Name: Sidharth Rao User-ID: 000868631

Algorithm A: Genetic Algorithm

Algorithm B: Ant Colony Optimization

Description of enhancement of Algorithm A:

Tournament Selection over Roulette Wheel Selection.
Tournament Selection takes 2 random chromosomes within the population and selects the more fit chromosome. The runtime of this is constant since it will always have a runtime of n/2. TS is also random since you could have 2 fit chromosomes, 1 fit and 1 unfit and 2 unfit chromosomes compete.
Mutations: this enhancement will randomly "mutate" or crossover 2 random chromosomes in the population once the main crossover is complete. This is to generate a random route which could potentially be better than the current best fitness of the population.

Generation Cycles: This enhancement will restart the population of the chromosomes once every x cycles (x depends on the number of cities). This is only include the n/8 best scores. This is to ensure that a new potentially better route can randomly get generated.

I also increase the max number of iterations and the population size based on the number of cities. When running this for long periods of time, this would ensure that there is a higher chance of breaking out of a local optimum.

Description of enhancement of Algorithm B:

Firstly I began by constructing an Ant System (AS) for the ant colony algorithm by setting the initial pheromone deposit τ_0 to be the Number of ants N divided by L^{nn} where L^{nn} is the length of the tour produced by the nearest neighbour algorithm. I also set the number of ants to be equal to the number of cities.

Then I created a heuristic desirability matrix based off the decision matrix where edges with a lower distance would have a higher chance to be traversed. I added this to my probability function.

$$p_{i,j}^{k}(t) = \frac{[\tau_{i,j}(t)]^{\alpha}[\eta_{i,j}]^{\beta}}{\sum_{m \in NG(i) \setminus Fk} [\tau_{i,m}(t)]^{\alpha}[\eta_{i,m}]^{\beta}}$$

Where η_e, the heuristic desirability is equal to $1 / d_e$ where d_e is the distance of a particular edge.

After lots of testing I found that tweaking Dorigo's values for alpha and beta to be 1.3 and 2.2 respectively.

Finally I implemented my version of a Ranked Based Ant System where all the ants are competing with each other. I did this by firstly ranking all the ants according to their score and concentrating the pheromone based on their ranking.

DESCRIPTION OF ALGORITHM ONLY IF THE ALGORITHM IS NOT COVERED IN LECTURES

Description of *non-standard* Algorithm A:

Describe any non-standard algorithms you have implemented that ***have not been covered in lectures*** *(otherwise these boxes should be blank) You need to convince me that your implementation is indeed that of the named algorithm and you need to* ***provide a full reference to the source for your algorithm****. You should* ***include a pseudocode description****. You can vary the sizes of these boxes but not the font (Calabri), font size (11) or paragraph properties (single space), and everything should fit onto one side of A4. (You can delete these instructions.)*

Description of *non-standard* Algorithm B:

Type here.