

Duet for laptop and cellular automaton

Abstract

A cellular automaton is a collection of “cells” on a grid of specified shape, in this case a two-dimensional grid, that evolves through a number of discrete time steps according to a set of deterministic rules based on the states of neighboring cells. The rules are then applied iteratively until the system reaches a steady state or disintegrates. This piece tries to explore the boundary between musical determinism and unpredictability by utilizing this concept to generate a random composition based on the output of the iterative propagation of the automaton.

This piece was generated by using the automaton output to control a variety of parameters on a recorded cello track and sampled sounds. Sub-sections of the audio recording are triggered by nodes in the 64 unit grid which are in-turn controlled by the input from the audience and subsequently propagated by the automaton. This two-dimensional implementation of cellular automaton, which is popularly named Conway’s “game of life” after its discovery in 1970 by J.H. Conway, is a binary ($k=2$) totalistic cellular automaton with a Moore neighborhood of range $r=1$.

The life cellular automaton is run by placing a number of filled cells on a two-dimensional grid. Each generation then turns cells on or off depending on the state of the cells surrounding it. All eight of the cells surrounding the current one are checked to see if they are on. Any cells that are on are counted, and this value is then used to determine the fate of the current cell.

1. Death: if the count is less than 2 or greater than 3, the current cell is switched off.
2. Survival: if (a) the count = 2, or (b) the count = 3 and the current cell is on, the current cell is left on.
3. Birth: if the current cell is off and the count = 3, the current cell is switched on.

Interestingly, the game of life is a universal cellular automaton in the sense that it is effectively capable of emulating any cellular automaton, Turing machine, or any other system that can be translated into a system known to be universal. An abstraction of this concept in terms of music would allow even a simple library of sounds to iteratively generate a massive range of possible musical styles starting from a basic starting block of samples/tones.

The controller was constructed using an FTDI FT254R serial to USB controller in conjunction with an ATMEL 8-bit microcontroller to generate OSC and MIDI data. This was assembled on a logic board from monome.org. The button kit and keypad kit which use conductive silicon were also sourced from monome. The Game of Life implementation which was created by Tehn and modified for this piece was written in the ChucK programming language. All instrumentation was recorded into a Max/MSP patch which was driven by a library of starting nodes for the automaton simulation.

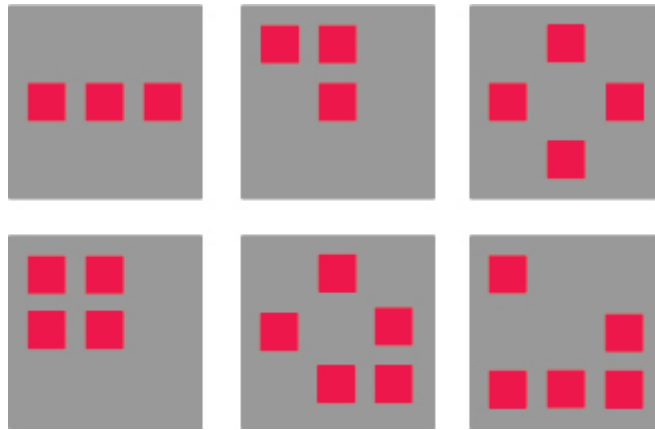


Figure 1: Starting populations for you to experiment with