CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36229

Project Title

Analyzing the Effects of Hidden Neuron Quantity on Neural Network Performance

Abstract

Objectives/Goals

The objective of this experiment was to determine how the amount of hidden neurons in an artificial neural network affect its performance in the game "Dots and Boxes." The opponent competing against the neural network makes a random decision each turn. The neural network will use an evolutionary/genetic model to learn how to play the game with no prior experience.

Methods/Materials

To investigate the objective, I made a simulation using an artificial neural network. The neural network competes against an opponent that makes random decisions. The neural network uses sigmoid neurons and an evolutionary/genetic algorithm. The game, "Dots and Boxes" uses a 4x4 grid in this simulation. Each turn, the owners of the lines in the game are fed to the neural network as inputs. There are three output neurons that represent the line the neural network chooses. If a line that is already claimed is picked, the game will restart. The fitness of the neural network is calculated by the expression pl+t, where p is the score of the neural network, l is the number of lines on the grid, and t is turns taken.

Results

The overall effect of increasing the number of hidden neurons in the artificial neural network is a decrease in the average highest fitness score of the network over 10,000 generations.

Conclusions/Discussion

The results show that adding more hidden neurons to the artificial neural network is counter-productive. One reason for this may be that larger neural networks take more generations to increase fitness. It is possible that because of the generations limit in the experiment, larger neural networks were under-developed. If this is the case, it is possible that adding more hidden neurons results in a slower fitness increase. It is also possible that additional training would have a positive impact on the performance of larger neural networks over many generations. The way that I chose to calculate the fitness of the neural network likely had a significant effect on the results.

Summary Statement

I analyzed how the number of hidden neurons used in an artificial neural network playing "Dots and Boxes" against a simulated opponent that made random moves affected the performance of the artificial neural network.

Help Received

I designed and programmed the algorithms used in the simulation for this project after doing research on how artificial neural networks work.