Exploring musical and computational thinking through musical live coding with kids in Scratch

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What might a Scratch algorithm look like that resulted in a rock drum pattern? How could you create an algorithm in Scratch that would generate the guitar riff from Led Zeppelin's *Dazed and Confused*? How could you use the modulo and random functions to create music that changes over time in interesting ways? How might you use analog sensors and the computer keyboard to perform a musical algorithm in Scratch?

These are just a few of the questions we've been exploring over this past year using Scratch as a creative platform for making music and exploring computational thinking with children and university students. Taking advantage of Scratch's design as a live compiler/interpreter, simple through complex computational algorithms can be implemented to create original music using the many functions from the sound category. Through hands-on workshops and classes with middle school and high school students in Lowell, MA, as well as with undergraduate students enrolled in a general education course entitled *Sound Thinking* and co-taught by a computer science and music professor, we have amassed an array of innovative examples of student work using Scratch to create generative, algorithmic music and music-enhanced animations.

Inspired by musical live coding traditions, Scratch is an engaging platform for exploring musical creativity and thinking alongside computational creativity and thinking. The music and sound functions within Scratch make it possible to "hear" mathematical and computational functions. On the flip side, students can experiment and create computational functions that create and approximate musical structures and composing techniques. Our most successful ventures with students have been in the use of Scratch to create pre-coded, interactive music, in the performance of musical live coding where aspects of the Scratch

code are created and manipulated live during run time in an improvisational performance, and through the design of interactive musical instruments in Scratch performed through sensor-integrated means using PicoBoards.

This workshop will begin with a live performance of some of the musical compositions created by middle and high schools students, as well as a demonstration of musical live coding and sensor-integrated performance. Next, undergraduate and school students alongside workshop leaders will lead participants in exploring Scratch as a musical tool to compose their own interactive music through computational processes. The workshop will conclude with a mini-recital of pieces created during the workshop and a discussion of the unique musical and computational possibilities afforded by Scratch.