Interactive app makes teaching music theory possible online

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Music professor Heinrich Taube's Harmonia application is the first computer app created at the U. of I. to appear on Apple iTunes. Photo by L. Brian Stauffer

University of Illinois music professor Heinrich Taube has developed a computer application that could change the way music theory is taught. Called Harmonia, the program allows teachers to create an endless variety of composition or analysis assignments, provides students with immediate feedback, and performs instant harmonic analysis of complex compositions. It is the first app created at the U. of I. to appear in Apple's iTunes store for computer applications, and could pave the way for teaching music theory online.

Taube, a composer who has also designed software for [music composition](), began working on a music theory program in 1996, soon after he arrived at Illinois and realized that teachers were still relying on chalkboards, paper and pencils.

"It was like some time machine," Taube said. "I had been working in the world of computer music production, where every year something new would come out. I stepped back into the classroom, and people were teaching theory the same way they did it a hundred years ago."

At most colleges, music majors spend their first two years learning theory – the formulas for building scales and chords, the complicated rules for moving from one sonority to the next, the laws of physics and the musical conventions that have formed the building blocks of Western musical compositions for centuries.

These lessons are traditionally taught in part by deconstructing existing compositions, such as Bach chorales – widely considered the canonical rules of harmony and voice-leading. From there, students move on to writing their own harmonies on worksheets, penciling in notes over the sketch of a bass line or a string of Roman numerals indicating the types of chords to be built. However, such assignments can have many correct answers, so grading the results can be tedious and time-consuming.

Taube's Harmonia application allows teachers to create assignments that students can complete online. The program can play the resulting harmonies so that the student can hear the notes, and then grade the result or simply provide helpful feedback, instantaneously.

"This is so much better than paper," Taube said. "It's the only way that music theory can participate in massively open online courses. If a university wants to have an online academy for music theory, you need something like this. Otherwise, it's just a bunch of videos."

At the heart of Harmonia is a program Taube wrote more than a decade ago (his article "Automatic Tonal Analysis: Toward the Implementation of a Music Theory Workbench," was published in Computer Music Journal in 1999). He created algorithms that detect and identify normative harmonic behaviors (triads, sevenths, inversions, cadences) and use a hierarchical scanning method, searching first for easily identifiable sonorities, making another pass to examine passing tones, then computing a complete functional and harmonic analysis of the composition, including detection of stylistic anomalies. This method is blazingly efficient; Taube's Music Theory Workbench can deconstruct Bach's dense, complex chorales at a rate of 19 chorales per second.

Harmonia can do much more than that. Besides chorales, Harmonia can analyze piano music and orchestral scores. It can generate and grade theory lessons using sonorities, Roman numerals or figured bass (chord progressions indicated by letter names, scale positions or inversions) and even discourage students from copying each other's work, thanks to a randomizer that changes assignments to a different key signature for each student. Teachers can add music, text, images and videos; Harmonia can edit music notation and multimedia.

Taube writes programs and computer languages, but said that his collaborator, William Andrew Burnson, "is responsible for more of Harmonia's coolness than I am." Burnson came to Illinois in 2007 to pursue a master's degree in music composition, and began working with Taube as a teaching assistant, eventually writing many of the 100,000 lines of computer code (about half the size of the Bible) that make Harmonia work.

The app is currently available for free on Apple's iTunes store, and Burnson said despite zero notice or advertising, Harmonia has been downloaded more than 2,000 times. "We've gotten some great feedback," Burnson said. However, he is no longer able to work on

Harmonia, having recently accepted a job in New Jersey with MuseAmi, a music software startup company, leaving Taube searching for funding to put the final touches on Harmonia.

"Software designers like Andrew don't just grow on trees," Taube said.

Taube estimates that the application is 90 percent complete, and plans to begin using it to teach [music theory](#) to undergraduate students at Illinois this fall.

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