CS 312: Artificial Intelligence Laboratory
Lab 4 Report

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1 Introduction

The objective of this task is to solve the Travelling Salesman Problem. Given a set of cities (coordinates) and distances between them, find the best (shortest) tour (visiting all cities exactly once and returning to the origin city) in a given amount of time, viz. Travelling Salesman Problem.

2 Methodology

2.1 Ant Colony Optimization

By comparing the three algorithms - Simulated Annealing, Genetic Algorithm, and Ant Colony Optimization in Lab 3, we found that in general Ant Colony always perform better. 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.

2.1.1 Results obtained on given Testcases

Let N represent the number of cities in the input.

Input	**Cost of Tour Found**		
	Ants = N/10	**Ants = N/5**	**Ants = N**
euc_100	1724.907	1686.441	1603.472
euc_250	2772.584	2728.332	2661.285
noneuc_100	5378.015	5313.832	5299.422

2.1.2 Iterative Improvements

It is generally observed that greater the number of ants is,the more likely it is to obtain a better tour with a more optimal solution, however, this happens at the cost of execution time. Therefore, we first increase the number of ants for each test case to be equal to N, ie, the number of cities. Next, to improve the solution and make the search more exploratory in nature, we randomly choose 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. Empirically, it is found that setting $k_{best} = 0.1 * N$ yields good results.

Finally, we tweak the parameters α, β, Qandρ. 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 update value(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 - $\alpha = 3, \beta = 3, \rho = 0.1, Q = 0.1$ and the number of ants equal to the number of cities.We see that if no better tour is found for 30s, we restart the algorithm setting $\alpha = 2, \beta = 2$

Thus, we obtain fairly well results with Ant Colony Optimization.