University of St.Gallen
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WAS Exercise 7

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Task 1

The solutions can be found in the code files

Task 2

Question 1

How do the parameters α and β impact the performance of your algorithm (comparing the produced solution to the optimal solution)?

If α converges to zero, the closest cities have the highest probabilities to be chosen. If β converges to zero, the most pheromones will have the most influence on the path probabilities.

And in fact to prove the above statement, I noticed that, the lower β (with $\alpha = 1$), the less optimal the path becomes. Also for values of $\alpha > 1$ I received less optimal results than if I just adjusted the β variable comparatively. This probably stems from the ants starting to follow the same path and constructing the same tour in these cases.

My best solution was found with $\alpha = 1$ and $\beta = 5$, for the shortest total distance of 11788. However, since the initial location is randomized and the choice of the next location as well, it is very improbable that I would reach the optimal solution anyways.

Question 2

How does the evaporation rate ρ affect the performance of your algorithm (comparing the produced solution to the optimal solution)?

Thinking about this, my theoretical assumption would be that the higher ρ is, the faster the pheromones evaporate, meaning the more the probability is dependent on the cost $\Delta\tau_{i,j}$. However, trying out different values for ρ did not show any trends in my experiments, therefore it is really hard to interpret this assumption.

A high evaporation rate would benefit if many ants go a suboptimal path, as the misleading high number of pheromones would be contradicted quickly, so they have a higher probability again to go the correct way.

Question 3

How would you modify your implementation in order to apply the ACO algorithm to a dynamic traveling salesman problem (DTSP), i.e a TSP in which cities can be added or removed at run time?

When cities can be added or removed at run time a TSP must be able to react to these changes in the environment thus becoming the DTSP. So most things would be kept the same (initializing the environment, solution construction, etc.) but the pheromone trails (and therefore the heuristic information) would need to be handled dynamically as well. If a city is removed, I'd think the values can simply be removed from the connections that disappear. If a city is added the new pheromone values need to be set "either to values proportional to the length of the associated connections or to the average of the other pheromone values" (Source: The Ant Colony Optimization Metaheuristic - Chapter 2.3.6).