CS312 Artificial Intelligence Lab Assignment 3

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Simulated Annealing Analysis and Observation

1. **Perturbation method chosen:**

   The method chosen for perturbation was to randomly swap two cities in the solution. This generates a valid neighbour and also ensures that the neighbours generated are random so that the algorithm does not get stuck at a local extrema.

2. **Cooling schedules tried:**

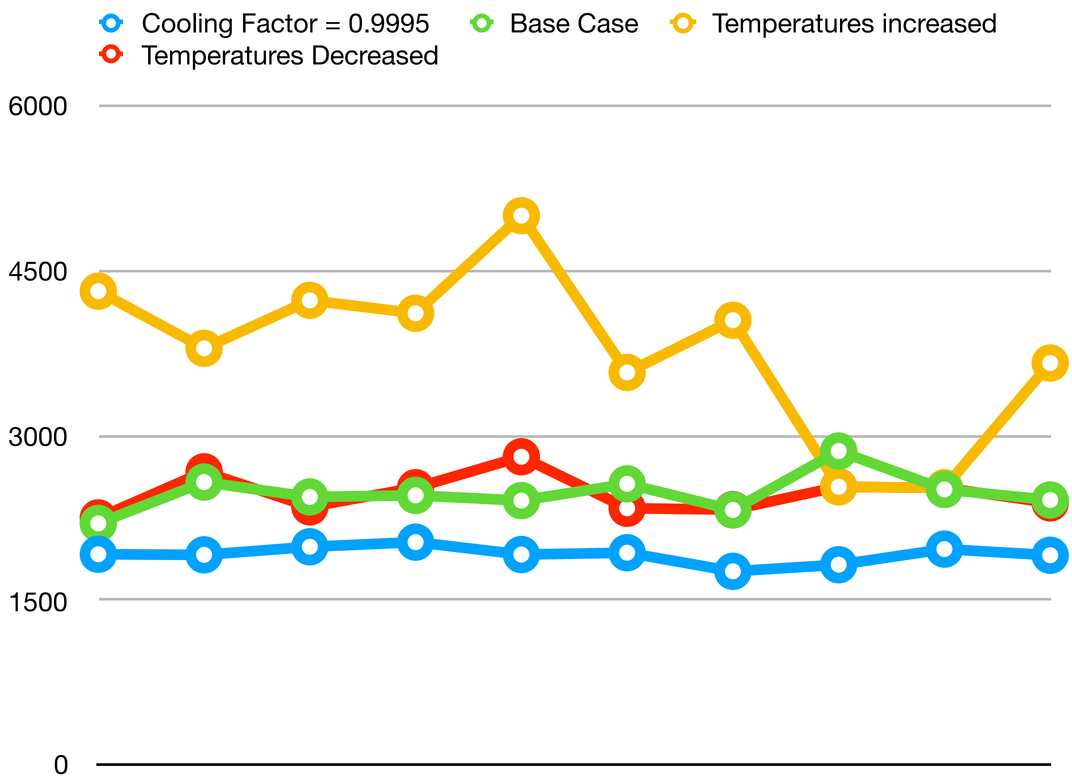
   Base Case: Starting Temp: 100, Ending Temp: 1, Cooling Factor: 0.995

   a. We tried to increase the cooling factor from 0.995 to 0.9995.
   b. Increase in starting and ending temperature
   c. Decrease in starting and ending temperature

3. **Results**

Simulated Annealing

Starting Temperature	Ending Temperature	Cooling Factor	Results (on average of 10 tries)
100	1	0.995	2473.3276
100	1	0.9995	1914.7625
1000	10	0.995	4114.4182
10	0.1	0.995	2469.9239



4. **Effect of Cooling Schedules on tour length**

   a. On increasing the cooling factor, we find that it has a positive effect on the tour length.
   b. On increasing and decreasing the starting and closing temperature, we find that the tour length is increased. It seems to suggest that the base case temperatures are very efficient.

Genetic Algorithm Analysis and Observation

1. Representation chosen and why (Path/Adjacency/Ordinal)

We chose the path representation for the solutions as it has been the same for all three algorithms.

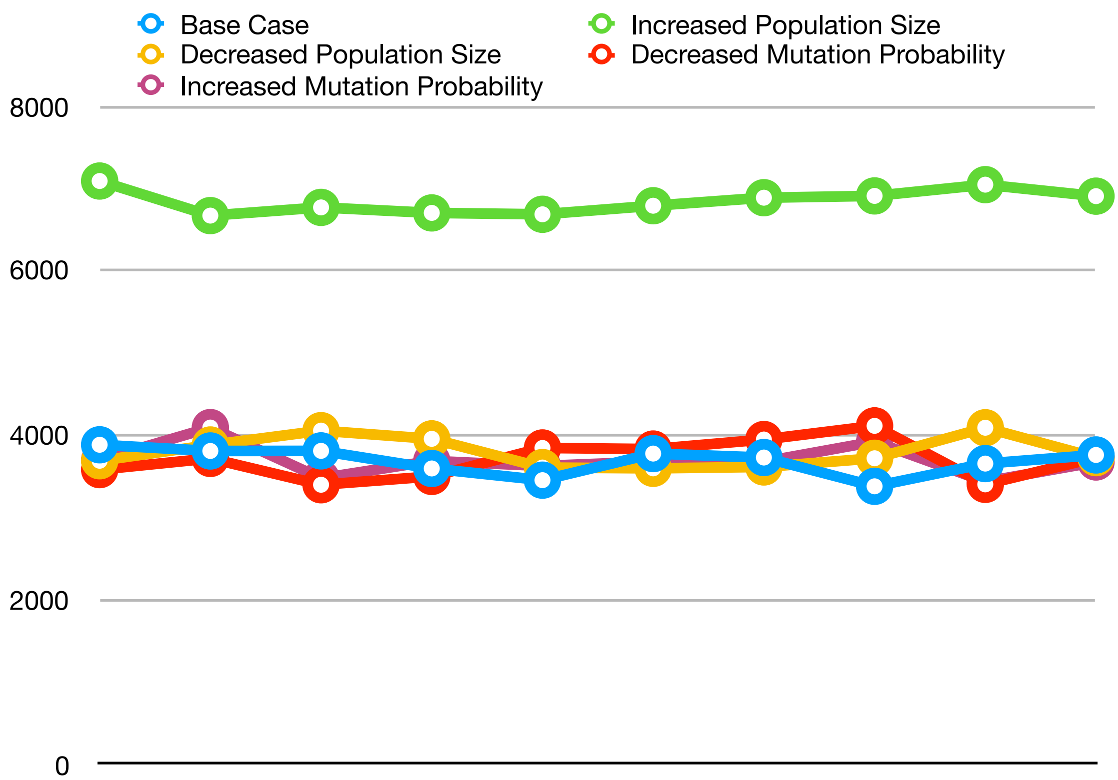
2. Crossover Operator chosen

We have chosen the order crossover method over the CX2 crossover method as it was giving shorter results for all settings in general

3. Results

Genetic Algorithm

Population Size	Mutation Probability	Iterations	Results
100	0.15	1000	3683.8805
1000	0.15	1000	6844.9243
10	0.15	1000	3775.3472
100	0.1	1000	3705.3134
100	0.3	1000	3696.2083



4. Effect of Population Size on tour length

It is clearly visible that with a greater population size, the path length becomes worse. This is because we are storing more paths with longer values, making many of the generations and crossovers redundant.

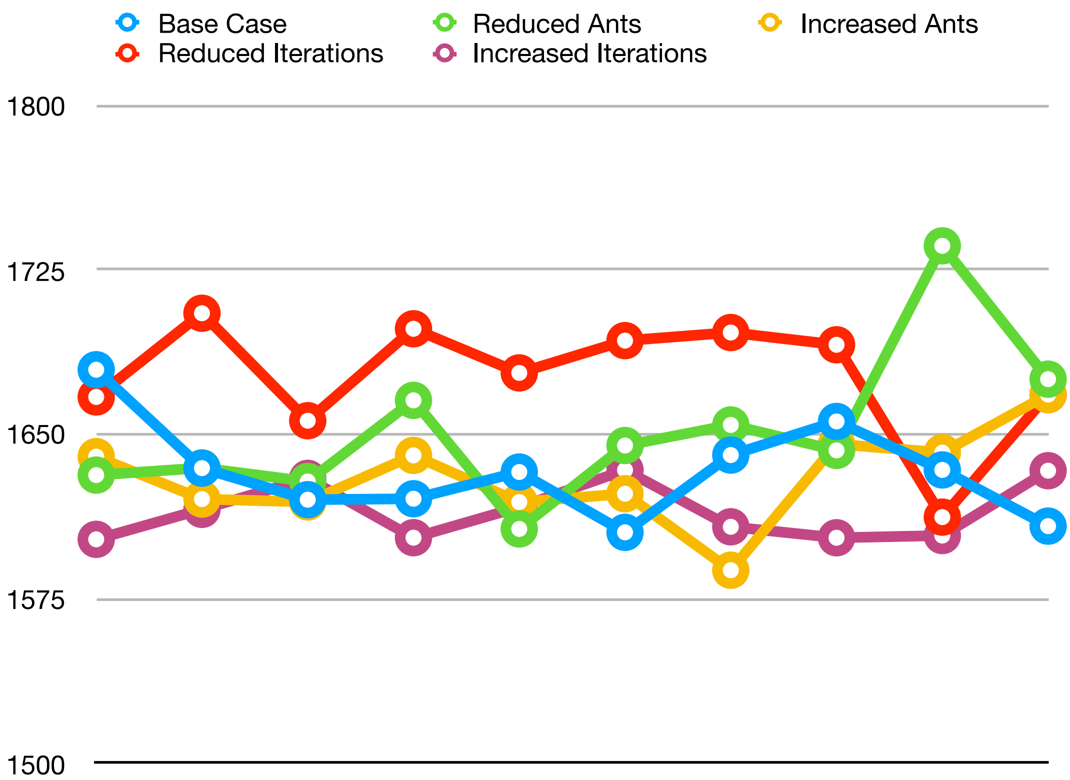
Ant Colony Optimisation Analysis and Observation

1. Results

Base Case: Number of Ants: 10; Number of Iterations: 100

Ant Colony Optimisation

Number of Ants	Number of Iterations	Result (on average of 10 tries)
10	**100**	1635.9576
2	100	1649.4593
20	100	1626.4051
10	10	1677.4422
10	1000	1612.9223



2. Effect of Number of Ants on Tour Length

It was found that the number of ants, when increased, causes a reduction in the length of the path, as is visible in the results. It was also noted that an increase in the number of iterations was beneficial, but at the cost of time.

Conclusion:

For the travelling salesman problem, the Ant Colony Optimisation is giving the best results. However, this is at the expense of time.

On the other hand, the Genetic algorithms are able to determine a result quickly, but it is usually far from the optimal path.

The simulated annealing is a good balance between time and tour length. However, this algorithm can give a variety of answers for the same set of points.

We would prefer a variation of the ant colony optimisation in which we run very few ants.