adjacent keys. The easy transition between the two chords or modes is now a feature of the new instrument you have just invented.

4.11. Clavier

The Clavier lets you see what Harmony Grid is playing on a standard piano-style keyboard, and to play it by clicking and dragging. It is also useful if you want to see how you would play a Harmony Grid pattern on a traditional keyboard.

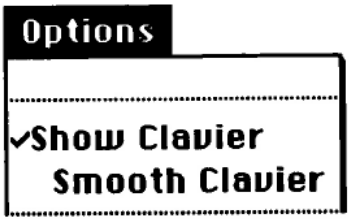
4.11.1. Show Clavier

If you check **Show Clavier** from the **Options** menu, the clavier appears at the bottom of the screen. If you don't check it, the clavier is replaced by two additional rows at the bottom of the grid.

As on the grid, the Clavier marks the pitches of the current scale with circles, now near the bottom of each key. The scale root appears as a filled circle, the other scale tones as unfilled circles. So, you can quickly see which notes on the piano are in C Ionian or Eb Ionian by setting the mode to Ionian and moving the root to C or Eb using to set root (`tab`) key, on the grid or keyboard.

4.11.2. Smooth Clavier

Smooth Clavier, in the **Options** menu, lets you improvise smoothly on the clavier, regardless of what mode and root you have selected. Check **Show Clavier** and **Smooth Clavier** in the **Options** menu to obtain this effect.



Ordinarily, when you drag the mouse across the clavier, the rhythm varies depending on when you touch each key. If successive keys in the mode span intervals of different sizes, it can be difficult to play a smooth scale on the clavier.

Smooth Clavier divides each octave into equal parts -- as many parts as there are pitch classes in the current scale. When **Smooth Clavier** is checked, wherever you click or drag the mouse on the clavier, it plays the scale tone nearest to the one you're over, in accord with its evenly-divided octave. To avoid confusion, when you click on the clavier in **Smooth Clavier**, the cursor disappears. You hear and see where you are on the keyboard by which note is playing (gray).

The 'Blues' and other documents use this to make it easier to jam on the clavier with the mouse.

4.12. Metronome

The metronome control keys are together in the QWERT area of the Mac keyboard, as shown in the Help screen. The area around the metronome icon shows whether the metronome is off or on, and the current rate in ticks-per-minute. The progress of ticks is shown with a pair of alternating, flashing rectangles.

When the metronome is *off*, notes are played immediately when they are triggered -- by clicking a key on the grid or clavier, or dragging the mouse onto a new grid circle or clavier key. The rectangles still alternate, so that when you turn the metronome on, you already know the pulse.

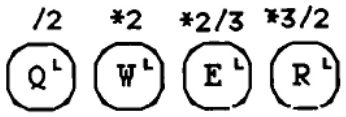
When the metronome is on (as it is in many Harmony Grid documents), events wait for the underlying pulse indicated by the metronome squares in the lower left corner. You can see whether the metronome is on by looking for an X in the Mac control box.

4.12.1. On/Off

To turn the metronome on or off, type the T key or click the metronome check box on the screen.

4.12.2. Metrical changes

You can change the metronome rate by any of four metrical values: *half*, *double*, *dotted*, or *triplet*. These correspond, respectively, to multiplying the rate by 1/2, 2, 2/3, or 3/2, respectively, as shown in the Help screen. They are available on Q,W, E, and R, respectively.

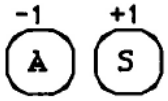


All four metrical keys are intermittent: holding them down produces a temporary change to the rate indicated on the rate setting. When the key is released, the rate goes back to its old value. The change always happens at the beginning of the next tick, so the underlying pulse is retained.

If you wish to make a metrical tempo change without holding the key, hold the command key before you press the metronome key. Now the metronome change is permanent, and subsequent key presses will affect this new metronome setting. To switch back to the previous tempo, remember that half and double are opposites, and that dotted and triplet are also opposites.

4.12.3. Incremental changes

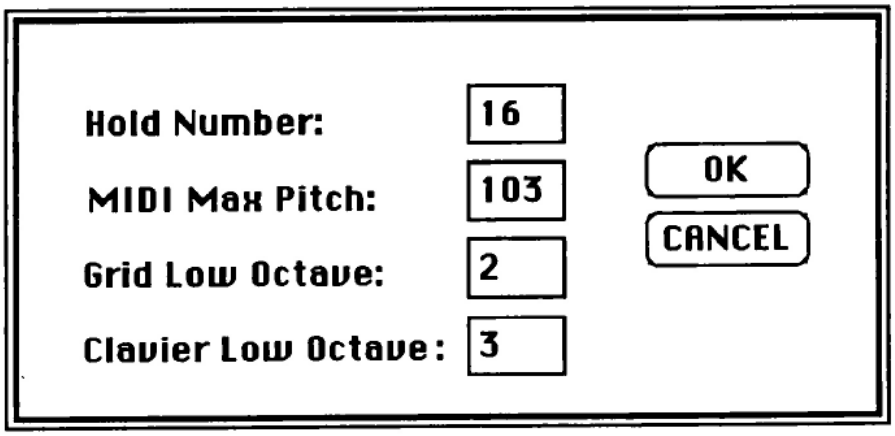
To slow down or speed up gradually, press the -1 and +1 keys (A and S), which are just below the other metronome keys.



They increment and decrement the current rate value, which is always a whole number of beats per minute.

4.13. Settings dialog

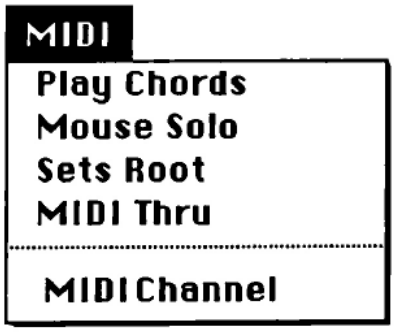
The **Settings** dialog is in the **Options** menu. It allows the user to modify four parameter settings:



- **Hold Number**: the maximum number of pitches that can be held at once. If this is exceeded, the least recently played chord is automatically released.
- **MIDI Max Pitch**: the highest MIDI pitch you can play on the grid *or* clavier. If you're using a MIDI synthesizer, set this to the highest pitch it will play.
- **Grid Low Octave**: the grid reference, expressed as a MIDI octave number for a C in the lower left corner. It can range from 0 to 9.
- **Clavier Low Octave**: a MIDI octave number for the lowest key on the Clavier. It can range from 0 to 4.

4.14. MIDI settings

If you've selected **MIDI** in the **Options** menu, several new capabilities come into play, and additional options become available in a **MIDI** menu on the right.



4.14.1. MIDI Shows Pitch Classes

Whenever **MIDI** is selected and connected, notes played on the MIDI synthesizer appear on both the grid and the clavier in the following forms:

- in light grey speckles on the clavier
- as black squares in the grid
- every pitch played on the controller appears as a dark grey square in every corresponding pitch-class on the grid. In effect, a pitch played in one octave is folded over to appear on the grid in *every* octave. This facilitates recognition of chords and intervals in any inversion, as discussed in sections 1.3 and 5.5 of this Guide.

The options in the **MIDI** menu allow several new capabilities, some of which are demonstrated in the Blues document.

4.14.2. Play Chords

When **Play Chords** is checked, every note played in from the MIDI synthesizer is echoed back to the MIDI output (typically, the same synthesizer) as the current chord, as if the same pitch were being played on the grid or clavier. If

you play a G and the chord is 7th, you instantly hear a G 7th chord.

4.14.3. Mouse Solo

Mouse Solo lets you play just one note at a time -- the Solo chord -- with the mouse on the grid or clavier, regardless of the actual setting of the current chord. This is especially useful with the **Play Chords** option, since it lets you play a monophonic melody on the grid or clavier, and accompany yourself with chords by hitting just one note on the MIDI instrument. The Blues document has both **Play Chords** and **Mouse Solo** settings checked.

4.14.4. Sets Root

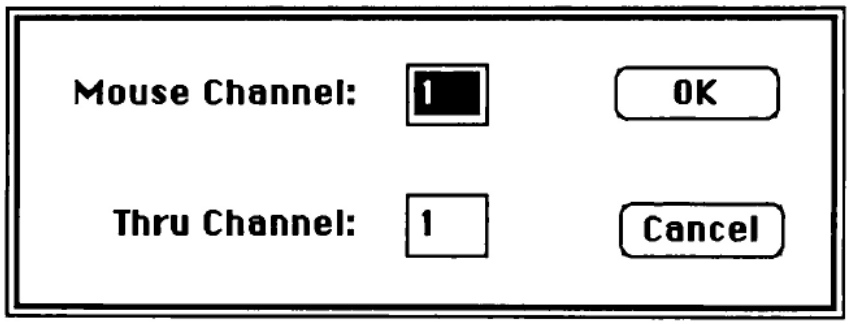
When **Sets Root** is checked, every new note from the MIDI synthesizer sets the root of the current Scale to its own pitch class. This lets you change the scale root without clicking the mouse button or typing `tab` on the Mac Keyboard, just by playing say, a bass line. Once again, the Blues document provides a clear demonstration of this.

4.14.5. MIDI Thru

If your MIDI synthesizer does not generate its own sound, or if you want to use another sound, your MIDI input can be routed through Harmony Grid to the MIDI out device using **MIDI Thru.** When **MIDI Thru** is checked, any input from MIDI is forwarded to the MIDI out device.

4.14.6. MIDI Channels

The **MIDI Channels** dialog lets you select the MIDI output channel numbers for the grid/keyboard, and for **MIDI Thru.**



Channel numbers must be between 1 and 16. The **Thru Channel** number determines the channel over which normal MIDI thru events will be sent as well as MIDI chord events generated by Harmony Grid. The **Mouse Channel** number effects all other MIDI output from Harmony Grid.

4.15. Saving Documents

The grid axes, chords, modes, and menu settings can be saved in a Harmony Grid document, using **Save** or **Save As...** in the **File** menu, in accord with the standard Macintosh interface guidelines. This way you can easily recreate the state of everything (except the mouse position and button state) just by opening that document.

Harmony Grid will warn you if you try to open a new document without saving changes. Any change in the current chord, mode, or scale root, Internal/MIDI status, etc. constitutes a change.

If you consider your changes trivial and do not wish to save them, simply click No. If you've worked on a document and don't want it casually changed, it's a good idea to lock the file from the Finder, using the **Get Info** item in the **File** menu.

4.16. Macintosh and Multifinder Compatibility

Harmony Grid has been tested with Apple's Release 5.0 and 6.0.2 System Software, one of which has been included on your Harmony Grid master disk. We believe Harmony Grid is compatible with every Macintosh, but it performs differently on each model.

When using 4 voices of Internal Sound on an SE, Plus, or earlier Mac, about half the machine cycles are spent producing the audio. Most operations, especially graphics updates during scale changes, will be slowed down substantially. With Internal Sound on these 68000-based Macs, melodies with more than 1 or 2 voices will work better as a tutorial than as a real-time instrument. On a Mac II, Internal Sound works fine, since the processor is 4 times faster and the sound is handled by special hardware.

Harmony Grid performs best when an external MIDI synthesizer is generating the sound. When using MIDI, Harmony Grid's graphic performance is real-time. When it does fall behind, Harmony Grid suspends graphic redisplay before resorting to glitches in sound; you'll see the graphics fall behind before the sound does.

4.16.1. Multifinder

Harmony Grid has been tested under Multifinder with a number of standard applications, including Ann Arbor Softworks' FullPaint™ and Microsoft's Word™ and Excel™. Harmony Grid relinquishes the modem port when it is suspended, so it should not interfere with other applications that use it, but we cannot guarantee its successful interaction with any other application under Multifinder. In particular, if you have an application that uses the modem port and are unsure how it is written, you may not want to launch Harmony Grid and other applications that use the same port, at the same time.

Ordinary applications don't run in the background, but servers may compete with Harmony Grid while they're running (e.g. Print Monitor during printing) and spoil the music's timing. To preserve Harmony Grid's real-time performance, do *not* run other applications *that do background processing* while playing it. If Harmony Grid's blinking metronome jerks unevenly under Multifinder, it is probably being interrupted by a background application. Depending on the application, you may be able to reset its Preferences so it doesn't run in the background. Or, if you have Apple's ResEdit program or some other Mac resource editor, you can reset the Background bit of its SIZE resource to 0.

In the rare case when a background application is interfering, don't leave the metronome jerking, or the music will sound awful. Find the offending application and quit it for a while. Harmony Grid will be much more fun.

5. Seeing Harmony Theory

Now that you've had a chance to jam with Harmony Grid and understand its basic operation you can explore what the different grids reflect about harmony theory.

In effect, this chapter is a tiny course in chromatic harmony, with Harmony Grid and the piano keyboard as the main instruments. It does not cover all of classical and jazz harmony, but it captures the basic concepts of set theory and arithmetic that are common to both. Harmony Grid is strongest in its presentations of intervals, chords, and scales as sets of pitches.

Harmony Grid uses the modern *chromatic* system of musical pitch: each octave is divided into 12 roughly equal, indivisible intervals called *semitones*. A majority of pitched music can be described this way, since modes with fewer than 12 divisions can usually be described as subsets of the 12 tones.

We've included documents that focus on traditional tonal music theory, but Harmony Grid itself is a more general musical tool that has barely been explored. If you're a musician, you may want to extend the libraries of traditional chords and modes you find in our documents. Any user can try new combinations of grid axes and see how they behave.

We stress that while the intervals, chord types, and scales in Harmony Grid are used widely in popular, jazz, and classical music, Harmony Grid's idea of *intersecting a 12-tone chord pattern with a scale* is a property of Harmony Grid, not of music theory in general. It's a bit like a stringed autoharp, where chords are made by filtering out combinations of strings with different shapes of dampers. On Harmony Grid, it's as though you can also 'strum' with different shaped 'picks' that have several points, hitting several notes at once separated by precise intervals. The scale determines the subset of pitches we'll actually hear.

Harmony Grid includes a black/white piano clavier, and some clever ways to represent 'diatonic' intervals of 7-tone modes, but deep down the grids are 12-tone beasts.

After an overview and definition of terms, we move quickly through the three main grids for traditional music concepts:

Modes: The 2x1 Grid shows structure in the common 7-tone scale types or *modes*. The traditional 'Major scale' mode (Do Re Me Fa So La Ti), standard classical and jazz modes, and most modes of 6, 7, or 8 tones appear as connected shapes on this grid. It is also a good grid for improvising melodies with stepwise motion.

The 2x3 Grid provides a transition between the Scales and Chords Grids, having one axis in common with each. Several Pentatonic modes appear as shapes on this grid.

Chords: The 4x3 Grid shows interval structure in the common chord types: Major and Minor triads (3-note chords) various 7th chords, and up to complex jazz 13th chords.

5.1. Music Terminology

It will be helpful to refer to musical pitches and intervals by their common names. The traditional naming system describes the modern 12–tone *chromatic* system in terms of the 7–tone *diatonic* system that preceded it. The names are cursed with some annoying historical oddities, but they're worth knowing if you ever want to talk to musicians. When possible we use a subset of the standard nomenclature, avoiding the confusion that can arise when a pitch or interval goes by more than one name. Most musicians can probably skip this section.

5.1.1. A Quick History of Pitch Systems

When an object vibrates, its pitch is determined by its main rate of vibration or *frequency*. People seem to have an innate ability to correlate sounds whose frequencies are related by simple ratios. In particular, we hear sounds whose frequencies are related by a factor of 2 as 'equivalent', and we say they have the same *pitch class*. Each factor of two in frequency is itself called an *octave*. So, the pitch class describes the basic harmonic character of the pitch, while the octave says how high or low it is.

Harmony Grid can give a quick lesson in this. Open the document 'PitchClass x Octave 1x12'. When you move horizontally on the grid, you're changing pitch class. When you move vertically, you're keeping the same pitch class but changing octaves. Look and listen.

Pitch classes are often simply called 'tones'. When we speak of a '7-tone' or '12-tone' system, we mean that each octave has been divided into 7 or 12 pitch classes.

Since harmonic ratios are inherent in the way instruments vibrate -- *and* in the way we hear -- people around the world have invented various 5, 6, and 7 tone *modes* whose relative frequencies were based on ratios. A few understood the math; most just tuned their instruments until the 'beating' of interference between harmonics went away.

The greek Pythagoras helped discover the mathematics of ratios around 550 B.C. He noted that equal musical intervals span equal frequency ratios. Pythagoras was especially fond of the simple ratio 3/2, now called the *perfect 5th.* Today's diatonic major is a variant of a mode he used.

You probably know the diatonic major mode as the melody 'Do Re Me Fa So La Ti Do', where the two 'Do's have the same pitch class and span an octave. If we start with a 'Do' whose frequency is 24 (a nice factorable number), the frequencies of the pitches in today's rational or 'just' diatonic major are:

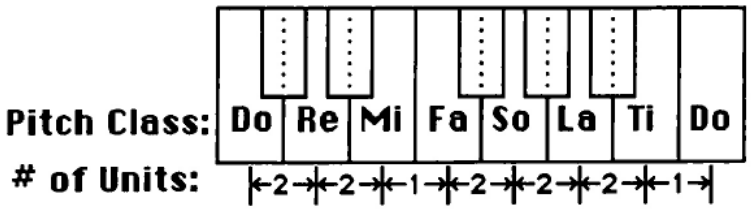
Frequency:	24	27	30	32	36	40	45	48
Pitch Class:	**Do**	**Re**	**Mi**	**Fa**	**So**	**La**	**Ti**	**Do**
Factor:		$\times\frac{1}{8}$	$\times\frac{1}{9}$	$\times\frac{1}{15}$	$\times\frac{1}{8}$	$\times\frac{1}{9}$	$\times\frac{1}{8}$	$\times\frac{1}{15}$

The factors show the ratio of each frequency to the one immediately below it. Each is a simple ratio: 9/8, 10/9, or 16/15. The glory of today's 12-tone system is, it lets musicians treat these 7 *unequal* intervals as if they were constructed from 12 *equal* intervals, called *chromatic semitones.* Without the chromatic system (for example, the addition of the black keys on the keyboard), we couldn't play both a major and a minor melody starting on the same pitch.

Apparently Pythagoras himself had two key insights that make today's 12-tone extension work. He noticed that 12 consecutive intervals of a perfect 5th (factors of 3/2) span *almost exactly*[1] 7 octaves (7 factors of 2), with 12 distinct pitch classes along the way. He also approximated a diatonic scale with just two sizes of interval: five larger (he used exactly 1 1/8) and two smaller (1 13/243 makes the octaves

[1]It's fractions: $(3/2)^{12}/2^7 = 3^{12}/2^{19} = 1.0136\ldots$, so it's less than 1.4% sharp.

come out to exactly 2). Still, over 1500 years elapsed before musicians seriously explored a system of *equal* units, where five larger intervals each span 2 units, while two smaller intervals each span just 1. It worked great.



The 12-tone *chromatic* system was born. Five black keys appeared on the keyboards, dividing the octave into 12 intervals called *semitones*. For a few more centuries, theorists and instrument tuners approximated the semitone with fractions, as in 'slightly more than 1 1/17'. Eventually roots and rational exponents were understood, and the irrational frequency factor of $2^{1/12}$ (about 1.05946...) was accepted as a mathematically consistent and practical semitone. Since Bach's day this has been known as the equal *tempered* 12-tone chromatic tuning system.

We should mention that tempered tuning inherently *can't* be in perfect tune with natural ratio-based or 'just' tuning. It's just very close. If you listen closely to intervals on a tempered instrument, you may even hear the faint tremolo or 'beats' that result. But if we used any other fixed 12-tone tuning, a melody would sound slightly different in each key. Tempered tuning is convenient for musicians who want to compose or play melodies that change keys *and* to hear intervals that are exactly equal, even though all intervals but octaves are very slightly out of tune.

This discussion of the creation of 12-tone from the 7-tone system should help clarify the next section, where the traditional names for pitch-classes and intervals are introduced.

5.1.2. Pitch and Interval names

To describe the common note and interval names, we'll continue to refer to the beautiful 'graphics' built in to the shape of every piano keyboard, with its white keys separated by black keys in groups of 2 and 3.

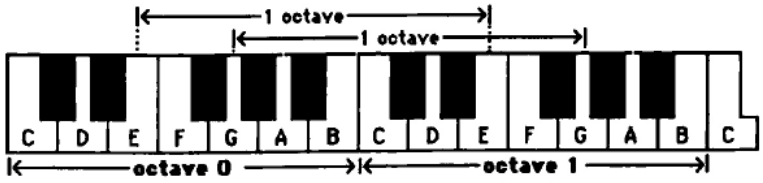
The keyboard clearly depicts the mapping of 7 *scale degrees* of the *diatonic major* mode (white keys originating with C) onto the 12 *semitones* of the *chromatic* mode (both black and white keys).

We find the diatonic major scale on the white keys of the piano, and label them with the first 7 letters of the alphabet -- though oddly, the 'natural' origin for a diatonic scale on the keyboard is C, not A. The origin of a scale or chord is called the root.

We label the piano keys with the first 7 letters of the alphabet, starting with C and going back to A after we reach G. First remind yourself that C lies just left of the group of *two* (not the three) black keys:

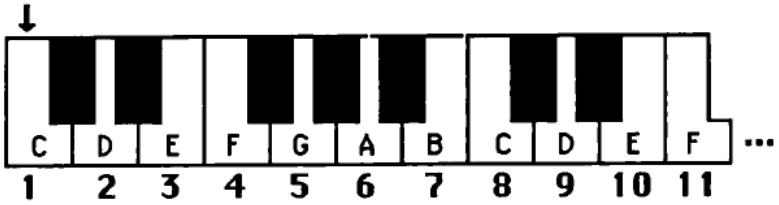
Now you can name all the piano keys: just cycle through those 7 letters in order, counting *only* white keys.

As shown, pitches one octave apart have the same pitch class.



Pitch names on the white keys

The names of *intervals* -- distances between pitches -- also originate with the 7-tone scale degree system. Sadly[1], the inventors of the traditional names counted from 1 rather than 0, so 'no distance' appears as scale degree 1. The figure below shows distances, in scale degrees, from the leftmost C.

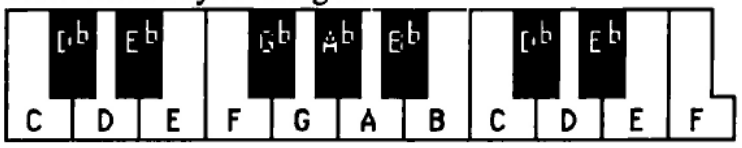


Scale Degrees with respect to low C

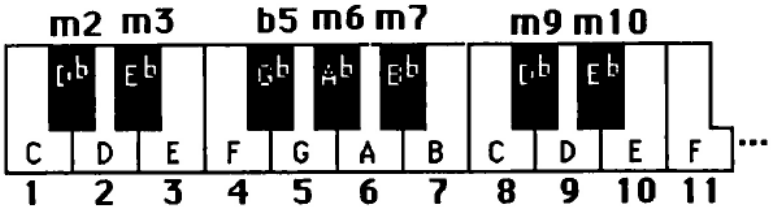
Note that pitch classes separated by 7 scale degrees have the same pitch class, i.e.1 and 8, 3 and 10, and so on.

[1]When we add and subtract intervals with ordinary arithmetic, results usually are off by 1. For instance, a 3rd + 3rd = 5th, 8ve - 4th = 5th. Convenient, huh?

Next we extend the naming system to include the full chromatic scale, with all 12 white and black keys. Pitches that were adjacent in the diatonic scale are not always adjacent on the chromatic scale. We name the black key by appending the symbol 'b', pronounced "flat"[1], to the name of the white key to its right.

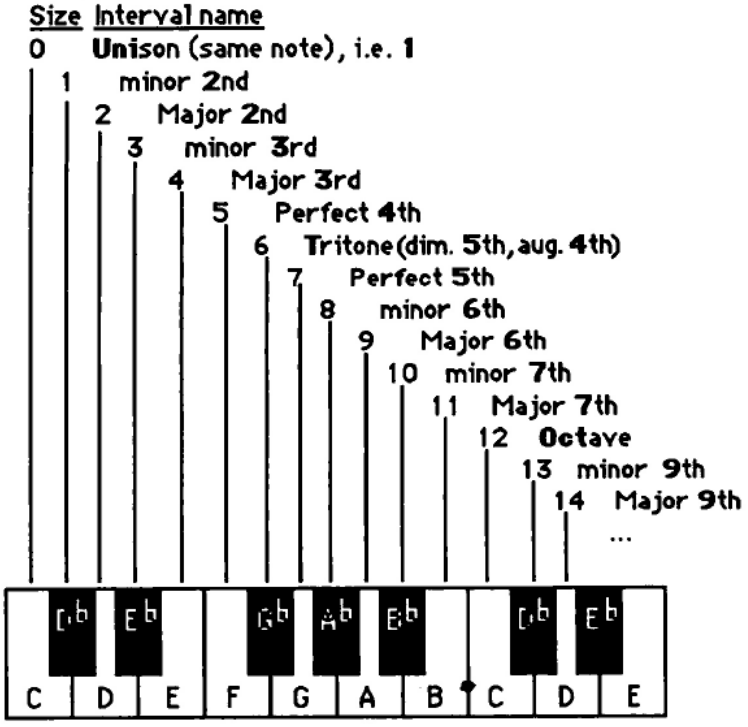


Likewise, the interval names are modifications of the numeric scale degrees we used. Musicians can prepend 'b' to describe a scale degree lowered by one semitone, or use 'minor', abbreviated as lower-case 'm'.



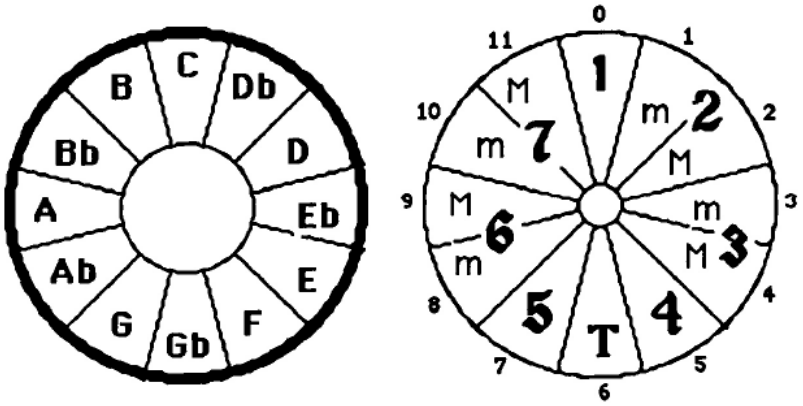
[1]Some harmony representations distinguish raised and lowered pitches, and can spell the same black key either Db or C#. Since Harmony Grid is at core a 12-tone system, we simply always use the lowered, 'flat' spelling.

The figure below spells out common names of the 12-tone intervals developed this way. The prefix 'Perfect' or 'Major' (abbreviated *capital* M) describes an unaltered scale degree, while 'minor' or 'flat' describes an interval lowered by one semitone. Finally, the interval of 6 semitones, exactly half an octave, is sometimes called the Tritone.



Traditional Note and Interval Names

The alternative view below reflects the cyclic nature of the system of pitch classes and octaves, in a display that reflects the reality of the modern 12–tone system: *intervals between successive keys span equal intervals, whether white or black.* The size of the interval is expressed in semitones outside the circle on the right, and in scale degrees inside that circle. Again we use capital M for Major intervals and lowercase m for minor.



We see that scale degrees 1, 4, and 5 don't split into a Major/minor pair. The 'Perfect' prefix on these three degrees is optional. Further stretching and shrinking of scale degrees is expressed by the prefix *augmented* or *diminished*, or simply by # or ♭.

5.1.3. Major and Minor tonalities

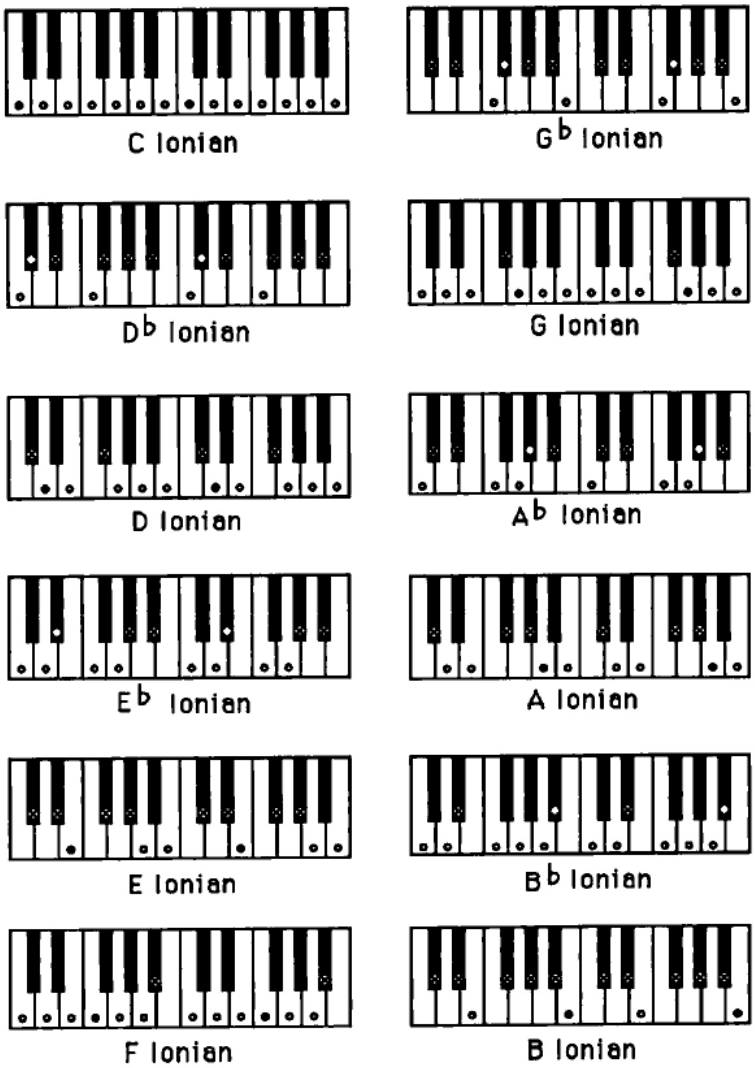
Though the terms *Major* and *Minor* can distinguish 'larger' and 'smaller' pairs in a few contexts, usually they refer to a particular scale degree, 1 thru 7. When we say 'major' or 'minor' without specifying a scale degree, it usually implies scale degree 3, a principal harmonic element in almost every chord and mode. Major and Minor triads (three note chords) are distinguished by the presence of the major or minor 3rd. Similarly, when we say that Dorian, Aeolian, and Melodic Minor are different kinds of minor modes, we're saying they all include the minor 3rd.

Hum the theme of Kubrick's 2001, Strauss' "Thus Spake Zarathustra." First three slow notes ascending; then two big chords, faster, and descending by just one semitone. Those last two jabs go from the major to the minor 3rd. The piece continues to alternate between them for a while, so it's a good way to think of Major and Minor.

In a chord or mode, the presence of the *major* 3rd relative to the root provides a 'bright and happy' quality, while a *minor* 3rd provides a 'dark and sad' one, respectively. Of course, these are very rough descriptions; the emotional character of a piece is influenced by tempo, loudness, orchestration, and other non-harmonic factors. As you read, *listen*. Compare the Major and Minor modes, and later, the Maj and Min chords in the Triads chapter. The significance of the major and minor 3rds will soon become apparent.

5.1.4. Harmony Grid vs the Keyboard

We've seen how C is the 'natural' root for the diatonic major mode on the keyboard, and learned how the additional 5 chromatic tones let you play diatonic melodies with the origin or root transposed to some other tone. The problem is, traditional instruments like the keyboard require different patterns to play a melody in different keys. The figure below shows the 12 scale patterns for diatonic major on the keyboard. The semitone interval pattern is 2-2-1-2-2-2-1 from the root, but the roots are all different. The roots are marked with a filled circle, and we use a traditional synonym for diatonic major, *Ionian*, as we will throughout the rest of the Users' Guide. Don't be intimidated! It's easy to see and explore these images with Harmony Grid's clavier. Moreover, the grid itself limits your need to learn them.



Diatonic Major in 12 keys

Isn't this annoying? The keyboard player has learned just one concept -- the diatonic major mode -- and already has to learn 12 different patterns to play it from any point in the octave. The black/white key pattern on the keyboard, which was so convenient when we were in C, has escalated the

problem of learning scales by a factor of 12. Asymmetries in the design of most instruments lead to similar learning obstacles.

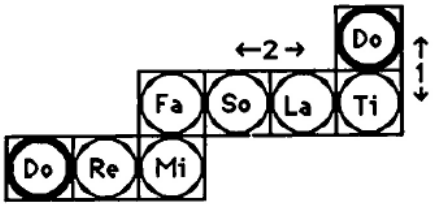
Musicians have no magical way of learning all this instantly. A few train equally in all 12 keys when they start; but the skill of transposing quickly from one key to another is difficult, and is by no means universal among musicians.

Irving Berlin, perhaps the most prolific composer of the 20th century, used a piano with a special 'clutch' that let *it* change keys while *he* alway played in G♭. Bebop wizards Charlie Parker and Dizzy Gillespie would dazzle other musicians with their transposing abilities, but the early Miles Davis liked to practice bebop tunes in just one key. When he played with Bird and Diz, they would always decide to try a new key while they were on stage. They made him cry every night.

But aren't concepts more important than technique? Can't the two be learned separately? If *we* had special instruments that made transposing easy, could we be as focussed and prolific as Irving Berlin?

It's not a new idea. Various alternatives to the traditional keyboard have appeared most of which were found to be inferior to the original in some way. Now, suddenly, computers and dynamic screens have become available. Harmony Grid is an early experiment in applying them to design instruments that make music concepts apparent.

On a Harmony Grid, diatonic major is played the same way in every key:



Diatonic Major (Ionian) in 2x1 Grid

The rest of this chapter presents the various intervals, chords and modes from traditional theory on their grids. You'll see specific examples of how Harmony Grid can help you learn basic and not-so-basic concepts in harmony, while you play.

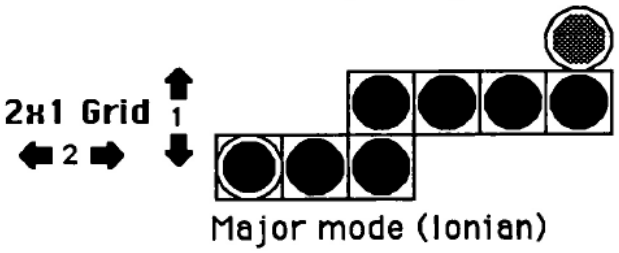
5.2. Standard Modes on the 2x1 Grid

Most 7-tone modes can be constructed from intervals of 1 and 2 semitones, i.e. by stacking consecutive minor 2nd and Major 2nd intervals. Modes made of those two intervals appear as contiguous shapes on the 2x1 grid. The characteristic shape of a Mode on the 2x1 grid is constant, even when the scale root is changed. The traditional 7-tone diatonic Major and Minor modes are fundamental structures that are easy to see and compare.

Play with the 'Major and Minor modes' document as you read this chapter.

5.2.1. Major (Ionian) mode

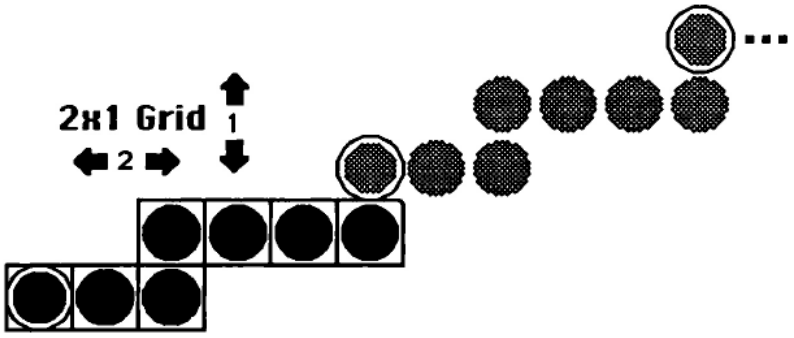
In the previous chapter, we described one of the fundamental structures of Western music: the 7–tone diatonic *Major* or *Ionian* mode, 'Do Re Mi Fa So La Ti Do'. When we discuss the 7 diatonic 'church' modes we'll use the synonym 'Ionian'. The figure shows the Major mode in our standard form for presenting a harmonic structure -- an interval, chord, or mode -- as a shape on a grid:



Major mode (Ionian)

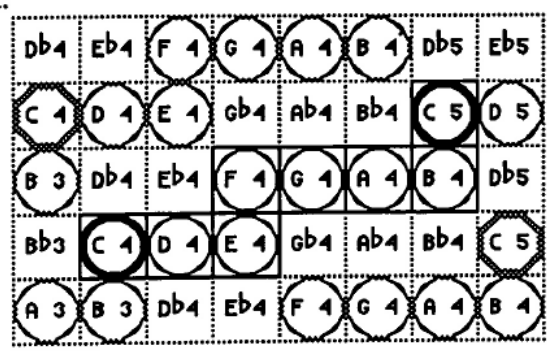
The grid axes show the intervals associated with the horizontal and vertical dimensions. Intervals are expressed in number of semitones. Since they must be positive, between 1 and 12, moving up *or* to right generally takes us to a higher pitch. The *root* of the structure, the low pitch at the lower left edge, is highlighted.

Often a gray circle will show where the root is repeated in the next octave, as in the previous figure. Its color and position outside the pattern of rectangles indicate it's the root of the next octave in a series of stacked octaves:

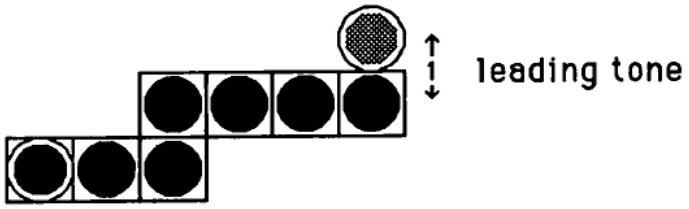


Two Octaves of Major mode

The shape is repeated throughout the grid, in different octaves and in different instances of the same octave. To recognize harmonic structures, *use the highlighted root as a reference point for the lower-left edge of the repeating shapes*. Thus we would recognize the Major mode in the grid by noticing patterns of connected circles leading northeast:



Now we can see, from a 12-tone space, how diatonic major is made of five intervals of 2 semitones and two of 1 semitone. The pitch just *below* the root -- lower in pitch *and* vertically on the 2x1 grid -- is called the *leading tone*. When ascending the octave, it leads immediately to the root.[1]



Leading Tone in Major mode

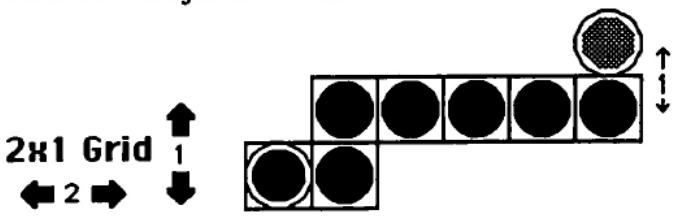
5.2.2. The Minor modes

Several different 7-tone modes containing the minor 3rd, are collectively known as minor modes. The next few paragraphs discuss them and the differences between them.

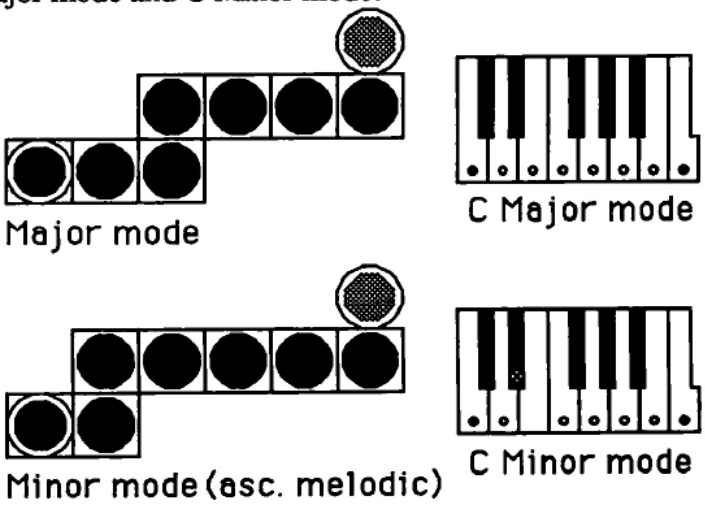
[1]This is a musical term, not to be confused with the 'lead pitch' we drag around the grid or clavier.

5.2.3. Minor (ascending melodic minor)

One important mode often known as *ascending melodic minor* is abbreviated simply as *Minor mode* here. Minor mode is just like Major mode, except the 3rd degree has been lowered from Major to minor.



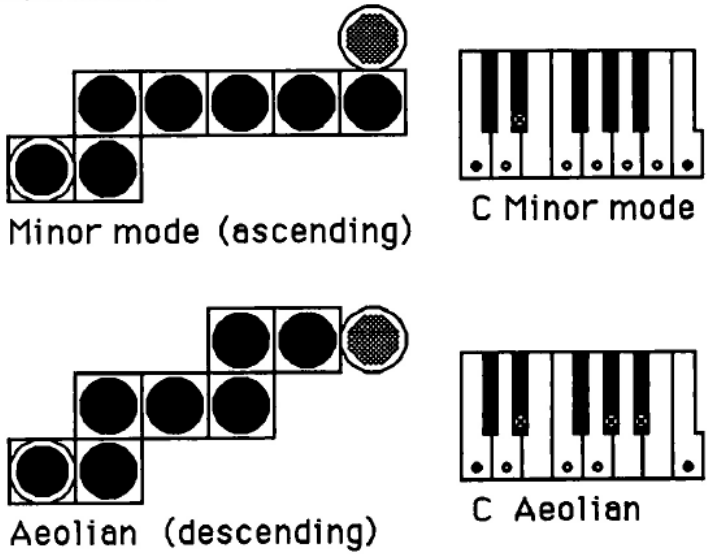
Once again we find five Major 2nds and two minor 2nds adding up to an octave, and a leading tone below the root. But now the first upward turn comes one step sooner, and the Major 2nds (horizontals) are in groups of 2 and 5, instead of 4 and 3. We can see this more clearly by showing the 2x1 grid patterns along with the clavier patterns for C Major mode and C Minor mode:



5.2.3.1. Ascending vs Descending Minor

Some music lends itself to description in terms of pairs of alternating modes: for example, one for *ascending* melodic motion, the other for *descending*. Ascending modes typically contain the leading tone, while the descending melody often does not.

A traditional example is found in the ascending and descending versions of the traditional Melodic Minor modes. We already know 'ascending melodic minor' by the name Minor mode. When descending, we switch to the Aeolian mode, also known as as 'natural minor' or 'descending melodic minor'.

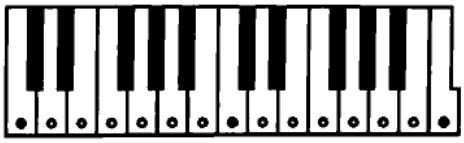


Ascending vs Descending Minor

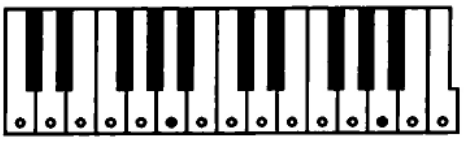
The figure above shows how the lowered 6th and 7th degrees of Aeolian appear on the 2x1 grid and the clavier.

In the 'Minor modes' document, play an ascending scale with Minor and descend on Aeolian. Try it on both the grid and on the clavier. Hear the similarity (the minor 3rd)? Hear the difference, especially the leading tone on ascent, and the semitone going from scale degree 6 to 5 on descent?

Try this: compare C Aeolian to Eb Major, on the grid and clavier. See how they describe the same set of pitches, even though they have different roots? Likewise, A Aeolian and C Major describe the same set of pitches: the white keys.



C Major mode



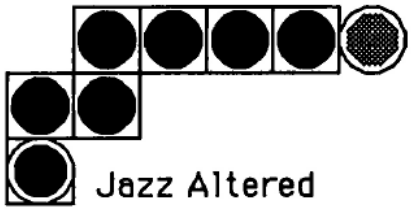
A Aeolian

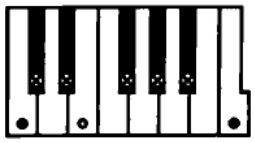
Mathematicians say Aeolian and Major mode are *rotations in the same group* of modes. The 'Church modes' section has more on this subject.

Minor mode (ascending melodic minor) had a *major* 6th and 7th, while Aeolian had a *minor* 6th and 7th. Dorian and Harmonic Minor offer one of *each*, M and m, 6th or 7th. Compare all four, and hear the difference -- especially how the leading tone works when Minor and Harmonic Minor are ascending. And hear how the 3rd still provides the overall minor harmonic quality.

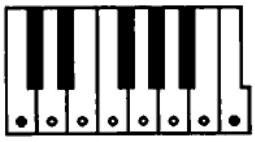
5.2.4. Jazz Altered

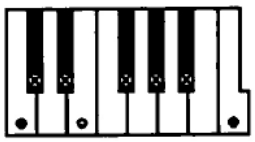
We've seen simple, traditional Major and Minor modes, and how they appear on the 2x1 grid and clavier. Let's look at a few more modes on the 2x1 grid.


Jazz Altered


C Jazz Altered

One simple way to describe the Jazz Altered mode: it's like the Major mode but *every tone except the root has been lowered by one semitone.* If we think of lowering a tone as making it 'blue'[1] or taking it 'outside' the major scale, the Jazz Altered mode is as far 'out' as you can get without changing the root itself. On the clavier, C Ionian contains no black keys; C Jazz Altered contains all five. Play up and down the scale on the grid or clavier, and switch from C Ionian to C Jazz Altered and back. Hear everything go *out* and back *in* again?


C Major mode


C Jazz Altered

Jazz Altered has some other simple descriptions. It is the rotation of Minor mode on scale degree 7 -- just as Aeolian is the rotation of Ionian at the scale degree 6. Demonstrate on the Harmony Grid that the C Minor mode describes the same set of tones as B Jazz Altered.[2]

Jazz Altered also has the interesting property that it contains both the Minor 3rd *and* the Major 3rd. Strict adherents to 7–tone terminology call the larger interval a diminished *4th.*

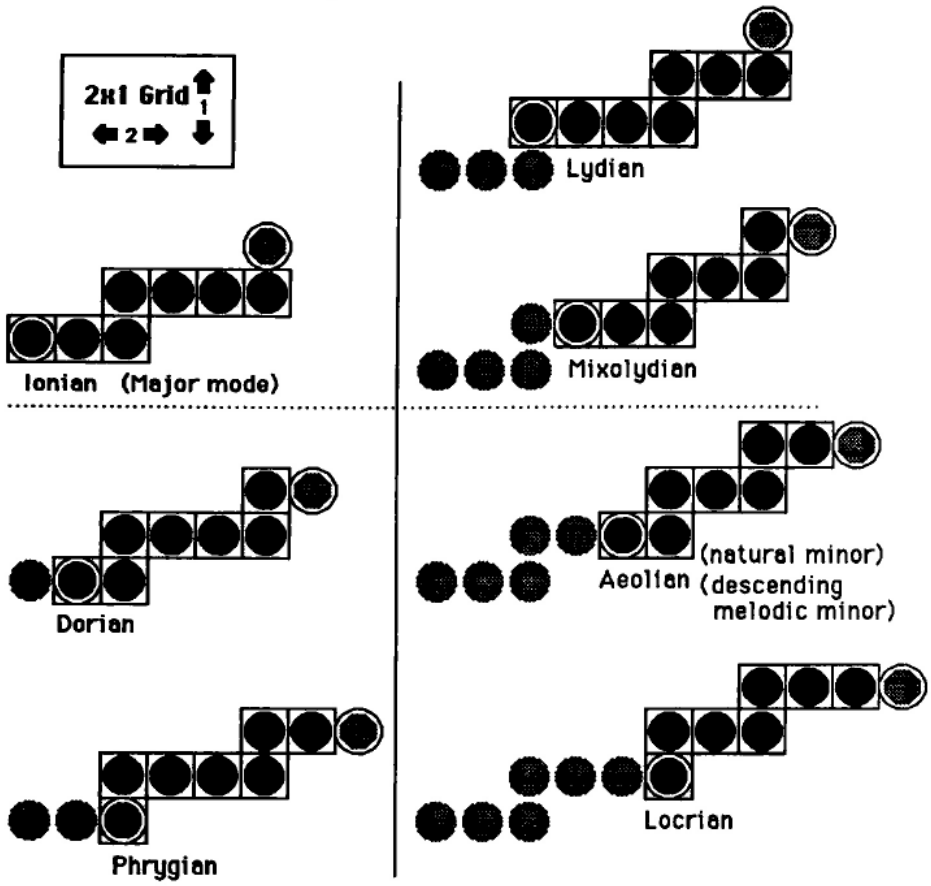
5.2.5. 'Church' Modes

The diatonic Major mode was studied extensively for centuries. All 7 of its rotations were named and used in religious music; they're sometimes called the 'Church'

[1]Indeed, a lowered scale degree is often called a 'blue' note.

[2]B is the 7th degree of C.

Modes. It's instructive to see how to view a set of tones in several ways, by in turn considering each one the root. Each is constructed from 5 major 2nds, in a sequence of 2 and another of 3, delimited by 2 minor 2nds in each octave.



The 7 Diatonic 'Church' Modes

Open the Church Modes document in the Modes folder. The 7 modes in the figure below, Ionian thru Locrian, appear as modes 3 thru 9. You can try them all by typing the corresponding digit, with `shift` or `caps lock` down.

The 'Church Modes' document shows the 7 modes above, enumerated vertically by column in the figure, each beginning on scale degree 2 (one step up) of the previous one.

Alternately, we can organize the same 7 modes so the most *similar* modes are adjacent. Open the 'Church Modes gray code' document and see that the modes are ordered as if the figure above were addressed horizontally in *rows*, beginning at the top with Lydian. Each successive mode differs by one tone from the previous one. Each new mode *lowers* an additional scale degree, in this order:

4, 7, 3, 6, 2, 5

So, first we lower the (already augmented) 4th of Lydian to get Ionian; then we lower the 7th and get Mixolydian; and so on through Locrian, where we've diminished everything once except the root. (If we lower Locrian's 4th degree one *more* semitone, we're in a Jazz Altered mode.) Try the modes in sequence in 'Church Modes gray code'[1] to play with the effect. Note that the first three have a major 3rd, the other four a minor 3rd, providing several varieties of both basic tonalities.

Whatever order we enumerate them in, it is mathematically and musically significant that they are all different. For any given scale on a church mode, there is exactly one Major mode and root that contains the same tones. Whatever church mode and root we're in, we just have to look for the Major mode shape on the 2x1 grid, and look in the lower left corner to see the equivalent Major mode's root. Likewise, there are 7 unique rotations of the Minor mode, of which Jazz Altered is one.

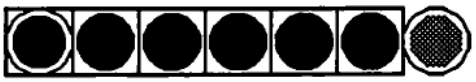
[1]'Gray code' is a computer term for special counting systems where only one digit changes at a time. It's appropriate here, since only one scale degree is changing at a time.

5.2.6. Ambiguous and Unstable Structures

The next section discusses the cases where a mode is equivalent to one or more of its rotations. This is apparent in the grid as a symmetry, and to the ear as an ambiguous structure, a set of tones with no unique origin or root. Open the Unstable Modes document.

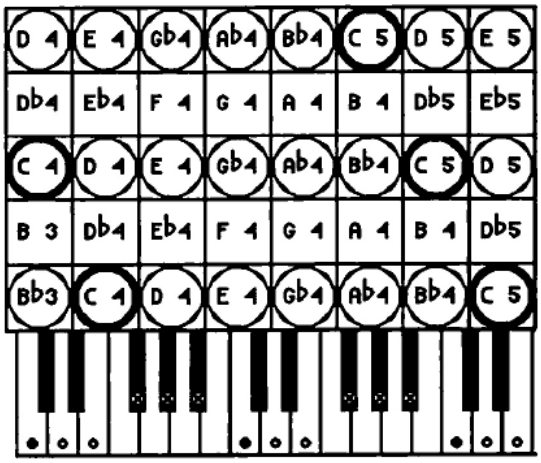
5.2.6.1. Whole Tone Mode

The Whole Tone mode has 6 rather than 7 tones, and all its intervals are major 2nds.



Whole Tone

Play on a C Whole Tone scale on the 2x1 grid.



See the striking symmetries on both the grid and the clavier? If it was not marked with a dark circle, how could we find the 'root' of this Whole Tone mode? We couldn't. And we couldn't necessarily tell by listening, either. Every rotation of the Whole Tone scale is just another Whole Tone scale!

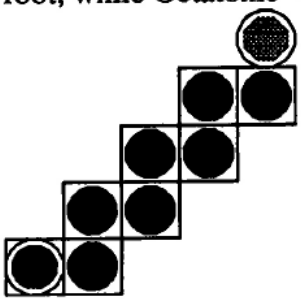
The set of 6 Major 2nds in an octave is ambiguous without some additional context. The single horizontal stripe makes it hard to get visually oriented, just as listening to a scale

made entirely of Major 2nds makes it hard to get aurally grounded. A Whole Tone scale whose root is any of C, D, E, Gb, Ab, and Bb has all the same tones. Likewise, Db, Eb, F, G, A, and B Whole Tone scales all contain the other 6 tones. In terms of distinct *sets* of tones, there are really just two different Whole Tone scales. Try C Whole Tone and Db Whole Tone to compare.

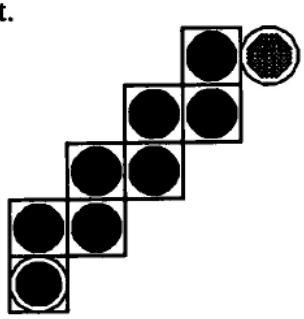
Few popular melodies are made from Whole Tone modes, but temporary structures can be built out of them. Jazz composer and pianist Thelonious Monk used them throughout his work, in suspensful, temporary scales that usually resolved to some 7-tone mode.

5.2.6.2. Octatonic Modes

Similarly, our two Octatonic modes (sometimes called the ascending and descending diminished modes) are internally symmetric and inherently unstable. Both are built simply from alternating major and minor 2nds, and each is a rotation of the other. Octatonic+ contains a leading tone below the root, while Octatonic- does not.

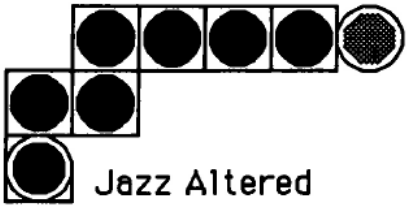


Octatonic+(ascending)



Octatonic- (descending)

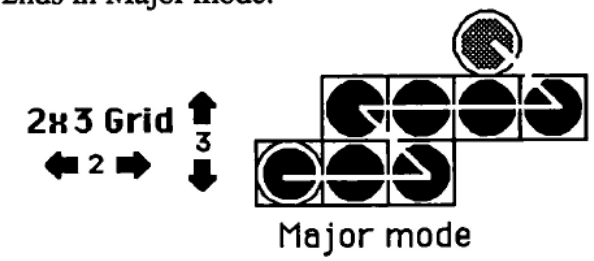
This discussion of unstable modes leads to yet another view of the Jazz Altered mode: the bottom half is an Octatonic-(1-2-1-2...) while the top half is a Whole Tone mode (...2-2-2-2). Try switching between them in the Unstable Modes document.



5.3. The 2x3 Grid

The 2x3 Grid presents major 2nds on its horizontal and minor 3rds on its vertical. It is a little harder to play a Major mode on the 2x3 grid than on the 2x1, but the 2x3 has greater reach -- with its diagonals it provides access to all the adjacencies of the 2x1 grid, as well as the Perfect 4th. The 2x3 grid provides a helpful transition from the 2x1 grid to the 4x3 grid, since it shares its horizontal axis with the former and its vertical with the latter.

Diagonal motions are required on the 2x3 grid to play the minor 2nds in Major mode.

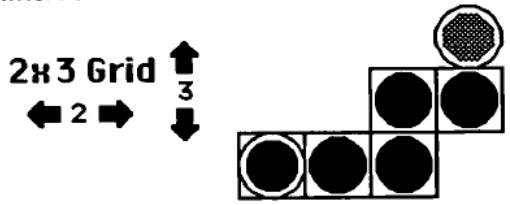


Major mode

The diagonals provide access to both the minor 2nd (3-2 = 1 semitone) in the north*west* and the perfect 4th (3+2 = 5 semitones) in the north*east*. The 2x3 grid is inherently better suited to modes with fewer tones, built out of larger intervals.

5.3.1. Pentatonic

The Pentatonic mode is a natural for the 2x3 grid. It drops the 4th and 7th from the Major mode, resulting in a simple staircase pattern.



Pentatonic

This traditional Pentatonic mode can found around the world. It is a simpler, 5-tone version of the ratio-based 'natural' mode that became our diatonic Major. Parallel motion in Pentatonic modes can create 'chinese' and other eastern and african harmony effects. It's easy to demonstrate on the Harmony Grid that the black keys on the clavier form a Gb Pentatonic scale.

The traditional 'Harmonic Minor' and 'Blues' modes include spans of 2 and 3 semitones, *and* intervals of 1 semitone. Therefore they are not representable as simple shapes (without diagonals) on either the 2x3 or 2x1 grid. However, they are easy to play on the clavier, especially if the **Smooth Clavier** option is used.

5.3.2. World Music Modes

The World Music modes document contains modes derived from asian and african instruments like the Balinese *suling* flute and the Chinese *zhung*. We encourage readers interested in non-western modes to try entering them on a grid, although some rely heavily on pitch bend or have more than 12 pitches per octave. Many others are variants pentatonic scales, that work just fine. The 'drone' key can be helpful for simulating dialects where a long note is held and a melody is improvised over it.

5.4. Standard Chords on the 4x3 Grid

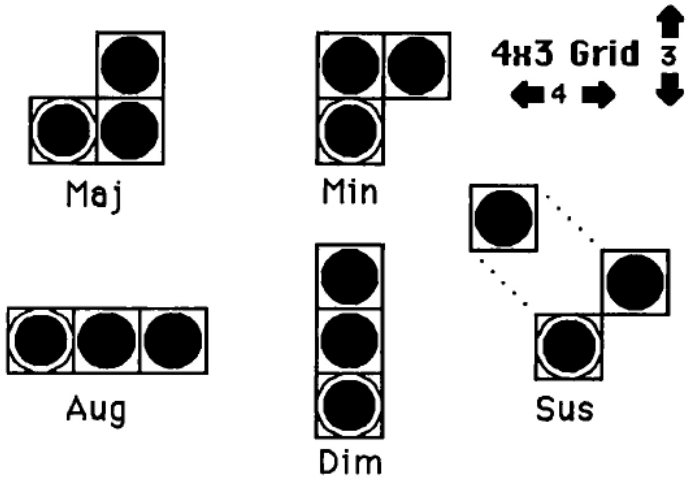
In sections 5.2 and 5.3 we built the modes out of major and minor 2nds and viewed them on the 2x1 grid. Similarly, we can build most of the traditional chords — from simple triads to jazz '13th' chords — from major and minor *3rds*, visible as contiguous shapes on the 4x3 grid.

Modes are very important in melodies, pitches moving smoothly in a sequence. The intervals between them are small. But to clearly distinguish *simultaneous* pitches, it's useful to separate them by at least a minor 3rd. In effect, one constructs a standard chord by *skipping even-numbered scale degrees* and building a stack of 3rds, between 3 and 7 elements high. A typical chord is a *triad* (3 elements) or a *7th chord* (4 elements) though a chord may go up to a 13th chord (7 elements).[1]

[1]That's right, another ad-hoc naming tradition. The *triad* is named for the number of elements in it The other chord types -- 7th, 9th, 11th, and 13th -- are named for their topmost scale degree. So, the number of elements in an Nth chord is (N+1)/2.

5.4.1. Triads

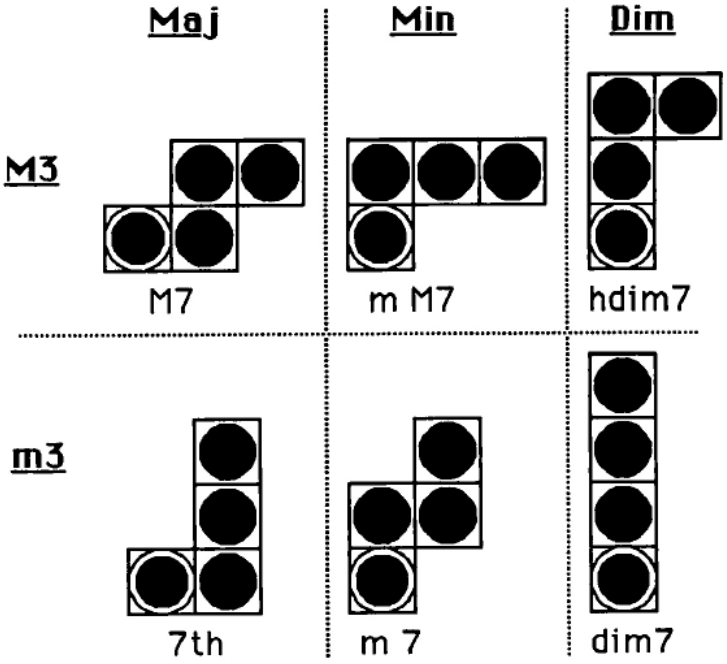
There are just a few triads, each of which has a distinctive character. We've abbreviated their names -- Major, Minor, Augmented, Diminished, and Suspended -- to 3 letters, to better distinguish the triads from all the other musical uses of those terms.



Maj and Min are the standard stable triads, dominated by their 3rd degree. Aug is ambiguous and unstable, just as the Whole Tone mode was; Dim is unstable too. In fact, we have a rule of thumb for unstable chords on the 4x3 grid: *any stripe of 3 equal intervals in a row is unstable.* Sus uses an augmented 3rd, and thus does not appear as a contiguous shape. It too is unstable, ordinarily resolving to Maj or Min.

5.4.2. 7th Chords

The 6 most common 7th chords are shown below. As shown, they are extensions on the Maj, Min, and Dim triads, with an additional major or minor 3rd going to the 7th degree. The columns indicate the triad, while the two rows indicate the additonal major 3rd (vertical step) or minor 3rd (horizontal).



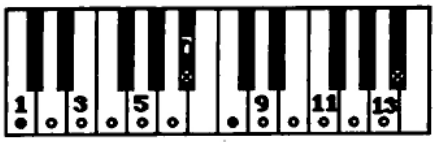
Since the default triad is Maj, the other four 7th chords include the base triad in the chord name; Min appears simply as a prefix of lowercase m. 'Hdim7' is pronounced "half diminished 7th" or simply "half diminished".

Using our "three in a row" rule for unstable chords, we can see that only the M7 and m 7 chords are stable; the others all contain unstable Aug or Dim triads. Comparing these Triads, we can see with some clarity that M7 and m 7 chord contain both Maj and Min triads, and so on.

5.4.3. 13th Chords

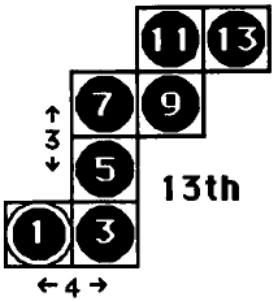
We can build a variety of larger chords, where the size of the chord is implied by the largest odd-numbered degree in its name, spanning up to two octaves. So chords with 4, 5, 6, or 7 tones are called 7th, 9th, 11th, or 13th chords, respectively. Each interval in such a chord has a default value that can be explicitly augmented or diminished, as need be, to describe a specific chord.

The default position of each odd-numbered degree of a chord can be found on the Mixolydian mode. In contrast to Major mode, in a chord the default 7th is minor, not major.

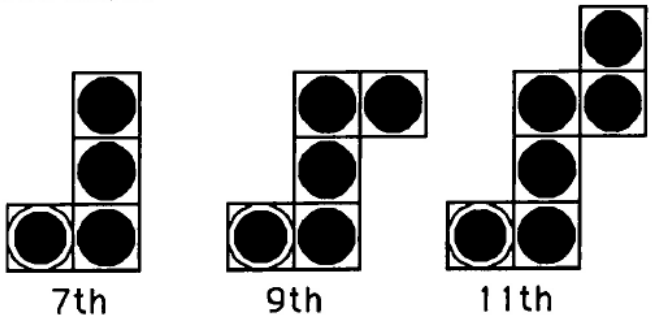


C Mixolydian

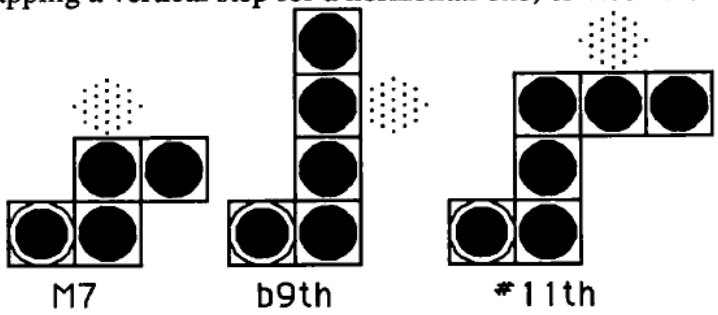
So, without any additional suffixes, a plain 13th chord falls on the numbered keys shown above, with the shape on the 4x3 grid shown below:



The default 7th, 9th, and 11th chords are subsets of this one, as shown below:



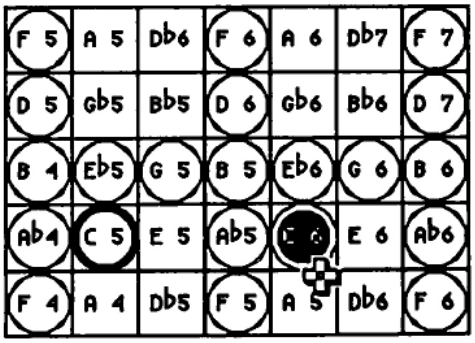
To describe other chords, we augment or diminish intervals in these, by preceding one or more scale degree numbers with # (or M) or b (or m) in the chord name. A move up or down 1 semitone amounts to a diagonal move with respect to the default tone (shown below in speckles). We're swapping a vertical step for a horizontal one, or vice versa.



This approach to chord naming is widely used in jazz, and in pop music books for piano and guitar. Different books tend to use slight variations on this overall format, but this description should help you recognize and name unfamiliar chords.

5.4.3.1. Harmonic Minor on the 4x3 Grid

Harmonic Minor is especially interesting when viewed on the 4x3 grid.

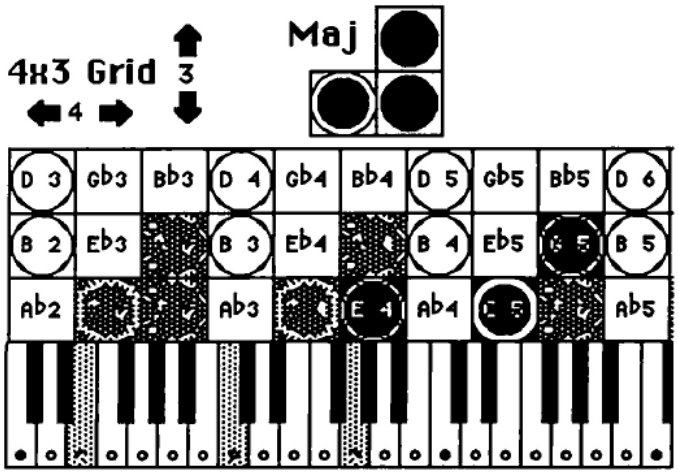


The pattern of vertical and horizontal stripes indicates the presence of two ambiguous chords within the mode: Aug triads in the horizontal, and dim7 chords in the vertical, intersecting on the leading tone. Only the mode's root lies outside of both of these.

Open Harmonic Minor 4x3 and travel around the grid with Solo or hdim7 chord. Can you hear the unresolved suspense when you move vertically or horizontally on the scales? Can you hear it resolve when you move back to the root? Harmonic Minor is a particularly suspenseful mode.

5.5. Recognizing Chords in MIDI input

If you have a MIDI synthesizer/controller, you can use the 4x3 grid and the chord shapes discussed above to recognize chords played in from MIDI. As explained in the 'Show MIDI Chords' in the reference manual, every pitch played in from MIDI results in a filled square in every corresponding *pitch class* on the grid. The actual pitch is shown in black, while the equivalent pitch classes are shown in gray. This means that whatever octave you play the tones in, you can see the corresponding chord shape in *every* octave. For example in the figure below we're playing a wide voicing of a C Maj triad. The E is in a lower octave than the C and the G. Still the Maj chord shape on the grid is clearly recognizable.



You can use the chord Reference Cards to help recognize chords played on MIDI, see how they overlap, etc.

5.6. Generic Chords and Filtering

Harmony Grid's ability to 'filter out' tones that are outside the current scale has several interesting applications, including the creation of 'generic' intervals and chords, which seem to change their type depending on what context they're in.

Open the 'Generic Chords 4x3' document and be sure the selected mode is Major. Drag chord 2, 'Mm Triad', inside the circles, and watch and listen to the results. When you're over degree 1, 4, or 5, you see and hear a Maj triad; when you're over 2, 3, or 6 it's a Min triad.

In fact, the Mm chord contains both major and minor 3rds relative to the root, by taking both horizontal and vertical paths to the 5th. If we switch to the Chromatic mode, we hear both 3rds at once -- a sharp dissonance. But when we move the root along a Major mode, one of the two is always filtered out. In effect, we're creating a triad that changes to be 'in tune' with the current scale.

When you play the 7th degree (B in C Major) see how the 5th goes away, and only two notes sound? The Mm Triad contains both 3rds, but only one perfect 5th. At degree 7, the Gb at the top of the triad (a perfect 5th above B) is filtered out.

In contrast, the Mm w/b5 chord contains both the perfect and the diminished 5th. When we play degree 7, the third voice of the triad no longer drops out; but when we play degree 4, we hear both the diminished and the perfect fifth -- along with the root and major 3rd, that's four notes at once. So the 'fix' for the 7th degree 'breaks' this generic triad for the 4th degree.

That is typical of filtered structures on Harmony Grid -- there's no guarantee that the number of unfiltered pitches in a chord will remain constant as we proceed up the scale. However, if you create the chords and combine them with scales thoughtfully, you can create a number of interesting

sounds and effects. The 'counterpoint' effect described in the next section is one good example.

If you don't like the fact that the Mm triad becomes a *di*ad on degree 7, you can switch to Mm w/b5 by touching it. The Copy and Paste functions make it easy to move chords to adjacent keys, so you can switch between them easily with two fingers.

The Mm7 chord applies the same basic principle -- including both major and minor 3rds and filtering -- to the 7th degree as well as the 3rd. This changes from M7 on degree 1 or 4, to m 7 on degree 2, 3, or 6, to 7th on degree 5. Once again, the 5th disappears when we move to degree 7, where the logical chord would be a hdim7. The same principle can be extended to make a generic Mm9th chord.

It's often interesting to drag a chord around by its *topmost* pitch, and cause other 'support' tones to appear below. Chords number 4 and 5 in the Generic Chords document are also Mm triads, but the root has been transposed one octave up, so we can drag it around by the top note, a melody tone. We indicate that the other pitches *descend* from the lead pitch by preceding the name with the minus sign: thus the names are '- Mm' and '- Mm7'

5.7. Counterpoint effects

The 'counterpoint' chord in the 'Try Me' document works by filtering an Augmented triad with a diatonic Major mode. Since a Major mode has no augmented chords in it, at least one of the notes is always filtered out. So the lead pitch is usually supported by a major 3rd *or* a minor 6th, but never by both. As the major 3rd and minor 6th appear and disappear alongside the lead pitch the subjective effect is of a support pitch that sometimes moves along with the lead pitch, and sometimes jumps in the opposite direction. Thus a counterpoint-like illusion is created.

In this 'counterpoint' chord on the Major mode, an exception comes up on scale degree 2, where both the major 3rd and the minor 6th are filtered out, and the second voice goes away.

Play an octave of the minor version of this counterpoint trick, 'min ctrpt', where the lead pitch is in the middle of a diminished triad, not an augmented one. 'Min ctrpt' also has an exception on scale degree 2. *Both* the minor 3rd and major 6ths appear, and instead of 2 voices we hear a 3-note chord.

As indicated in the 'wide' chords in the Counterpoint document, the same basic concept can be applied to an 'open' chord, where the support tones separated by an additional octave or two. This provides clearer perception of the pitches in the chord as distinct voices.

5.8. Circle of 5ths

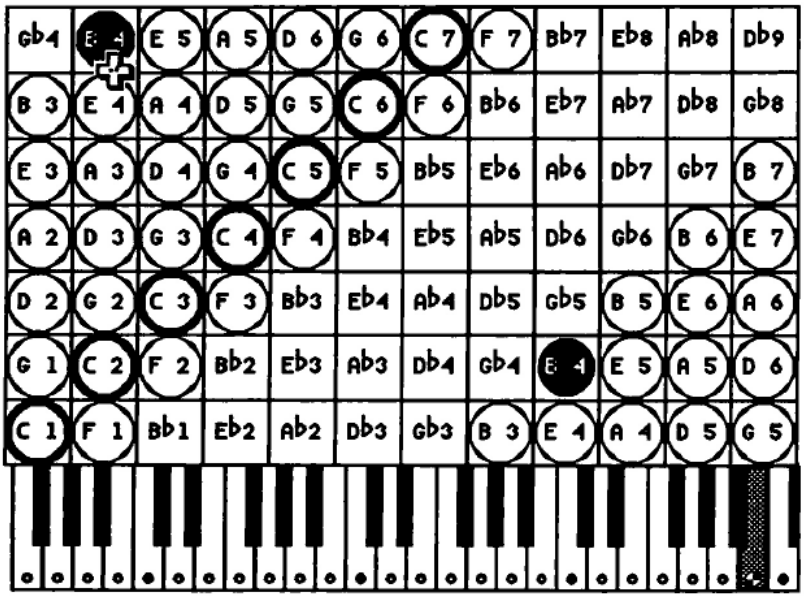
The *circle of 5ths* usually means a pattern of *descending 5ths* or *ascending 4ths*. It is used widely by musicians, but it is unfamiliar to most people, and tricky to show on an instrument like the piano. It's easy to describe on the Harmony Grid, because you can arrange for the circle of 5ths to appear on a grid as an axis -- vertical, horizontal, or diagonal -- by setting that axis to 5 or 7 semitones.

The circle of 5ths is central to the standard harmony for musical endings, the *cadence*. The descending 5th is the most typical path taken by successive roots in a harmonic progression. Most progressions use it in some form. It is a natural pattern in the same sense that the diatonic Major and Pentatonic modes are: perfect 5ths and 4ths are related to the root by the simple ratios 4/3 and 3/2. These are the simplest fractions between the unison (1) and the octave (2).

By the principle of octave equivalence, we know that ascending by 7 tones, a perfect 5th, and descending by 5 tones, a perfect 4th, result in pitches of the same pitch class, 12 semitones or one octave apart. So an ascending 4th and a descending 5th are harmonically equivalent.

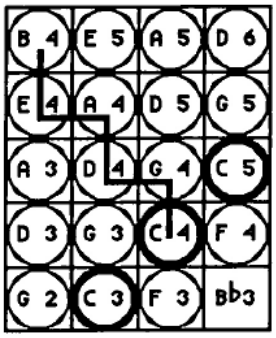
Actually, you've already encountered the circle of 5ths if you've used the diagonals on the 2x3 and 4x3 grids. The NorthEast diagonal on the 2x3 grid is ascending 4ths (2+3=5), while the SouthWest diagonal on the 4x3 grid is descending 5ths (-4 + -3 = -7). But we can also make grids with the circle of 5ths on the vertical and/or horizontal.

Open the 'Circle of 5ths 5x7' document in the Concepts folder to see a grid organized with 4ths in the horizontal, and 5ths in the vertical. As shown, the diagonals are the major 2nd (NE) and the octave (NW).



Another fact jumps out when you look at the C Major mode on the 5x7 grid: the scale (the circles) can be seen as a construction on the circle, going from B, through the root C, and ending at F.

Drag chord 1, the Solo chord, horizontally to the right to hear a sequence of single tones *ascending in pitch* on the circle of 5ths. It sounds like the low four strings of a guitar[1], or the tuning on some other string instruments. To *descend in pitch* on the circle of 5ths, you can descend the screen vertically. To move gradually within an octave on the circle of 5ths by combining the two moves in a staircase pattern, toward the SouthEast.



Try this same pattern with a generic Mm triad or Mm7 chord. You'll hear a typical chord pattern that appears to resolve -- reach a natural ending -- on the highlighted root. Of course, you won't see the familiar, connected chord shapes from the previous section, because we're no longer on the 4x3 grid. But you'll hear how typical chord progressions use the circle of 5ths as an axis of motion.

[1]Jazz guitar virtuoso Stanley Jordan tunes all 6 strings by perfect 4ths, so he can take advantage of the symmetries -- much the way Harmony Grid does. For him, the guitar's chromatic fretboard becomes a kind of 1x5 grid, and chord fingerings become similar.

5.9. 10ths Voicings document

This document is a bit more challenging than the others, and is much more harmonically exciting. It goes to the heart of Harmony Grid's ability to represent harmonic patterns that are very tonal, yet use all 12 tones.

The 10th Voicings document, in the Instruments folder, plays left-hand piano patterns, of the sort pianists like Earl "Fatha" Hines and Art Tatum invented in the 1920's and 1930's. They're called 10th voicings because the lowest and highest notes in the chords are separated by 10 scale degrees. Remember that harmonically, a 10th is just a 3rd, with an additional octave separation.

To play 10th chord progressions, first make sure 'caps lock' isn't down, and move the mouse over any grid square near the center of the screen. Now *watch the metronome*, and shortly before each tick, type 2 or 3 at the Mac keyboard. Alternate between 2 and 3. As indicated on the Chords buttons, you're alternating between a minor 7th chord, with degree 3 on top, and a dominant 7th chord with its 7th on top.

To change keys and play progressions, move to a neighboring square on the 2x1 grid before beginning the next 2-3 pair. You'll find that if you move:

- to the left (by descending Major 2nds) the progression moves in a very familiar pattern known as the 'circle of 5ths' pattern;
- downward (by descending Minor 2nds) the progression is a variant, the 'chromatic circle of 5ths'.

Motion in these or any other direction has the effect of changing or, *modulating* the apparent key.

This pattern — alternating the lead pitch between 3rds and 7ths, while implicitly moving on the circle of 5ths — is a common motif in jazz and other tonal music.

To complete our 'circle of 5ths' alternating m7 and 7th chord progression, we resolve to a stable chord like the M7(3)

chord under Mac key 4 while descending one square *vertically* from the previous chord. You'll find you can safely draw out the progression indefinitely, and wind up on any pitch you want, if you move from the 7th(7) to a stable chord at the end. You can descend vertically one square to a M7 (3) or Maj (3) chord; or move to the left while switching to a Min (3) chord.

5.10. More Grids and Documents

We hope that somewhere between the basic examples of modes, triads, and 7th chords, and complicated ideas like 13th chords and 10th voicings, you've found inspiration to begin making your own chords, modes, and documents -- to customize Harmony Grid into your own musical instruments. We haven't described all the chords in every document we've included; and we certainly haven't tried all the possible combinations of grids, chords and modes we've already created.

Consider those exercises for the reader. Unlike a music book, Harmony Grid can surprise its authors. We want to know about the original instruments and exercises you create. More grids and documents may become available from ЖНР, but they can also come from you.

6. Performing Tips

If you want to show off with Harmony Grid, or make particularly interesting music, there are techniques you can learn as on any other instrument.

Since it's impossible to hit a 'wrong' note, you can focus on organizing your improvisation. Don't just wave the mouse around; goals are more interesting for you, and organized activity will be much more interesting for your listeners.

Keep things moving. When you stop, the music stops. If you do, it may not work musically -- it's always *you* playing. There's no random number generator or pattern maker.

Set goals for yourself. Create little problems and carry them out. Below are just a few examples that work.

- Once you're fluent at playing a scale, try skipping over each note before going back to it.

- Create the illusion of two voices with one, by jumping between low and high pitches at each metronome tick, the way Bach and Bobby McFerrin sometimes do.

- Hear what happens if you're careful to get back to the root (dark circle) every 8 or 16 ticks? It underscores the root and tells your audience what key you are in.

7. Appendix I: Menu summary

Harmony Grid Help (in desk accessory menu)

File

- **Open**
- **Save**
- **Save As...**
- **Revert**

Edit

- **Copy (C)**
- **Paste (V)**

Options

- **Internal Sound**
- **MIDI**
- **Show Clavier**
- **Smooth Clavier**
- **Auto Button**
- **Settings...**
  - **Hold Number**
  - **Grid Low Pitch**
  - **Clavier Low Pitch**
  - **MIDI Max Pitch**

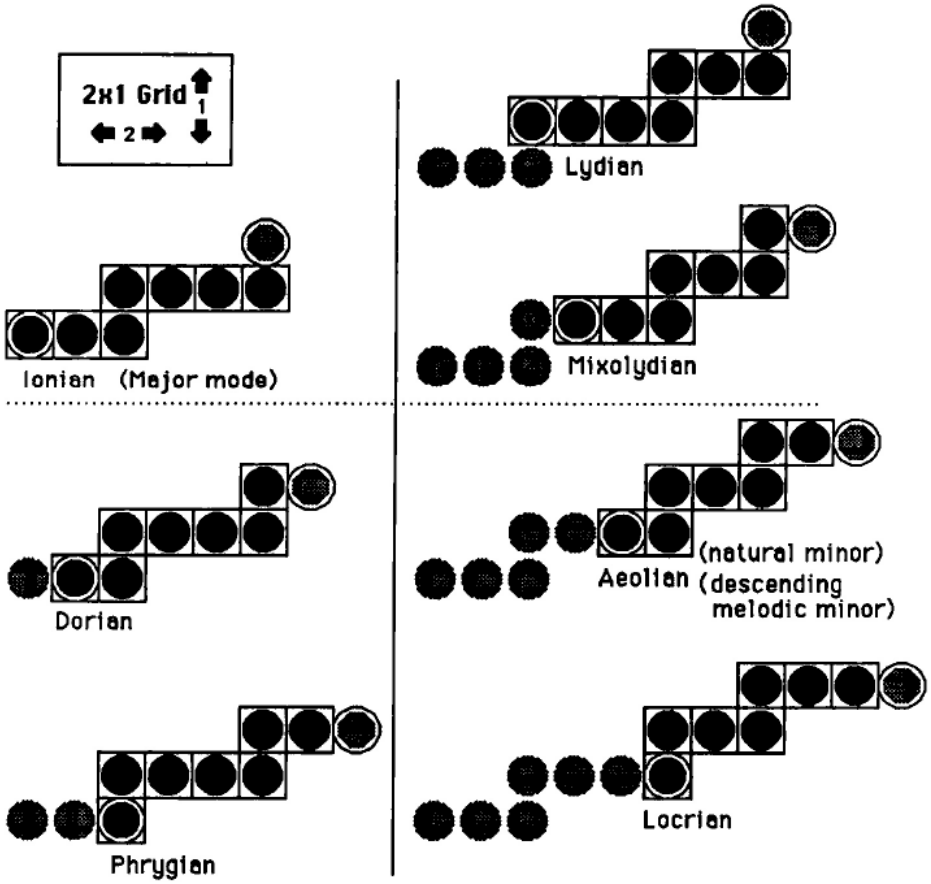
Operations

- **Make Chord (N)**
- **Make Mode (M)**

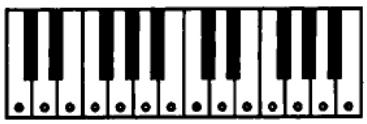
MIDI

- **Play Chords**
- **Mouse Solo**
- **MIDI Thru**
- **MIDI Channel**

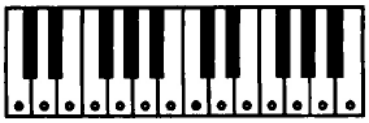
8. Appendix II: The Diatonic Modes



The 7 'Church' Modes on the 2x1 Grid

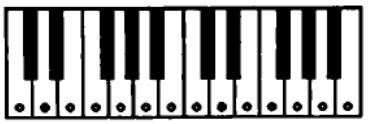


C Ionian



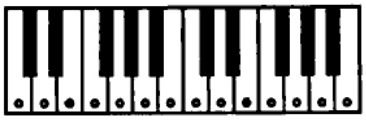
C Ionian

C Dorian

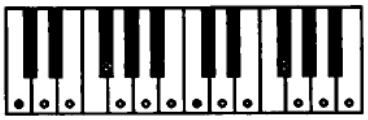


D Dorian

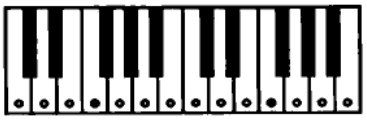
C Phrygian



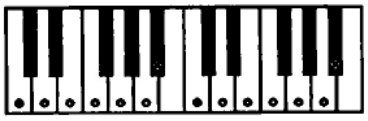
E Phrygian



C Lydian



F Lydian



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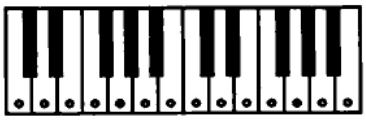

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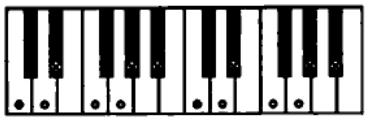

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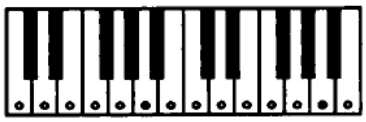

A Aeolian

C Locrian

B Locrian

9. Bibliography

The ideas in Harmony Grid are part of a body of harmony theory actively being studied by music theorists and mathematicians. If you'd like to know more about them, you might want to refer to these papers and programs.

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