CS 314, Lab 4 - Report

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1 Abstract

In this task, with a given a set of cities (coordinates) and distances between them, find the best (shortest) tour given that visiting all cities exactly once and returning to the origin city in a given amount of time had to be found. It encloses the concept of Travelling Salesman Problem .

2 Pseudo Codes

In the following subsections, pseudo codes for important functions in the code are explained.

2.1 Ant Colony Optimization

In this trial run, we have implemented Ant Colony Optimization. In this trial round, we optimize Ant Colony Optimization to solve the Travelling Salesman Problem. The strength of Ant Colony Optimization lies in the fact that it has little chance to get stuck in a local optima. It also uses a probabilistic based approach while forming a tour during the simulation of an ant, and hence tends to give better solutions than the other algorithms.

Algorithm 1 ACO(graph)

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procedure ACO(graph)
    Initialize()                                  ▷ Initialize all parameters
    while stoppingCriterion() != 0 do
        positionAnt ← startingNode
        while eachAntSolution == 1 do
            for each ant do
                stateTransition(nextNode)
                pheromoneUpdate();
        update(bestSolution);
        pheromoneUpdate();
```

Input File	Cost of Tour
euc_100	1634
noneuc_100	5270

Table 1: Output Statistics

3 Output & Inference

Table 1 shows the Output Statistics for various input files.

In order to improve the solution and make the search more exploratory in nature, we randomly chose a starting city for the tours of the ant, instead of fixing them to one city alone. Further, inspired by the rank Ant Colony System approach, we update the pheromones using only the k best ant tours. The empirical equation used was as follows:

$$k_{best} = 0.1 \times N$$

Using the above mentioned empirical equation, we got good enough results.

Finally, we tweak the parameters α, β, Q and ρ. The following are the definitions to the parameters:

- α determines the contribution of the pheromones in the probability of choosing the next city for the tour.
- β determines the contribution of intercity distances in the probability of choosing the next city for the tour.
- Q is a constant value that determines the $updateValue(pheromones\_delta)$ of the pheromones.
- ρ is the pheromone evaporation constant that plays a major role in updating the pheromones after every N ants are simulated.

Experimentally and intuitively, we see that good results are obtained with the following parameter assignments:

$$\alpha = 3$$

$$\beta = 3$$

$$Q = 0.1$$

$$\rho = 0.1$$

It is to be noted that number of ants here are same as the number of cities (N).