

Initial Project Overview

SOC10101 Honours Project (40 Credits)

Title of Project:

Evolution of Neural Network Controllers for Gameplay Behaviours

Overview of Project Content and Milestones

The idea is to implement a card game with four players. One of the players is the human, another is an AI agent that has no idea how to play the game, and the other two are hard-coded to know the rules and how to play. The intention is for said card game to be Switch, however this is subject to change if the rules are found to be too difficult for the scale of the project – in which case a simpler game will be substituted in.

The agent then learns how to play by trying to make moves based on neural networks. Initially this will be totally random but after the first generation of the algorithm cycle, it will be based on the chromosomes with the highest fitness, which should then begin to provide better results. These moves can be blocked if they are not legal. There'll be a scoring system for the agent that will be negatively affected by illegal moves and it will then use this to learn how to do better the next time it plays. The scoring system will also see the agent penalised for losing or not winning. This will be what our fitness is based on.

It is worth noting that how *successful* you are in a game of Switch depends entirely on the hand you're dealt, and how your opponents play the hands they are dealt. A lot of the game is about luck, and so negatively affecting the agent's score should take this into account and deploy *some* leniency.

The project will make use of the NeuroEvolution of Augmenting Topologies (NEAT) library and will most likely be coded in C++. It will use neural network controllers, coevolving weights and topologies.

The Main Deliverable(s):

- A playable card game that incorporates an Artificial Intelligence agent that must learn how to play the game from scratch based on a score system that penalises the agent for illegal or costly decisions.
- Experimental research into improving the performance (in terms of score) or speeding up the learning process of the agent.
- A report into what positively or negatively affects the agent, and what causes the effects that it has including experiment results using charts and figures. Changes will be made by varying parameter settings of the evolutionary algorithm in a systematic way.

The Target Audience for the Deliverable(s):

Whilst the final product will be a playable game, it will really be aimed more at being experimental research into Artificial Intelligence techniques and, more specifically, evolving neural network controllers for playing games. Thus, the audience most likely to be interested in the project are those who also want to look into artificial intelligence agents.

The Work to be Undertaken:

- Design and build a game of Switch without the AI agent
- Thoroughly test the barebones game to ensure it works perfectly without bugs
- Research neural networks and evolutionary algorithms
- Implement the AI agent
- Experiment with a few different techniques and test how they perform in terms of improving or decreasing the agent's intelligence/performance in game.

Additional Information / Knowledge Required:

Neural networks and evolutionary algorithms

Information Sources that Provide a Context for the Project:

- Lubberts, & Miikkulainen (2001). *Co-Evolving a Go-Playing Neural Network*.
- Stanley, Bryant, & Miikkulainen (2005). *Evolving Neural Network Agents in the NERO Video Game*. IEEE Press.
- Thrun (1995). *Learning to Play the Game of Chess*. MIT Press.

The Importance of the Project:

Exploring possibilities and limits of AI in games, particularly evolved controllers which do not have to be hard-coded.

The Key Challenge(s) to be Overcome:

- Complete lack of knowledge and experience with Artificial Intelligence techniques