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Multi-Agent Musicians

# Project Proposal

## Introduction

AI-generated music is a fascinating topic which has been done in various ways such as with recurrent and/or convoluted-recurrent neural networks which learn from data [1], with multi-agent systems which treat each musical note as an agent and which use reinforcement learning and music theory rules [2], and from multi-agent systems which have a composer agent and drumming agents which co-evolve a rhythm together [3], etc. The first two essentially learn to improvise on a single instrument, which can be thought of as a single musician or agent. By creating an agent for several different instruments, I can create a multi-agent band. Each agent can create its own music that sounds good in its self-interests, but playing together would require communication in the form of things like pulse, rhythm, key, and chord progression.

## Possible Approaches

Each of the listed approaches to creating musical agents have their merits and pitfalls. With neural networks, agents can learn from data and learn different styles, but it isn’t a multi-agent system unless I use distributed NN approaches. With the multi-agent system where each note is an agent, consonant chords are created, but it seems like features are crafted by hand, which is something I want to avoid. The third system mentioned in the introduction places drumming agents in a drum circle, so I would extend this system to including more than just drummers.

In terms of data, finding sheet music for classical pieces is quite easy, and I also have tens of thousands of written out songs which can be exported to XML. The XML contains lots of information on the measure, timing, note, and which instrument plays it. The idea is to train each agent on a different instrument such as guitar, bass, and drums for contemporary music like bands with similar styles and large repertoires like Led Zeppelin, or violin, viola, and cello for classical music, depending on which approach to the data I take. Then, the agents would generate music alongside each other and have social interactions.

There should be a small hierarchy for communication and who decides what. For example, a composer agent can keep the pulse and determine the tempo and key. The drummer will use the tempo and try to match a rhythm with the bassist. The bassist will determine and communicate the chord progression. The guitarist will try to stay in tempo and in the chord progression.

## Schedule

Assignment 2 - September 22

* Read up on multi-agent learning in the book
* Find papers which do similar things and which generate music
* Decide which approach to creating single agents
* Preprocess music files

Assignment 3 – October 11

* Begin creating single agents (perhaps using multiagent NNs)
* Generate music with single agents

Assignment 4 – October 27

* Generate music in real-time
* Create a communication framework for the agents to interact

Demo – November 10

Assignment 5 – November 15

* Allow the agents to interact and communicate
* Improve interaction between agents

Report – November 29

## Links

[1] - Composing Music With Recurrent Neural Networks http://www.hexahedria.com/2015/08/03/composing-music-with-recurrent-neural-networks/

[2] – A Musical Composition Application Based on a Multiagent System to Assist Novel Composers <http://computationalcreativity.net/iccc2014/wp-content/uploads/2014/06/7.4_Navarro.pdf>

[3] - THE CREATION OF EVOLUTIONARY RHYTHMS WITHIN A MULTI-AGENT NETWORKED DRUM ENSEMBLE <http://www.sfu.ca/~eigenfel/MultiAgents.pdf>