TJHSST Senior Research Project Proposal: Ant Colony Optimization 2006-2007

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Abstract

Ant Colony Optimization (ACO) is an algorithm that is used to find near-optimal solutions to computationally intensive problems. The algorithm mimics the system that ants use to find the closest food source (optimal solution). ACO simulates the moving of these ants as they choose which direction to go based on where other ants have been. As ants travel they leave behind pheromones that other ants will follow, so that a trail that leads to a food source will be followed and reinforced.

Keywords: Ant Colony Optimization, Traveling Salesman Problem

1 Program Versions

1.1 1st Quarter

1.1.1 Creating the Environment

The first version of my program area will consist of an environment to test the ACO algorithm. The environment will be a model of the Traveling Salesman Problem, where there are n nodes on a planar surface and the computer needs to find the shortest way to visit all the nodes and return to the starting node. The initial environment will find the solution to this problem iteratively for multiple values of n to test the validity of the model. The model will deal

with data sets of nodes (represented as random coordinate points), evaluate the distances between all the nodes, and find the shortest path that visits all the nodes.

1.2 2nd Quarter

1.2.1 Creating the Algorithm

The second version of my program area will consist of creating the ACO algorithm and applying it to the Traveling Salesman problem. The ACO algorithm will work in the environment created in the first quarter by asking the environment for information, such as the distance between two nodes, and storing/using that information to find an optimal route. The algorithm will be compared to the iterative result for small values of n to test its effectiveness and accuracy.

1.3 3rd Quarter

1.3.1 Testing the Algorithm

The third version of my program area will consist of trying to improve the basic ACO algorithm. Such improvements could be: (1) the evaluation of the weighted probabilistic selection of routes used in the ACO algorithm, (2) the efficiency of the ACO algorithm compared to other algorithms at the Traveling Salesman Problem, and (3) updating the ACO algorithm so that it would be able to handle the addition or removal of nodes while the process is running.

2 Expected Results

The end result of my program would be a functional ACO algorithm that finds near-optimal solutions to the Traveling Salesman Problem faster than going through the solution set iteratively. The results could be presented in multiple graphs that show ACO performance versus iterative performance and how varying certain variables in the ACO algorithm effect how quickly it arrives at a solution.