April 21, 2015
CS 3445
Final Project Proposal

Proposal: Structuring Neural Networks with Ant Colony Optimization

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While there has been substantial research in using bio-inspired approaches alter the weights of neural network, there has been less research in using these approaches to find optimal structure for the network. By structure we mean the connections between nodes in the network. This is surprising since researchers have shown that neural network structure affects the learning capabilities of a neural network (Kavzoglu, 1998). We will use Ant Colony Optimization techniques to explore the effect of neural network structure on performance. Some research (Martin, 2009) indicates success in using ACO as a form of "self-assembly" to construct the network.

Our testing will consist of character recognition problems. **If character recognition proves too simple a problem to differentiate success rates in experimental and control Neural Networks, we will look into other problems from available data sets (http://archive.ics.uci.edu/ml/datasets/Abalone).** First, we will record the accuracy of a **baseline** neural network in identifying the correct characters. **This control network will feature the same initialization as our experimental network, but without ACO training. Currently, we expect our network to contain only one hidden layer.** We will then run the same tests on an "optimized" neural network, using ACO techniques to determine its structure. **Based on conclusions from earlier ACO testing, we have determined that the Ant Colony System variant of ACO will be the reference for our algorithm.** Comparing the performance (accuracy) of these two network will allow us to make conclusions about the benefits of this initial ACO "training." We hope to explore at what point (if any) ACO demonstrates positive effects, any trends or common themes in optimized structure, and whether the additional overhead of ACO is a worthy trade off for training a neural network. **In addition to accuracy, we hope to gather information on the overall speed, node-size, and training time trade-offs of an ACO restructured networks as compared to more our more conventional implementation.**

Kavzoglu, T., & Vieira, C. A. O. (1998) *An Analysis of Artificial Neural Network Pruning Systems in Relation to Land Cover Classification Accuracy*. In Proceedings of the Remote Sensing Society Student Conference

Martin, C., & Reggia, J. (2009) *Self-assembly of neural networks viewed as swarm intelligence*. Springer.

Tentative Schedule:

Week of April 13th: Implement single hidden layer neural network and back-propagation learning in C++.

Week of April 20th: Test and debug neural network on character recognition problems.

Week of April 27th: Modify ACO algorithm to find optimal neural network structure. **At this point, we will have discovered the secret to creating artificial life.**

Week of May 4th: Start testing in order to compare the two neural networks: the control and the one optimized with ACO. Write report.

May 11th: Give final project presentation.