Comp 6321 - Machine Learning - Project proposal

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1 Introduction

The purpose of this project is to implement a neural network classifier that will evaluate the goodness of board-configurations for the well-known game reversi or othello, which uses an 8x8 board, has a medium-sized state-space, takes an average of 60 moves to complete yet is difficult to master.

The established AI approach to game-playing consists of conducting an n-ply minimax search per move. Said search spans the branches stemming from the current game state using explicit and deterministic heuristic evaluation functions.

An alternative solution that has achieved some degree of success, is to train a neural net to evaluate the goodness of configurations . The training stage of each net takes place competing against other neural nets, all having been generated by GAs. This is referred to as co-evolutionary neural networks.

The nn evaluation component of such a system will be the focus of this class' project whereas the minimax search componenet will be developped for another project.

2 Methodology

The method to be followed is described in [2]. T. The Evolutionary Neural Net is implemented is based on [1].

We briefly describe the network topology from [2]: one input layer, three hidden layers and one output neuron. The input is made up of 64 inputs, one per square on the board. The first hidden layer contains 92 neurons divided up as follows: 36 neurons, one for each 3x3 sub-board; 25, neurons, one per each 4x4 sub-board; 16 neurons for all 5x5 sub-boards; and 9, 4 and 1 neurons for each 6x6, 7x7 and 8x8 sub-boards respectively. Additionally there is one neuron for evaluating piece differential.

The second layer consists of 40 neurons, each receiving the weighted output from each one of the first hidden-layer's neurons [1]. For the third and last hidden

[1] with the exception of the piece-differential neuron.

layer, each of its 10 neurons receives the output of each one of the second layer's outputs.

The first layer's piece-differential neuron and all outputs from the third hidden layer are connected to the input of the output neuron which gives positive values up to 1 for advantegeous board configurations or negative values down to -1 for disadvantegeous configurations.

The neurons from the original paper, were modelled as hyperbolic tangents of the weighted sum of the inputs and a bias, thus having outputs within $[-1, 1]$.

The co-evolutionary aspect will allow 20 nn for each generation, 10 parents and 10 offspring. The weights and bias are given by the GAs and after every tournament round, 10 nets are chosen and used to generate 10 new networks; both groups to be pitted against each other in the following generational tournament round.

References

[1] Kumar Chellapilla and David B Fogel. Evolution, neural networks, games, and intelligence. *Proceedings of the IEEE*, 87(9):1471–1496, 1999.

[2] Siang Y. Chong, Mei K. Tan, and Jonathon D. White. Observing the evolution of neural networks learning to play the game of othello. *IEEE Transactions on Evolutionary Computation*, 9:240–251, 2005.