MACHINE LEARNING SYMPHONIC UNIVERSE CREATOR

Swarm Sound

SYMPHONIC UNIVERSE WHA???

- Admittedly, it is a bit of a wordy name. But, I like it.
- Imagine an sound art installation built in a room with walls sculpted for tasteful reverb.
- The installation would be a multi-dimensional feedback loop made up of multiple instruments, acoustic and electronic.
- Each instrument would be controlled by a machine learning software program which takes input from sound sensors and gives directions to the physical components which play the instrument.
- The sound sensors monitor the qualities of sound in the room. The program then analyzes the sound and makes complex decisions on how to best add to the collection of sounds (symphony).
- Where does it start? Don't the sensors need something to listen to in order for the instruments to play? It can start anywhere. The program begins with a unique musical phrase at any instrument; each unique beginning procures a unique culmination of events. LIKE A UNIQUE UNIVERSE.

EACH UNIQUE UNIVERSE BEGINS WITH A UNIQUE SET OF INITIAL CONDITIONS

- Ten Dimensions Explained: https://www.youtube.com/watch?v=JkxieS-6WuA
- This video gave me inspiration for the concept and the title.
- The video discusses the theoretical ten dimensions in a way that can be visualized.
- A key concept relating to this installation idea is that each unique universe of the infinite possible universes begins with a unique set of initial conditions.
- Our universe is said to have began with “The Big Bang,” which synthesized unique initial conditions specified by the existing elements in this universe.
- The MLSUC would have the potential to create many unique symphonies, or symphonic universes (in that they can be explored in a physical installation).
- If the symphony creation begins with a 3 consecutive note phrase on the violin, its end result would be entirely different than if the creation were to begin on a chord on the guitar.

INSPIRATIONS

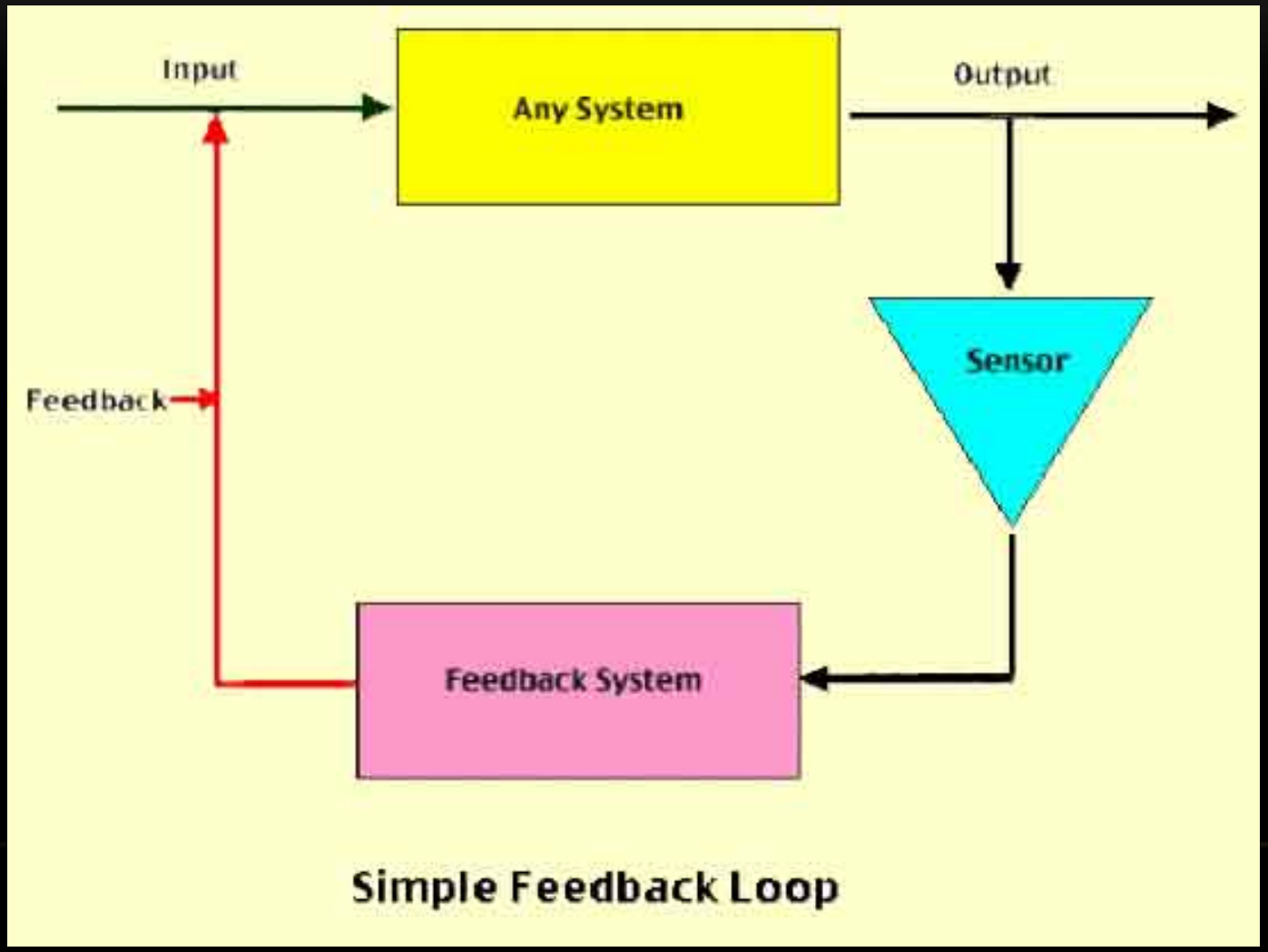
- Swarm relationships/cooperation in nature (bees, ants, termites, crickets, birds)
- I had a conversation with someone about how bees know exactly where to contribute when they are altogether building a hive.
- Exploring this concept further I began to think of cricket and bird symphonies
- When I am going to sleep I hear the crickets outside and when I am up at 5am studying I hear the birds singing in the eucalyptus grove with the sunrise. One morning I was having a really difficult time falling asleep, so I tried to imagine that the bird sounds were one fluid song rather than many successive disruptive chirps. In my sleepy mind, when I imagined this, they actually became one fluid composition. All of the individual contributions seem so purposeful to me, like these creatures are actively listening and purposefully contributing. It could also be possible they are all just singing their own song and it just happens to be working out.
- This cooperative effort made me think of flow jamming in music; when multiple musicians are improvising and contributing to a piece of music in a state of flow. Often times, some of the best music is produced. Each individual has an intuition on what contribution is needed from them. Unless you have one person who just wants to run the show, but that's another story ;-)

CRICKETY SNIPPET: A COMPOSITION BY ME (2017) EXPLORING CRICKET SYMPHONIES (COHESIVE WITH CONCEPT OF PROJECT)

WHAT DO WE NEED TO MAKE THIS HAPPEN?

- Statistics / Machine Learning Algorithms / Software
- Sensors / Physical Computing (instruments played as response to sensor data)
- Physical Instruments With Mechanical Mechanisms of Kinetic Instrumentation
- Ability to analyze sound data (Pitch, Amplitude (Volume) , Timbre)
- Vocal and potentially rhythm input (for human interactive capabilities) – was thinking of a rhythmic floor where steps or stomping could manipulate the rhythms of the piece in sort of mass unified decision making.

THE SIMPLE FEEDBACK LOOP

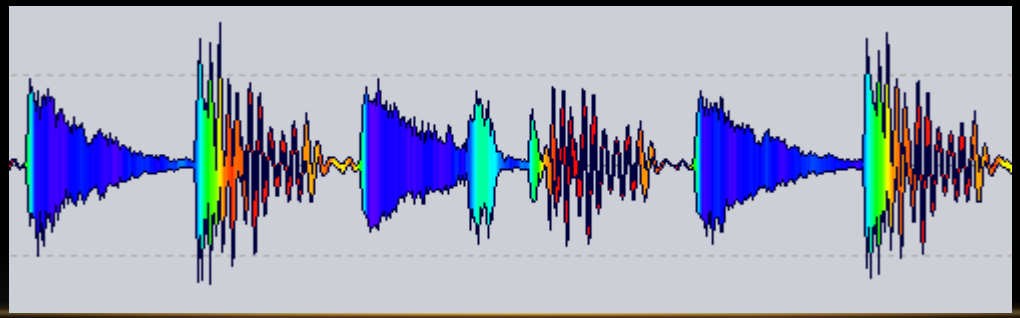


HOMEOSTATIC SOFTWARE ENGINE

- Part of the software operating the installation is designed to learn and recognize how to remain at a general homeostasis ➔ one defined by certain specified parameters.
- An example of this balance-keeping could be, if the frequencies range played by the first 2 or 3 instruments going in the symphony is higher, the piece could be balanced with lower frequencies in the next passage.
- This part is inspired by mushrooms. In my Data Mining and Machine Learning class this quarter did analyzed a dataset on wild mushrooms and found some pretty intriguing discoveries of the properties these beings:
- 1.) In the classification analysis of mushrooms as poisonous or edible, most of the mushrooms on (human/animal made) paths through nature or in urban areas were found to be poisonous. This could explained by natures homeostatic tendencies influencing poisonous mushrooms to grow in places disturbed by humans/animals as a form of protection, rehabilitation, or retaliation. Evolutionarily, if the mushrooms couldn't survive they could have been trained to produce poisonous chemicals in order to lower the populations of the animals interfering with their survival.
- 2.) It was also found the mushrooms that grow on feces are always edible (at least the ones in this dataset). That represents a sustainable cycle and FEEDBACK LOOP.

ஜ SOUND ANALYSIS ஜ

- Digital pitch and relative amplitude recognition in this day and age is very simple.
- Real-time timbre analysis is much more complex, but . . . I think its possible.
  - → Timbre – The quality of sound that is not pitch or amplitude. Some may use words like texture, color, depth, medium; uniqueness of timbres is due to the material of the medium the sound runs through and the space the sound inhabits.
  - A significant component of the timbre analysis would be done using spectral centroid analysis—this is a technique used in Digital Signal Processing (DSP), in which the "center of mass" (central tendency) of the frequencies spectrum is indicated—spectral centroid has a robust correlation to the perception of "brightness" in sound. The spectral centroid of an audio signal is calculated using a statistical/ mathematic method called Fourier Transform.
  - The study of timbre is a premature field. It will progress significantly in the coming years with development in statistical techniques.



ANOTHER CRAZY IDEA

- If everyone that walked into the installation scanned their face, and the increasing bank of faces was passed to a machine learning algorithm that then determined the relative average difference of the features in all of the faces, we could choose a randomness component for each piece determined by the variation in faces in the crowd.
- This could represent unity in difference and cultures fusing together and disappearing altogether, possible beauties of future globalism.

FOOD FOR THOUGHT: HOW DO WE DECIDE THE ORDER IN WHICH INSTRUMENTS RESPOND?

- Musical Intelligence? (specified parameters due to human understanding of music)
- Some sort of unspoken communication between the instruments—they are quietly notifying each other when they are about to make a decision to change their play or begin an important passage—this way, if one instrument made a decision a split-second before another in linear time, the two would have a real-time decision-making process or conversation about what is going to happen next in the live composition. And then it would proceed—but that would be happening so fast and so secretly that no one would even notice what was making everything so organic.
    - “music is a conversation” – said by a lot of people probably

ON SITE RESEARCH/INSPIRATION:

- Location: Don Buchla Memorial Concert (modular synthesis 2017) at Gray Area, SF
- David Rosenboom's Brainwave Feedback Loop Performance: this live composition explored a musical feedback loop between digital sound software responding to the EEG monitored brain waves of two meditating individuals and Rosenboom playing the electric violin, and in turn, affecting those individuals brain pattern response.
- Video 1: https://vimeo.com/221524303
- Video 2: https://vimeo.com/221524845


David Rosenboom's
Musical-Brainwave
Feedback Loop
Experiments

Rosenboom

Composer David Rosenboom, seated in front of an ARP modular voltage-controlled system. Matrix switches run horizontally along the top and bottom of the ARP, taking the place of patchcords.

RB
WITH
TABLAS

A LITTLE BIT OF MATHY STUFF AND RECAP

- This instrument can play itself and/or it can receive input from “players”—vocal input maybe from multiple sources, rhythm input.
- The instrument playing itself without any external input is a closed realm of probabilities. It is not infinite and it is actually someone calculable. This is because the database for the installation would store a certain number of initial conditions and those would be the number of possibilities of musical universes. However, as soon the gate for external input opens, the probabilities are becoming increasingly more infinite and the composition is becoming more and more interesting.

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