

An Interactive Tool for Learning Improvisation Through Composition

Bob Keller
Stephen Jones
Belinda Thom
Aaron Wolin

Harvey Mudd College
Claremont, California 91711

{keller, sjones, bthom, awolin} @hmc.edu

Introduction

Many, if not most, jazz musicians appreciate that improvisation is a form of composition. However, based on our experience, written composition as a learning device often seems to be recommended with a much lower priority than is transcription of the solos of others. There are some notable exceptions, such as expressed in David Baker's articles [Baker 97].

We have been exploring the idea that composition is an activity that can contribute as much to improvisational knowledge as does transcription. After having taught improvisation a number of years we have concluded that students could be aided significantly with an interactive tool that would help them make choices during the composition process (but not compose everything for them). Accordingly, we have created a software tool that assists one in composing solos of a type that could be improvised.

Note that we are not advocating that the student memorize and perform a solo that he or she has constructed, which would not be true improvisation. As with transcription, the benefit of the composition activity for improvisation is in the experience of doing it, rather than in the end composition itself. It is also well known that famous players, from Bird to Coltrane, engaged in forms of composition that were subsequently used as bits in their solos. In this regard, we believe that our tool could also be of value to the advanced player.

Our tool is known as *Impro-Visor* (short for "Improvisation Advisor"). It is now available on the world-wide-web free for downloading (<http://www.cs.hmc.edu/~keller/improvisor>) on PC, Mac, and Linux platforms (any platform supporting Java 1.5).

We don't wish to minimize the value of transcription and ear-playing in learning to improvise, but rather offer something that will tangibly complement those two activities. Some advantages of composition over transcription include:

- The student's creativity is exercised to a greater degree.
- The student has greater intellectual pride of ownership in the results.

We believe that the information that *Impro-Visor* is able to capture can be of benefit to the composer as well, as a kind of active notebook (cf. [Lewis 05]). Our tool provides a humanly-readable textual notation for representing leadsheets, which can be of benefit to musicians and composers of all levels. Because it stores leadsheets using this notation, *Impro-Visor* allows one to use text created by any means to produce a leadsheet in musical notation.

Composing Jazz Lines from First Principles

A typical assignment in a jazz improvisation course taught by the first author is to compose one or two choruses of a solo on one of the tunes of the week. The student will have access to a leadsheet with the head melody and chord changes. Using the *Impro-Visor* tool, the student can readily manipulate and play the melody in the context of the changes using MIDI instruments.

The student can then erase all of the original melody and construct a new one based only on the chords. *Impro-Visor* provides menus called *advice* that change content based upon which note and chords are selected. A student who is not familiar with the spelling of all of the chords in the piece can immediately see the tones that comprise the chord. Chord tones can be prioritized so that the ones that distinguish the chord sound most appear

earlier in the menu. Scales and other artifacts that go with the chord, such as substitutions and extensions, can also be provided.

In the following paragraphs, we attempt to convey the feel of Impro-Visor by taking the reader through a sample composition scenario.

Let's say that our student, call her "Alice", wants to construct a solo over Charlie Parker's tune "Blues for Alice". We'll use the rendition shown in Figure 1, as it appears in the Impro-Visor display.

Figure 1: A leadsheet displayed in Impro-Visor

Although she could use pieces of the original melody, Alice decides to keep things simply by first erasing all of the melody notes. This requires two keystrokes: one to select everything, and a second to erase the notes in the selection. The result would then appear as in Figure 2.

The screenshot shows a music software window titled "Blues for Alice". The interface includes a menu bar (File, Edit, View, Stave, Play, Help), a toolbar with various editing tools, and a control panel with sliders for Tempo (160.0), Melody Volume, and Chord Volume. The main area displays a treble clef staff with 12 measures of music. Above the staff, the title "Solo on 'Blues for Alice'" is centered. The chords for each measure are: Measure 1: F6; Measure 2: Em7; Measure 3: A7; Measure 4: Dm7; Measure 5: Cm7; Measure 6: F7; Measure 7: Bb7; Measure 8: Bbm7; Measure 9: Eb7; Measure 10: F6; Measure 11: Abm7; Measure 12: Db7. The staff contains only chord symbols and measure numbers, with no notes or stems.

Figure 2: A leadsheet with melody erased

Although Alice could start construction anywhere in the piece, let's say she starts at the first measure. The light vertical line in measure 1 of Figure 3 shows the starting point, chosen with the mouse. When this point is chosen, a menu is opened on the right. We call this the "advice" menu, since it gives a set of reasonable options from which the next step may be taken.

The screenshot shows a music software window titled "Blues for Alice". The main window displays a leadsheet with a treble clef and a 4/4 time signature. The first measure is marked with a red vertical line and the chord "F6". The subsequent measures are marked with "Em7", "A7", and "Dm7". Below the treble clef, there are three staves of bass clef notation, with measures 5 through 12 labeled with various chords: "Bb7", "Bbm7", "Eb7", "F6", "Abm7", "Db7", "Gm7", "C7", "Am7", "D7", "Gm7", and "C7". An advice menu is open over the first measure, titled "Advice for Blues for Alice". The menu items are: "Advice for F6 -> Em7 (unspecified starting note)", "chord tones", "color tones", "tones approaching target in current chord", "chord tones approaching target in next chord (Em7)", "non-chord tones approaching target in next chord (Em7)", "scale tones", "cells", "licks", and "quotes".

Figure 3: A leadsheet with the advice menu opened corresponding to measure 1

To give a closer look, Figure 4 repeats the advice menu contents.

The screenshot shows a close-up of the advice menu window titled "Advice for Blues for Alice". The menu items are: "Advice for F6 -> Em7 (unspecified starting note)", "chord tones", "color tones", "tones approaching target in current chord", "chord tones approaching target in next chord (Em7)", "non-chord tones approaching target in next chord (Em7)", "scale tones", "cells", "licks", and "quotes".

Figure 4: The advice menu corresponding to measure 1

For the rest of our presentation of this scenario, we will alternate between showing such menus and showing the corresponding changes in the leadsheet as a result of making selections. (The reader who wants a preview of where this leads can skip ahead to Figure 36.)

Measure 1: Suppose that Alice chooses the cells menu item. A *cell* is defined to be a melodic grouping of a few notes, typically between three and nine (cf.

[Steinel 95]). Upon opening the cells sub-menu, a list of cells is displayed, part of which is shown in Figure 5.

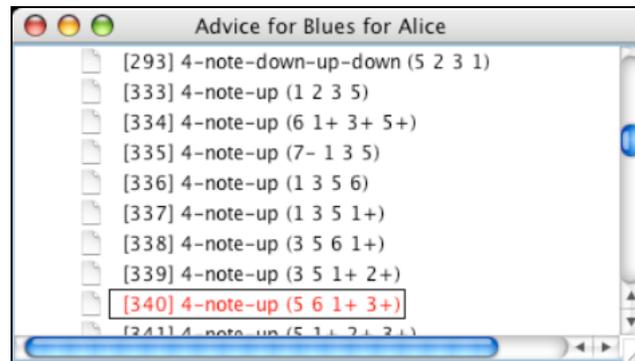


Figure 5: Part of the cell selection

The soloist can make a choice, as highlighted in Figure 5, and it will immediately be entered on the leadsheet at the focus point, as shown in Figure 6. It will also be played simultaneously on a chosen MIDI instrument.



Figure 6: Cell selection on the leadsheet

At this point, Alice can decide to accept that choice or try another from the menu. Each choice made over-writes the previous one and is played. She is also free to make modifications to the leadsheet by changing of the notes individually to suit, and she can undo arbitrarily-many such modifications.

In this scenario, Alice decides to accept the chosen cell. She can always return to it later for modification. Now she is going to focus on the transition from measure 1 to measure 2 by selecting just the last note in the cell, as shown in Figure 7.



Figure 7: Note selection on the leadsheet

The advice menu automatically changes to specialize to the selected note. The result is that only choices that start with the selected note are shown in the menu, as in Figure 8.

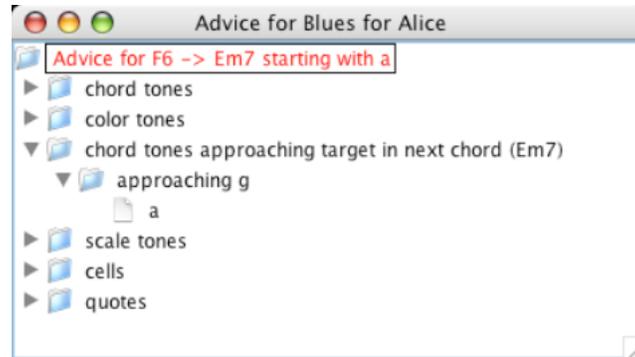


Figure 8: Menu with a specific starting note

Measure 2: Assume that Alice is familiar with the idea of an "approach tone" (or "tendency tone", cf. [Berg 92]). She wants to try to use the last tone in measure 1 to approach a chord tone in measure 2. As the menu shows, the only possibility that starts with 'a' is to approach 'g', so she chooses that. The result is that 'a' is re-entered and 'g' is entered, as shown in Figure 9.



Figure 9: Illustrating the use of an approach tone

Now Alice focuses on measure 2, and gets a new menu, as shown in Figure 10.

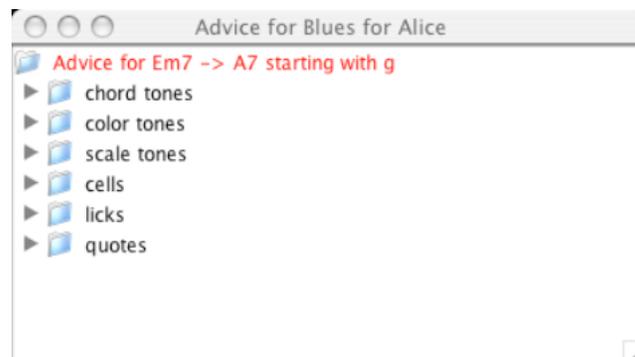


Figure 10: Menu for measure 2

In order to leave some space, Alice decides to end the first phrase on the 'g' and move to the next chord, A7, as shown in Figure 11.



Figure 11: The next focus

which produces a different menu, as in Figure 12, since we are no longer necessarily starting with 'g'.

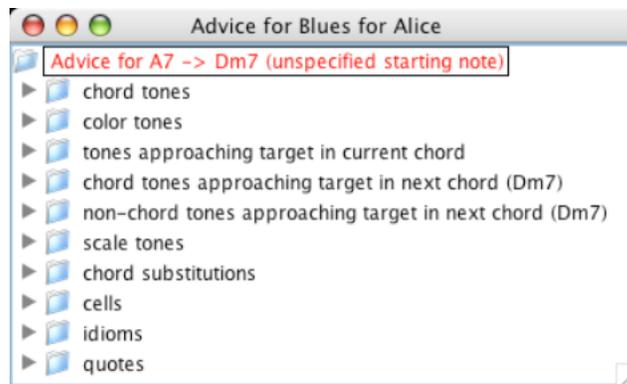


Figure 12: Menu for the second half of measure 2

Alice again opens the "cells" menu and chooses the selection shown in Figure 13.

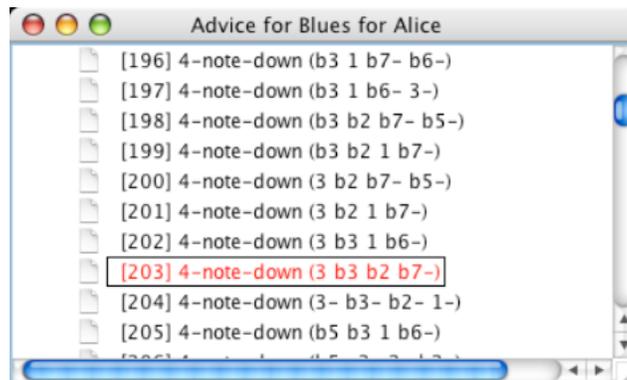


Figure 13: Cell choice for the second half of measure 2

The result of this choice is shown in Figure 14.



Figure 14: Cell choice for the second half of measure 2

Measure 3: Once again, Alice decides to use the approach tone idea, as in Figure 15, and 'f' is the note approached.

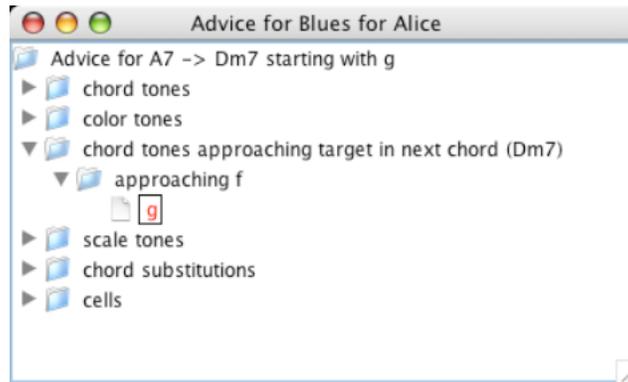


Figure 15: Approach tone for the transition from measure 2 to measure 3

As Figure 16 shows, Alice's solo is beginning to take shape.



Figure 16: First two and a half measures

The advice menu now is shown in Figure 17.

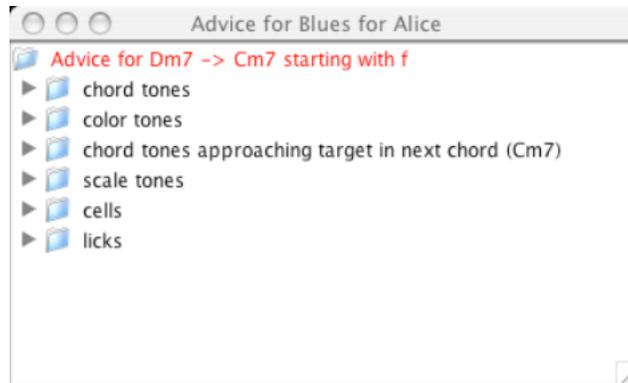


Figure 17: Advice menu for measure 3

Now Alice decides to explore a scalar approach, so she opens the "scale tones" sub-menu, as shown in Figure 18.

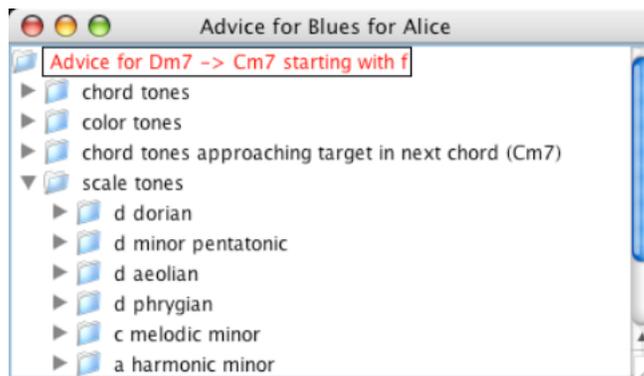


Figure 18: Scale choices

Let's suppose that Alice chooses the "d minor pentatonic" scale. It can be used note-by-note or in its entirety, as shown in Figure 19.

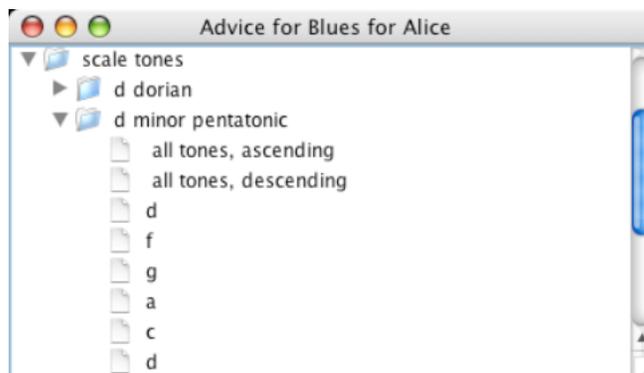


Figure 19: A particular scale choice

Choosing “all tones, ascending” gives the highlighted portion in Figure 20.



Figure 20: d minor pentatonic choice

Measure 4: For the fourth bar, Alice decides to try a lick and makes a choice as shown in Figure 21, with Figure 22 as the result.

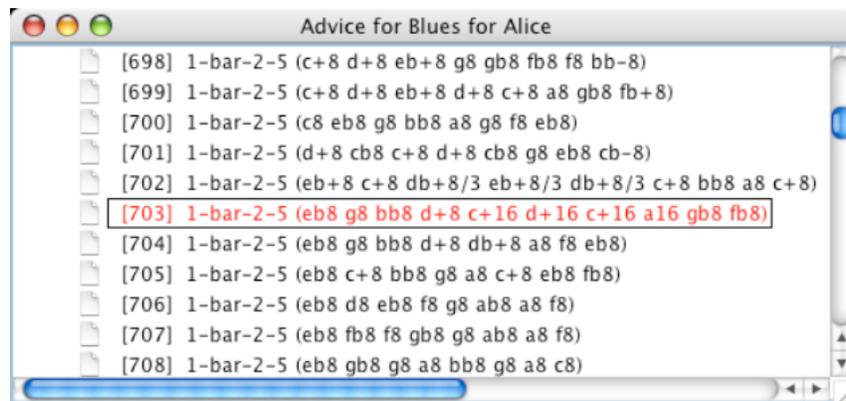


Figure 21: Choosing a lick

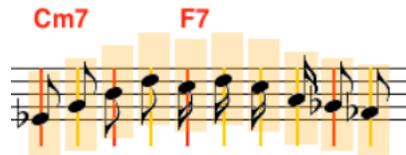


Figure 22: The chosen lick for measure 4

For the transition from measure 4 to 5, Alice selects the last note, which is note a chord tone, but which can nevertheless be used as an approach to a chord tone in measure 5, as Figure 24 shows.

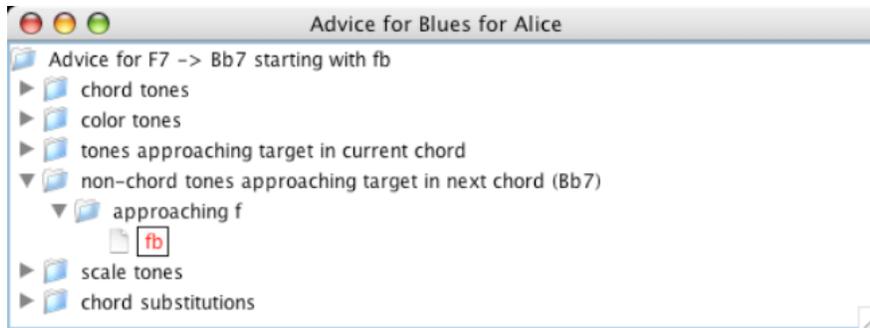


Figure 23: Menu for the transition from measure 4 to 5

The choice is made and Alice gets a start on the second line, as shown in Figure 24.



Figure 24: The start of measure 5

Measure 5: Alice again decides to use a cell, as in Figure 25.

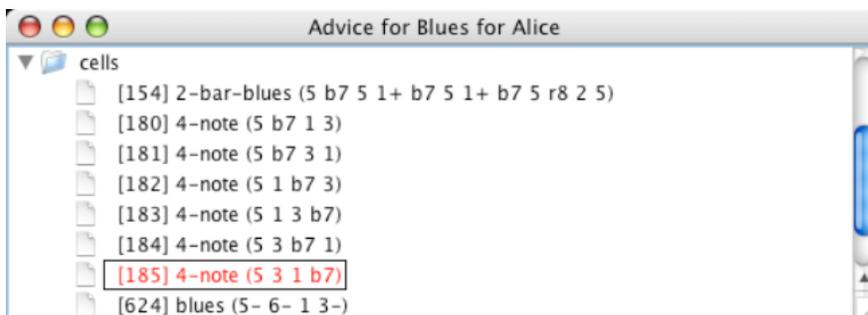


Figure 25: Cell selection for measure 5

Measure 6: In measure 6 we have a minor 7 chord parallel to the previous dominant chord on the same root, so Alice decides to use imitation. She copies the cell from measure 5 to measure 6 using two key strokes: one to copy the selection and one to paste it. Then she adjusts the 'd' to 'db' consistent with Bb minor, resulting in Figure 26.



Figure 26: Imitation

Measure 7: Focusing on the transition from measure 6 to measure 7, the Eb dominant bebop scale is chosen from the menu in Figure 27, giving Figure 28. Alice has decided to omit the last note of the descending scale.

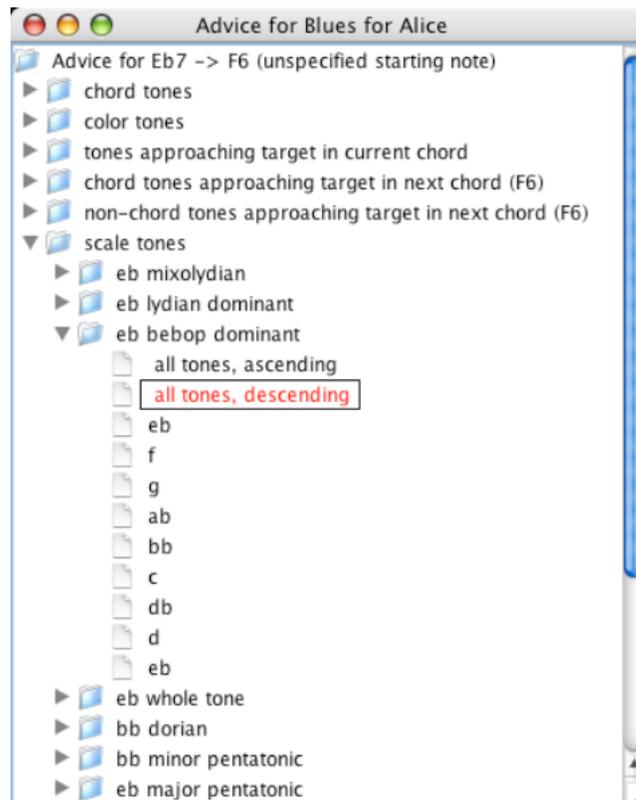


Figure 27: Selecting the descending bebop scale



Figure 28: Using the bebop scale

Measure 8: Alice now chooses another lick, as shown in Figure 29.



Figure 29: Lick for measure 8

Measure 9: Alice uses the approach-tone approach once more, giving a start on the third and final line.

Figure 30: Starting measure 9

Alice now uses a quote from another Parker tune, "Billie's Bounce", as shown in Figure 31, giving Figure 32.

Figure 31: Selecting a quote

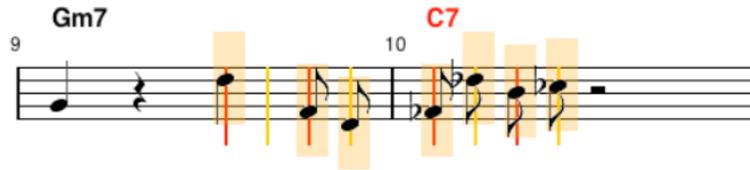


Figure 32: Inserted quote

Measure 10: Alice then decides to change the last note to a chord tone, 'c', as shown in Figure 33.



Figure 33: Slightly modifying the quote

Measures 11-12: For the turn-back in the last two measures, Alice decides to use another lick to expedite the process, as shown in Figure 34, resulting in Figure 35.

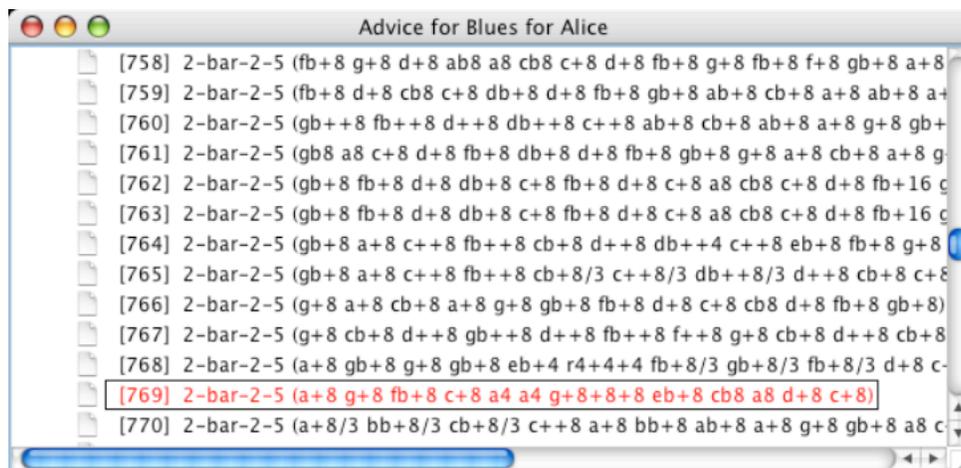


Figure 34: Selecting a longer lick

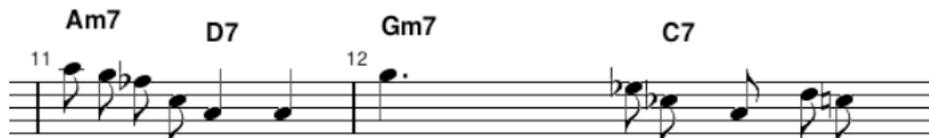


Figure 35: Turn-back lick

Alice's first chorus is now complete, as shown in Figure 36.

Solo on "Blues for Alice"

The musical score is written in 4/4 time and consists of three staves. The first staff contains measures 1 through 4, with chords F6, Em7, A7, Dm7, Cm7, and F7. The second staff contains measures 5 through 8, with chords Bb7, Bbm7, Eb7, F6, Abm7, and Db7. The third staff contains measures 9 through 12, with chords Gm7, C7, Am7, D7, Gm7, and C7. The melody is primarily eighth and quarter notes, with some rests and ties.

Figure 36: The constructed solo

The Information Underlying Advice

Obviously quite a bit of jazz theory can underlie the various advice menus. One of our challenges as designers is to represent this information in an intellectually economical manner, since the information currently has to be entered by a human in some form. The information is provided in the form of a text file known as a **vocabulary file**. Although Impro-Visor is supplied with a vocabulary file, the student or instructor can extend, reduce, or otherwise personalize the one provided.

We have tried to design Impro-Visor so that there is minimal repetition of a given piece of information. For example,

- Each scale and chord type is defined once, in a single key.
- Each cell for a chord only needs to be defined in a single key
- Each lick needs to be given for a chord sequence in a single key.

Impro-Visor handles any necessary transpositions to make the above items work in all keys.

Of the various items in the vocabulary file, the chord specification is the most complex. The chord must specify its spelling. But optionally included might be:

Priority: which notes are more important in defining this particular chord. This information is relayed to the user in the advice menus.

Extensions: what chords extend this chord. One use of this is for the color item, discussed next.

Color: which non-chord tones can be used as coloration over this chord. The first priority here is given to tones specified explicitly, but others are derived implicitly from extensions (see Figure 35 below).

Approach: which tones are best used to approach the chord tones, as we illustrated in the previous scenario. In a future version of Improvisor, we plan to include double-approach tones and enclosures, well-known jazz melodic devices (cf. [Baker 85]).

Substitutions: what are possible substitute chords for this chord. These chords have their own associated menus.

Scales: given by name, these are scales that go with the chord. They need not have the same tonic as the root of the chord. For example, a C7alt chord could specify a Db melodic minor scale.

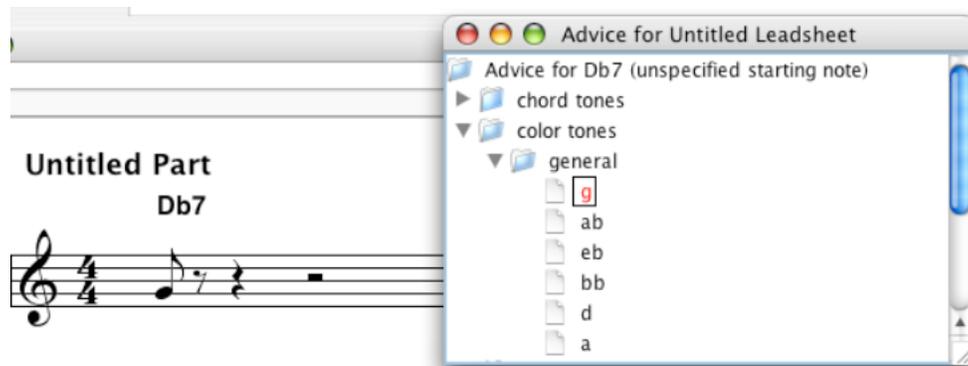


Figure 37: Color tone choices

Mult-Chord Information

When one chord is followed by another, Impro-Visor provides a richer dichotomy of tone choices. A known device in composition involves choice of notes that are either (a) the same, or (b) different in two successive chords (cf. [McNeil 00]). Impro-Visor dichotomizes the tones along these lines, as shown in Figure 38.

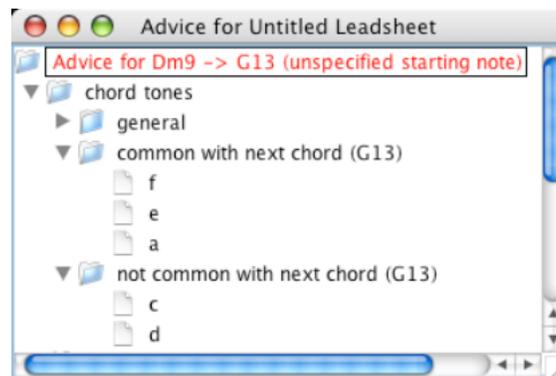


Figure 38: Chord Dichotomy

Perhaps somewhat more interesting is the use of chord tones in one chord to approach chord tones in the next chord. The best-known jazz example is the 7-to-3 pitch change in a II-V progression in either major or minor. Impro-Visor is aware of both the current chord and the next chord, and thus can display these transitions, as shown in Figure 39.

Figure 39: Inter-Chord Approach Tone

Melodic Constructs in Advice

Constructing a solo one note at a time can be slow going at first. As we've seen, Impro-Visor provides power assistance in the form of pre-composed melodic fragments. There are currently four categories:

- Cells
- Idioms
- Licks
- Quotes

Impro-Visor provides menus of all the above. These would allow a solo to be constructed more quickly and can be used to give the new soloist a head start.

Recall that a cell was defined earlier to be a few notes (say 3-9) over a single chord. An *idiom* is like a cell that is clearly identifiable as a jazz melodic idea (cf. [Lewis 04]). Thus the distinction between a cell and idiom is mostly subjective and in the mind of the vocabulary creator. However, a novice user might want to be aware of whether he or she is using an idiom or not, since the former edges more closely to being a cliché.

A *lick* is defined a phrase, generally longer than a cell, and usually over a sequence of chords rather than a single chord. A *quote* is melodic material from a known song, which may well be used as a lick.

An attraction for the more advanced user is the fact that licks, etc. constructed by the user can be saved in the vocabulary for immediate or future use directly from user interface.

An information-organizational and presentation question that we are still pursuing is that of further structuring the array of available cells and licks so that a user can quickly home in on an appropriate unit. We envision that there will be thousands of these units, which would be overwhelming. Providing further levels of menu structure is one possibility.

We are not suggesting that chaining together cells and licks, instructive as it may be, should be done without tasteful editing. Among the many types of edit that can be considered are:

- Dropping out notes (leaving space)
- Changing note durations (e.g. eighth-notes to triplets)
- Changing pitches
- Side-slipping by transposing part of a line

As a notation tool, Impro-Visor makes it relatively easy to perform such edits and immediately hear the result. We have begun the automation of other classical melodic techniques, such as inversion and retrogression, and plan to add time expansion and compression, enabling the user to easily experiment with these ideas.

Combined Melody and Chord Notation

Impro-Visor leadsheets are stored as text files in a notation invented for ease in human communication. The chord part of the notation is similar to ones used for communication of chord changes in typewritten books and on the worldwide web. At the same time, the notation is formal and electronically interpretable so that it can be used to produce the leadsheet.

Our leadsheet notation includes melody as well as chords. Melody and chords can be intermingled, and we use the following distinction to sort them out:

- Chords begin with upper case letters
- Melody begins with lower case letters

In both cases we have strived for a level of simplicity that would allow the user to type out entire leadsheets in textual form and have them be correct the first time upon loading.

Chords use common symbolic notation: **C7**, **Gm7b5**, **Fo7**, **E7sus4**, **A7/G**, etc. Support for poly-chords will be added in the near future. Within the context of a basic simple framework, the set of chord symbols can be customized by the user, as all chords are defined within the vocabulary file, in the manner

describes in the next section. Moreover, it is possible to have more than one symbol for the same chord, to suit multiple user preferences. For example, **Fdim** could be used in lieu of **Fo**.

Chord duration is based on dividing up measures. Bar lines are given by the vertical-bar symbol, and any number of chords can be placed in a measure. The chords are given equal durations within measure that by default. If unequal duration is desired, then a slash is used to mark the beat. For example,

| Dm7 / / G7 | CM7 A7alt |

would give the **Dm7** 3 of four beats in the first bar, whereas the **CM7** would get two of four beats in the second.

Melody, on the other hand, uses an entirely different system to determine note duration. We wanted a simple system to translate text into note pitches and durations, rather than one that would define all aspects of layout. For example, we wanted to be able to give melodic durations that last across bars without explicitly representing ties.

Each melody note begins with a lower-case letter, followed by an optional sharp (#) or flat (b). The default pitch is in the octave from middle C up to, but not including the next C. To go to higher or lower octaves, the note is followed by any number of + or - symbols, respectively.

The duration of notes is expressed in terms of the whole-note, half-note, quarter-note system. A half-note is indicated by a 2 following the pitch; a quarter-note is 4, and so on, to 8, 16, 32. A triplet is indicated by /3 following the duration, so for example **e+4/3** would designate an E in the second octave above middle C with the duration of a quarter-note triplet.

In addition, we permit dots, which add half the value of the note again. For unusual lengths, we permit durations to be added, so that **ab2+16** would be an A-flat in the octave above middle C with a duration of a half-note plus a sixteenth-note.

Rests are represented by treating the letter *r* as a note, followed by the duration of the rest. If no duration is specified for a note or rest, then an eighth-note is assumed. With a little practice, it becomes quite easy to construct a leadsheet using only a text editor.

As an example, Alice's solo in Figure 36, along with chord changes, is represented in our leadsheet notation as shown in Figure 40.

F6	Em7	A7	Dm7	Cm7	F7			
Bb7	Bbm7	Eb7	F6	Abm7	Db7			
Gm7	C7		Am7	D7	Gm7	C7		
f8	a8	c+8	g8	a8	d+8	r4		
e+8	d+8	cb8	g8	gb8	a8	db+8	e+8	
d+2	r8	c+8	f8	a8				
bb8	g8	eb8	c8	f4+8	a8			
ab4+8	bb8	ab8	d+8	bb8	f+8			
db+8	bb8	ab8	f8	eb8	g8	bb8	db+8	
c+4	r4	a8	f8	g8	c+8			
cb8	gb+8	eb+8	ab8	f8	ab8	db+8	cb8	
bb8	g8	a8	d+8	bb8	g8	f+8	d+8	
c+8	bb8	g8	e4+8	r4				
a8	g8	c+8	e+8	d+8	c+8	a8	gb8	
g4	r8	a4	g4+8					

Figure 40: Alice's solo in leadsheet notation

Although we have formatted it nicely for viewing ease (each line of chords is a staff line and each line of notes is a measure), the notation is completely free-form. We could also arrange it so that the melody notes are woven in with the measures in which their respective chords occur if that were desired.

A Glimpse at the Vocabulary File

The vocabulary file begins with scale definitions followed by chord definitions. These are followed by definitions of cells, idioms, licks, and quotes. All of these components use the leadsheet notation described in the previous section for notes and chords.

Figure 41 illustrates a few examples taken from a vocabulary file. As with the leadsheet notation, this text is also free-form with respect to formatting. The parentheses are the sole determiner of hierarchical structure. A more detailed description is given in the User's Guide.

```
(scale (name C lydian)      (notes c d e f# g a b c))
(scale (name C major)      (notes c d e f g a b c))
(scale (name C mixolydian) (notes c d e f g a bb c))

(chord
  (name C7b9)
  (pronounce C seven flat nine)
  (key f)
  (family dominant)
  (spell c e g bb db)
  (color f#)
  (priority db bb e c)
  (approach (c b) (e f eb) (g f# g#) (bb a b) (db d eb))
  (scales
    (Db diminished)
    (F harmonic minor)
  )
  (extensions C7b9#11 C13b9#11 C7b9b13)
  (substitute Dbo)
)

(cell (name 4-note) (chords C7 Gm7b5) (notes e8 db+8 c+8 bb8))

(lick (name 1-bar-2-5) (sequence Dm7 G7)
  (notes c#8 d8 r8 d8 ab8/3 bb8/3 ab8/3 g8 f8))
```

Figure 41: Some fragments of a vocabulary file, showing scale definitions, a chord definition, a cell definition, and a lick definition

The notation for individual notes and chords within the vocabulary file is the same as with leadsheet notation. As stated earlier, each scale is defined in only one key, and Impro-Visor takes care of any necessary transpositions.

The *family* attribute of a chord is currently what ties together chord definitions with chords in cells and licks. This is currently used to solve an interesting problem: If an exact match were required between chord names in the vocabulary and chords within cells and licks, there would need to be a tremendous redundancy of licks, since, for example, if a C9 is specified on a leadsheet, a lick for a C7 would also work. The current matching scheme allows one chord to be used for another so long as they are in the same family. Obviously this could result in some dissonant choices-- but this is

jazz! The user can and should become aware of the trade-offs. Meanwhile, we are continuing work on more refined matching approaches.

Conclusion

We have described our design and realization of a composition tool intended for use in enhancing one's improvisation abilities. We have gone through a scenario of the tool's use, and explained some of the design choices we made as well as some anticipated future enhancements.

Learning how to best present advice information is an on-going research process. Most of our energy to date has been consumed in the programming aspects, and we need the programming done to be able to test the musical ideas in an educational setting.

As the tool makes its first appearance on the web in November 2005, we have little feedback so far as to whether it achieves its intended purpose. This is part of the reason for this paper: to make the tool known to the community. Please try it and send any feedback to improvisor at cs.hmc.edu.

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