

KEYBOARD HARMONY: A COURSEWARE SYSTEM FOR HARMONIC SKILLS ACQUISITION

Naphtali Wagner

Teaching music, perhaps more than any other subject, requires the integration of formal rules with subjective considerations. A music teacher's role is, therefore, to impart technical skills while simultaneously developing creative abilities. A similar differentiation may be made concerning the distribution of tasks to men and machines, that is, between the human teacher and the mechanical one—the computer. The finer points of interpretation, criticism of exercises in composition, and analysis of musical works are areas that will most likely remain in the domain of the human music teacher for a long time to come. However, such skills as aural perception development (music dictation), solfege, keyboard harmony, exact renderings of notes and rhythm are well suited to computer-aided drill.

The traditional study of harmony clearly illustrates the polarity between technical and creative aspects. It involves technical drill such as playing harmonic progressions, realization of their schematic outlines, developing harmonic aural perception, as well as more creative tasks, raising from free harmonization of a given melody, through improvisation based on harmonic progressions, to composition in a variety of specific styles.¹

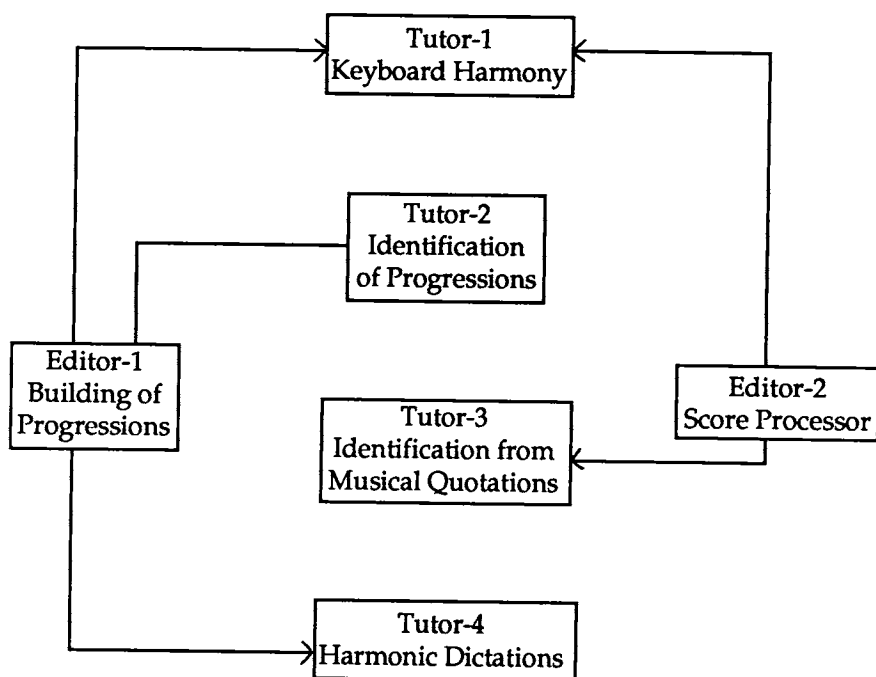
The project here outlined had as its goal the creation of a user-friendly work environment for the computer-assisted drill of the technical skills necessary for the foundations required for creative work.

"H" (Harmony), a Xanadu Ltd. project under development by Hebrew University of Jerusalem musicians and software specialists, is part of "Musicom," a courseware series encompassing a variety of music education areas, music theory basics among them. This courseware, which deals in an in-depth fashion with the tonal system and provides a broad range of drill in the construction and identification of scales, intervals, and chords, is a particularly well-suited preparation for study with the "H" series.

JOURNAL OF MUSIC THEORY PEDAGOGY

The hardware necessary for operating the above-mentioned software consists of an IBM PC (or IBM-compatible PC), an interface card, and a MIDI music keyboard. The "H" software system contains four tutors and is supported by two editors:

Chart 1. Keyboard Harmony.



The system focuses on two topics: construction of harmonic progressions (Tutor 1) and harmonic ear training (Tutors 2, 3, & 4). Editor 1 and 2 provide the tools necessary for putting together exercises and examples for all four Tutors.²

STUDY MATERIALS

At present the software system under discussion is geared to diatonic harmonic progressions and excludes those exceptions engendered by me-

KEYBOARD HARMONY

lydic and harmonic minor scales. The system will eventually be extended to include chromatic harmony and various types of modulation.

Exercises are harmonic progressions from two to six chords each. Short progressions are usually examples of harmonic idioms, such as opening formulas or cadences. Longer progressions are likely to contain these formulas in broader and more detailed contexts.

Progressions are organized around topics such as the V⁷ chord and its inversions, diatonic sequences, super-tonic and subdominant 7th chords. These same topics are drilled in each unit from a different viewpoint. A student studying a specific topic in harmony, such as the cadential II⁶, may practice playing the cadence, learn to identify it by ear, and take harmonic dictation of progressions in which the same cadence occurs.

TARGET POPULATION

The courseware is primarily intended for harmony students within any program offering theory courses, such as schools of music or college music departments. Study material may be explained in lectures, following which the instructor refers students to relevant material for drilling. Alternately, students interested in auto-didactic work may find, in the courseware, the answer to their needs. An accompanying study manual guides them from one exercise to the following one and from one unit to the next. This user's handbook explains all screen options from the viewpoints of both their functional and their musical significance. In this sense, the independent student does not discover himself suddenly abandoned when faced by bewildering material.

THE PEDAGOGICAL APPROACH

One of the pedagogical decisions arrived at during the development stage of the system was to avoid, insofar as possible, any coercion or pressure on the user. The program contains no quantitative evaluation of the student's achievements but relies uniquely upon comments relevant to accurate performance and includes occasional words of praise or encouragement.

No conditions are set that demand successful completion of exercises as a prerequisite for advancing to more difficult drill. Progress is not automatically effectuated—students can be as hard or easy on themselves as they wish and determine their program and rate of progress by choosing both the content and method of drill. This does not mean that the student

JOURNAL OF MUSIC THEORY PEDAGOGY

receives no guidance or direction in his work. Exercises are presented in a pragmatic sequence and with logical method, yet this sequence is offered as a suggestion only. The practice options offer hints, by their very presence, at various "routes" of progress, assuming that students will discover the route that best suits them.

The role of the instructor or supervisor is likely to find expression in the directing of students' choices of study routes according to the demands made by a specific theory course or an individual's rate of progress.

Eventually, support programs are to be developed that will provide the opportunity for a teacher to dictate the content of exercises by constructing their own harmonic progressions and entering their choice of examples from the music literature.

The description that follows focuses on the main "Keyboard Harmony" program and describes in concise terms the other programs that make up the "H" project.

TUTOR 1: KEYBOARD HARMONY

Keyboard harmony is one of the more important subjects taught in music theory courses and poses a frustrating pedagogical problem.³ The average student is likely to view the subject as a direct continuation of the tortures of the Spanish Inquisition, while instructors are often ill-equipped to increase student motivation. Workbooks intended for drill do not assist the students with the tiresome process of transposition and leave them in a state of uncertainty as to the accuracy of their performance of exercises. Musical examples meant to "illustrate" structures are likely to be too difficult for the beginning student, especially in cases where such a student has had little training at the piano or at score-reading.

The "Keyboard Harmony" tutor offers solutions to these problems. The principal task presented to the student by the tutor is the construction of harmonic progressions notated by symbols.

This task was chosen because of its accepted pedagogical value and because it permits evaluation. In other words, the accuracy of a harmonic progression constructed by the student may be verified by a computer. The evaluation requires that the computer be given the basic rules of traditional harmony. This was the major task confronting the software developers. The rules governing what is "permitted" or "forbidden" in traditional harmony are, indeed, defined with relative clarity in the body of theoretical knowledge upon which the teaching of harmony is based but they are not formally structured or formulated. For them to be expressed in algorithms, their definitions must be refined and clarified beyond ambiguity. Certainly

KEYBOARD HARMONY

not every rule of harmony needs to be considered as a distinct and independent algorithm—interdependence of rules needs to be taken into account. For instance, when following one rule leads to the breaking of another, preference rules must be established and the “transgression” permitted. Rules of counterpoint, such as avoidance of parallels, resolutions of dissonance and so on, overrule doubling conventions. Preference rules do not always present themselves as clearly as the above example and must, therefore, be formulated extremely carefully.

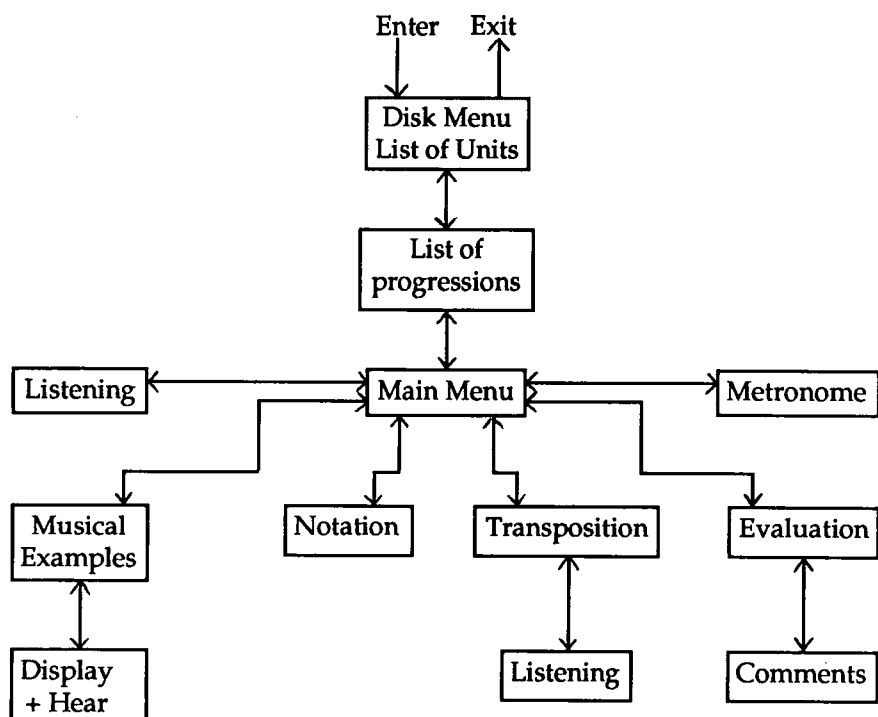
The system of evaluation offers no comments on the eloquence of performance, yet some assistance supporting this aspect is provided. Students may listen to the progression they have played in either of two fashions: They can hear an actual recording of their performance containing all the hesitations and errors (if any have occurred) and compare it to a correct rendition played in strict tempo.

In addition, the courseware provides a metronome to help the user develop rhythmic accuracy, expressed in this case by the maintenance of strict harmonic rhythm. There exist, in addition, the options of students recording and hearing their improvisations based on a given progression and of hearing recorded examples from the music literature exemplifying the hidden potential of a schematic progression. These tools are intended to encourage the development and exercise of self-criticism, in addition to the formal evaluation provided by the computer program.

PROGRAM STRUCTURE

Chart 2 displays screens from the user’s viewpoint. This chart displays the structural principle governing the courseware—a main menu that provides access to sub-menus. These sub-menus offer a variety of options; some are essential to the main purpose of the tutor (such as the Notation and Transposition menus) and some are secondary supplements (Listening, Metronome and Musical Examples menus). Essential are those options subject to the evaluation process.

Chart 2. Flow Chart of Tutor 1.



PROGRESS PROGRAMS

A student is likely to advance from simple to more difficult tasks on the following orientations:

Harmonic content: from simple to complex progressions.

Transposition: from keys with few sharps or flats to those with four or more.

Notation: advancing from complete, full, on-screen notation to minimal visual data, such as Roman numeral notation of harmonic degrees or figured bass.

Evaluation: options are available that allow for choosing between real-

KEYBOARD HARMONY

time corrections for each chord or corrections after completion of the entire progression only.

Tempo: (metronome) allows for slow to rapid performance of progressions.

An example follows that describes study methods or step procedures by which a student may practice each progression in a variety of soprano positions and in various key signatures. Notation remains constant:

- 1) Choosing a study topic
- 2) Choosing a progression
- 3) Establishing notation for the progression (e.g., outer voices & figured bass)
- 4) Progression construction, by playing, according to notation specification, for evaluation
- 5) Attending to computer feedback ("comments")
- 6) Repetition of steps 4 and 5 until successful performance has been achieved
- 7) Changing the initial soprano position of the progression
- 8) Repetition of steps 4 through 7 in all available soprano positions
- 9) Performing the progression in transpositions
- 10) Drill of all steps described above
- 11) Drill from step 2, skipping step 3 (notation remains unchanged).
In a supplementary session, it is advisable to practice the same progressions, as established in steps 1 and 2, from more abstract forms of notation.

An example of graduated notational difficulty follows:

- 1) Full, four-voice, score
- 2) Scored soprano and bass with Roman numeral notation of harmonic degrees
- 3) Figured bass and numerically indicated soprano positions
- 4) Figured bass only
- 5) Harmonic degrees only.

As notational abstraction is increased, voice-leading freedom is expanded and the probability of error increases.

Let us demonstrate the courseware by printing and explaining a few choice screens.

JOURNAL OF MUSIC THEORY PEDAGOGY

Figure 1. Main Menu.

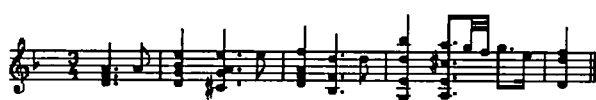
112 within an Opening Formula (2)



The example above is the third harmonic progression in Unit 3, Volume 2. This progression will remain the topic for drill around which will revolve all secondary details indicated by symbols at the bottom of the screen which may be activated by means of the function keys.

The fashion in which the progression appears indicates that sub-menus have been put to use: the key (D minor) and opening soprano position were determined by the Transposition Menu, while the Roman numeral symbols were determined from the Notation Menu.

Figure 2. Examples From The Music Literature.



The link between the schematic harmonic progression and actual music is expressed by examples from the music literature that accompany the majority of the progressions. Students may either play the quoted examples or listen to them. Figure 2 (Bach, Chaconne, mm.1-5) illustrates the progression presented in Figure 1.

KEYBOARD HARMONY

Figure 3. Comments Screen.

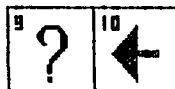
COMMENTS

[U3P3]

112 within an Opening Formula (2)



WRONG RESOLUTION OF 7TH



In the principal evaluation mode, computer feedback is given in two stages: in the first, vertical stage, the computer highlights all those notational elements not realized by the student. This stage takes place in real-time, while the student actually plays. When an incorrect chord is played, the computer prevents the student from progressing to the following chord before the incorrect chord has been properly played.

In the second, horizontal stage, contextual comments are displayed, referring primarily to voice-leading conventions, doubling, and soprano melodic contour.

The screen above (Figure 3) displays the second stage of evaluation, in which students have completed playing a given harmonic progression (Figure 1). In other words, they have correctly constructed the chords indicated by the Roman numerals but have erred in voice-leading. Each chord requiring comment is marked by an "x." The verbal comment "wrong resolution of 7th" refers to the chord marked by a framed "x." A student can survey all comments concerning a particular progression by using function keys 1, 2, and 3, and can listen to each error individually (by function key no. 4). Listening to an error entails hearing all the chords

JOURNAL OF MUSIC THEORY PEDAGOGY

connected to the incorrect chord whose erroneous tones are heard accentuated.

In the present example, only the third and fourth chords would be heard, with the g2 tone in the third chord and its incorrect resolution to d2 in the fourth chord both accentuated.

The following is a partial list of error messages provided by the program:

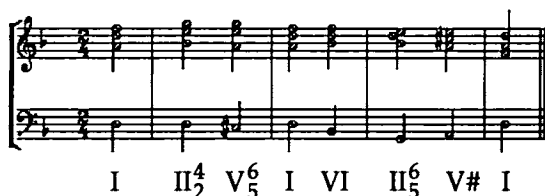
Parallel 5ths or parallel octaves
Hidden 5ths or hidden octaves
Unprepared seventh
Wrong resolution of 7th
Unresolved leading tone
Alto is too far from soprano
Tenor is too far from alto
Doubling the third is not desirable
Discontinuous melody
A leap from a 6/4 chord
etc.

Figure 4. The Evaluation Screen.

EVALUATION

[U3P3]

112 within an Opening Formula (2)



CORRECT!
PRESS SPACEBAR TO START RECORDING



KEYBOARD HARMONY

The example displays a correct interpretation of the given progression, although, of course, more than one correct interpretation exists. Any progression that does not elicit a comment may be considered acceptable.

The evaluation system is, then, the heart of the "Keyboard Harmony" tutor. It analyses the progression played in terms of the conventions of traditional harmony. This system of conventions has never been defined in a standard or uniform fashion, and each version of the system in theoretical and methodological literature presents an individual interpretation of basic principles. In a sense, this program is also no more than an interpretation of a consensus on theory.

As in any other field, the formulation of conventions or rules into algorithms requires their unequivocal articulation and leads to sharper and clearer definitions. This process takes place due to the attempt to avoid, inasmuch as possible, arbitrary formulation of rules. Flexible formulation of the rules in harmony obviously entails treatment of the special circumstances that permit divergence from strict tradition. Treatment of inner voices, for example, is less strictly criticized than treatment of outer voices, while doublings are verified in reference to the chord played. The evaluation system is a compromise between the trend to a general and elegant formulation of rules and the intended purpose to treat specific circumstances and exceptional musical idioms.

HARMONIC EAR TRAINING

Ear training, of all areas in music education, is probably the best suited to computer drill, for the following reasons:

A. Aural perception is almost impossible to drill on one's own. A second person, dictating is almost always necessary.

B. Group drill is often a frustrating experience due to individual differences among students. Students differ not only in their perceptual speed, but in their problematic areas, which, in such situations, come into maximum play.

C. The basic function necessary in computerizing ear training presents, in principle, little difficulty: a musical "entity" (an interval, chord, melody, rhythmic pattern) must be played for the student. The student attempts to identify it and then reports to the computer. The computer must receive the report, evaluate it, and then accept or reject it. Programs that enable students to report by playing or by singing into a microphone complicate tasks of reception and analysis of input somewhat, but a typed-

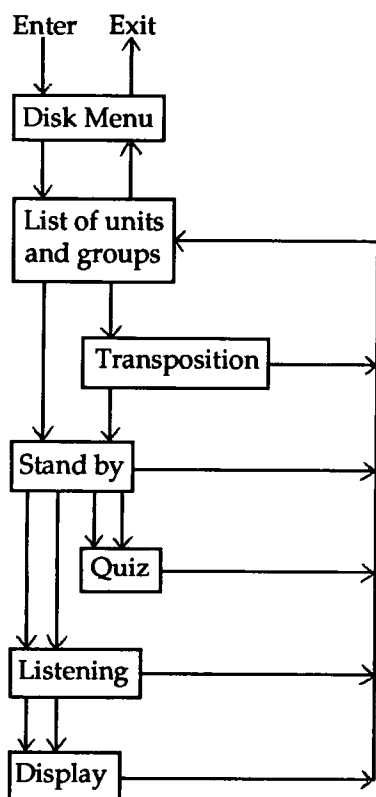
in student response is simple to receive and evaluate.

Harmonic ear training develops the ability to hear the harmonic progression that lies beneath music actually heard. A student's task consists of reducing an actual polyphonic texture heard to symbols representing harmonic degrees. This involves a certain level of abstract thought, despite the fact that the analysis remains very much at a descriptive level.

The present project treats the topic from a number of viewpoints, all of which reflect a Gestalt approach: two of the tutors enable the student to acquire the relevant musical terms (i.e., the idiomatic harmonic formulas). The third tutor integrates these formulas into complete harmonic progressions that are, in effect, combinations or prolongations of idiomatic expressions.

TUTOR 2: IDENTIFICATION OF HARMONIC PROGRESSIONS

Chart 3. Flow Chart of Tutor 2



KEYBOARD HARMONY

In this tutor, based on a multiple-choice principle, most of the activity centers around the "Quiz" screen. A number of harmonic formulas are individually displayed to the student on the screen in a randomized sequence. Students must correctly identify the progression they have heard from the list displayed.

In this framework, students can dictate the manner in which the progression is played: they may repeat the progression, change the tempo, arpeggiate the chords, and raise the volume of the bass in relation to the other voices. After having indicated one of the possible formulas, a computer comment will appear on screen confirming or rejecting the identification. Progressions are displayed in Roman numerals, as in this group of cadences:

Figure 5. Stand By Screen.

STAND BY M=80 [U8G1]

- | | | | | |
|----|----|-------|------|---|
| 1. | I | II6/5 | V | I |
| 2. | I | IV | V | I |
| 3. | VI | II7 | V7 | I |
| 4. | I | II2 | V6/5 | I |
| 5. | I | II6 | V7 | I |

PRESS SPACEBAR TO HEAR

F1=ADD
F2=SUB

F3=LISTENING

F5=SLOWER
F6=FASTER

F7=ARPEGGIO
F8=BASS

F9=HELP
F10=MENU

JOURNAL OF MUSIC THEORY PEDAGOGY

In the "stand by" mode, students can narrow or broaden the scope of their choice within the framework of given progressions. Furthermore, they may perform certain specific groupings to their taste, allowing an expansion of the level of variety or similarity between progressions.

In the "Listening" mode, students can familiarize themselves with each of the formulas displayed on screen. They may hear them in a variety of soprano positions and in major or minor modes. In addition, they may call up a complete notational display by using the "Display" option. These listening and display options may be utilized as a "time-out" from "Quiz," for error clarification, and for preparation for "Quiz."

Choosing drill material and a group of specific formulas for "Quiz" is effectuated by using the two opening menus (see above Flow Chart). In "Transposition" mode one may define the degree of randomization of the multiple-choice process: should all the formulas be played in a single soprano position or in a number of positions? In one key or in all keys? In one "mode" (major or minor) or in either?

TUTOR 3: IDENTIFICATION OF PROGRESSIONS IN LITERATURE

This Tutor resembles the previous one except for one main feature: while the first plays harmonic formulas in a schematic chorale format, this one plays passages from the musical literature. These passages are sorted according to the following categories: opening formulas, cadences, and sequences. The progressions in each category are organized within the "multiple-choice" framework. For example, in the "sequences" category, a number of groups are found, each of which contains some four types of harmonic sequences. The shared feature of the group given here as an example is the common use of first-position triads.

Each type is exemplified by a number of excerpts from the musical literature. Figure 7 is one of six excerpts demonstrating type 3 of the group.

KEYBOARD HARMONY

Figure 6. Stand By Screen - Sequences.

STAND BY

M = 80

[U5G1]

1. Descending 5ths
2. Ascending 5ths
3. 4th down / 2nd up
4. 3rd down / 4th up

PRESS SPACEBAR TO HEAR

F1 = ADD

F3 = LISTENING

F2 = SUB

F5 = SLOWER

F7 = ARPEGGIO

F9 = HELP

F6 = FASTER

F8 = BASS

F10 = MENU

Figure 7. Mozart, Symphony No. 38, K. 504, First Movement, mm. 66-68.



F1 = HEAR

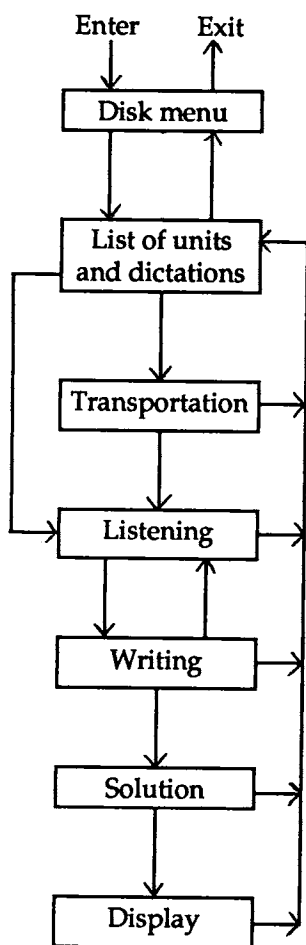
F9 = HELP

F10 = BACK

JOURNAL OF MUSIC THEORY PEDAGOGY

TUTOR 4: HARMONIC DICTATIONS

Chart 4. Flow Chart of Tutor 4.



Within the framework of this tutor, drilling is done in two principal fashions, the "Listening" and "Writing" modes. A toggle function enables immediate passage from one to the other.

In the "Listening" mode, the computer dictates a harmonic progression according to parameters defined by the user. The student establishes

KEYBOARD HARMONY

the size of the fragment heard (which may be the entire progression), an excerpt, or even an individual chord.

As in Tutor 2, which deals with formula identification, the student can, in this case, determine tempo, relative volume of the bass line (which facilitates the identification of inversions) and can choose between simultaneous and arpeggiated performance. The above options represent the pedagogical attitude that favors students' freedom in choosing their own learning styles, yet the program encourages certain options simply by making them easily accessible. For example, every harmonic progression is divided into a few harmonic fragments that form a pattern. The fragments are numbered, and students may access any one of them by typing its ordinal number in the sequence they prefer. In this fashion, the program encourages the student to learn harmonic degrees from their structural context. Despite this, nothing prevents them from hearing shorter fragments by combining single chords appearing in sequence.

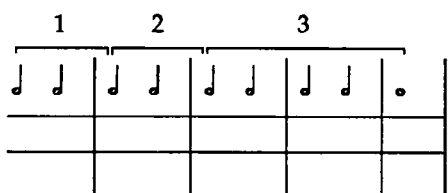
Figure 8. Listening Screen.

LISTENING

[U1D1]

KEY = C

M = 72



Press SPACEBAR to write

F1 = HEAR WHOLE

F3 = SLOWER

F6 = BASS

1 - 3 = HEAR PART

F4 = FASTER

F9 = HELP

← → = HEAR CHORD

F5 = ARPEGGIO

F10 = MENU

The table displayed includes three horizontal matrices: the upper displays the harmonic rhythm of the progression and shows the fragmentation described above. The middle one, intended for the user, is for filling in the harmonic degrees, and the last one displays the (correct) solution.

JOURNAL OF MUSIC THEORY PEDAGOGY

In "Writing" mode, the keyboard functions as an editor that enables the writing of harmonic degrees and their inversions in Roman numerals. The order of entries is of no consequence; students may freely move within the middle matrix and enter any element they have perceived. For example, it is possible to begin by entering the cadence, follow with the opening pattern, and complete by entering the connecting fragment. The "Writing" and "Listening" modes are, as previously mentioned, the main focal points of activity. One may ask for evaluation at any stage. Solutions are not offered with evaluation, so that a student can continue the dictation and attempt to correct errors. The computer provides specific corrections and differentiates between errors in degrees and those in inversions, as shown in Figure 9.

Figure 9. Writing Screen.

WRITING
[U1D1]

KEY = C
M = 72

1	2	3			
♪	♪	♪	♪	♪	.
I V ₃ ⁴	I	IV	I ₄ ⁶ V	I	

Press SPACEBAR to listen

F1 - F7 = DEGREES	DEL = DELETE ALL	← → = MOVE
2 - 7 = FIGURES	0 = DEL FIGURES	F9 = HELP
F8 = EVALUATION	ENTER= SOLUTION	F10 = MENU

At any given moment, a student may ask for the solution to a dictation. This option is especially significant in those cases where students can not, on their own, complete the dictation, yet wish to locate their error(s).

KEYBOARD HARMONY

Figure 10. Solution Screen.

SOLUTION [U1D1]

KEY = C M = 72

1	2	3		
I V ⁴ ₃	I	IV	I ⁶ ₄ V	I
I V ⁶ ₅	I VII ⁶	I ⁶ II ⁶	I ⁶ ₄ V ⁵ ₃	I

Incomplete

F1 = DISPLAY F2= PRINT F9 = HELP F10 = MENU

In "Solution" mode, the dictated progression can be displayed in full notation, in all four voices on request.

Figure 11. Display Screen.

DISPLAY [U1D1]

I	I	I ⁶	I ⁶ ₄	I
V ⁶ ₅	VII ⁶	II ⁶	V ⁵ ₃	
I	I		I ⁶ ₄	I
V ⁴ ₃		IV	V	

1 = HEAR F2= PRINT F9 = HELP F10 = MENU

JOURNAL OF MUSIC THEORY PEDAGOGY

After a while, a student may review a dictation and attempt it under more demanding conditions: increased tempo, reduced usage of the listening options, unaccented bass line, without arpeggiation, with fewer requests for evaluation, and without using the musical keyboard.

EDITOR 1 & 2: AUXILIARY PROGRAM

To prevent limiting the scope of material in the library of prepared progressions, the user (teacher or student) should be equipped with auxiliary programs to produce additional harmonic progressions. The software developed for this project enables users to dictate by playing a progression they have composed.

The program interprets and displays the progression in standard format. The bass is displayed in the lower clef and the three upper voices in the upper clef. In effect, the computer reconstructs, by default, the new progression from the soprano and bass voices as played, according to rules of spacing and doubling. The computer then displays the progression to users and allows them to depart from the default parameters to correct or improve voice leading. In this fashion, the user may create groups of exercises for each of the other tutors included in the project.

Xanadu's educational software system includes an editor that writes and edits piano notation. The editor was originally intended for computer-monitored piano playing, yet it may be used as a teaching aid. Teachers can thus bring to life the harmony exercises they have composed with examples from the music literature. They will also be able to use these excerpts in Tutor 3, which deals with the identification of harmonic progressions as they appear in actual music.

SUMMARY

The "H" project demonstrates a systems approach to an encompassing topic in the field of music theory acquisition. The student learns the language of harmony by acquiring two basic complementary skills: perception and performance. Computer-monitored drill provides training towards more creative expression, such as improvisation and composition on the one hand, and analysis on the other. The computer is gaining ground in these fields as well, but changes, at this point, from an instructional tool to a technical device. The more creative the skill to be acquired through the computer, the less meaningful and detailed the evaluative possibilities

KEYBOARD HARMONY

become for the student. That is not to say that a computer could provide no indication at all for more creative endeavors. Courseware designed to develop improvisation skills might include exercises in which a student would have to play within the framework of a particular key, harmonic scheme, and so on. The evaluation function could verify the extent to which the student succeeds in respecting these parameters. Such evaluation could not, of course, relate to very many aesthetic aspects of consequence in appraising any creative endeavor. At some stage, direct intervention of the human teacher's judgement becomes necessary.

NOTES

¹The "H" project resembles, in its systems approach, the "Lasso" project, which deals with sixteenth-century counterpoint and was developed in the Florida State University Center for Music Research. Our approach differs in a few aspects from that of the "Lasso" creators, mainly in that we avoided providing quantitative evaluation and did not make progress to advanced exercises contingent on the master level of preceding exercises.

See Steven R. Newcomb, "Lasso: an Intelligent Computer-based Tutorial in Sixteenth-Century Counterpoint," *Computer Music Journal* 9/4 (1985): 49-61.

²The present state of the "H" project (January 1990): Tutor-1 was completed in 1987 and marketed under the following label: XANADU, Music Software Series: MUSICOM, Keyboard Harmony Course. Tutors 2 and 3 are in their final stages of development and are in use in the Department of Musicology in the Hebrew University of Jerusalem.

Tutor 4 was completed in 1988 and put on the market as a supplement to Tutor 1. Editors 1 and 2 are now serving the developers of the courseware. In the future they will be compiled with the courseware and made available to the user.

³"Keyboard Harmony is probably the most frustrating course taken by a college music major." See Joan M. Wildman, "A Re-Evaluation of Keyboard Harmony," *College Music Symposium* 22/2 (1982): 112-119.

Wildman introduces several ideas that may enliven the subject and make it more attractive, such as a less strict attitude towards four-part writing and uses of chord notation while placing an emphasis on improvisation. Realization of these ideas is largely dependent on the personality and musicality of the instructor. Our attempt, within the framework of the present project, aimed to intensify the attractiveness of the formal-technical aspects of the subject, which are given to instructor-free, computer-controlled, drill.