

Name: Theo Hinton-Hallows

User-ID: tvnj26

Algorithm A: Genetic Algorithm

Algorithm B: Ant System

Description of enhancement of Algorithm A:

*My basic genetic algorithm code performed orders of magnitude worse than my ant system code. I suspected this may have been due to the use of a crossover (breeding) algorithm which corrupted the parents' data slightly through the process to re-establish tour validity. This meant that children were not directly related to their parents so evolution could not take place as easily. I therefore decided to look for a different implementation of the crossover operation, and found an operation called order crossover [1]. This does not have to corrupt the parents' data as it produces valid tours. It also largely preserves order between cities from the same parent. It works by selecting two random partition points and preserving the cities in between these points in a child. The other slots are then filled, in order moving rightwards from the end of the middle segment, with the remaining cities in the order they come from the other parent. I also implemented a way to filter the population so only a lower quantile of tour lengths could be used as parents, however this only worsened performance (although i've left it in with QUANTILE set to 0 as this has no effect on functionality – to reintroduce this set QUANTILE to a value between 0 and 1). Finally, I changed the way parents were chosen so each tour was weighted by the inverse of its length rather than tau-length. These changes slowed down execution of the code so I had to lower some of the parameters (population size and number of iterations) but the trade-off was worth it as tour lengths were noticeably lower in many cases (although still not close to the ant-system algorithm).*

*[1] Larrañaga, P., Kuijpers, C., Murga, R. et al. Genetic Algorithms for the Travelling Salesman Problem: A Review of Representations and Operators. Artificial Intelligence Review 13, 129–170 (1999). <https://doi.org/10.1023/A:1006529012972>*

Description of enhancement of Algorithm B: