Ant Colony

Important operations

The idea behind this algorithm is to create the behavior of ants. It uses *pheromone*, which each artificial ant drops off while they walk the path. The pheromone is meant to function in a way that, the more pheromone there is on a path between two cities, more ants will choose that path because other ants have walked there. If one path has a greatly amount of pheromone, that path is good. The pheromone handler has an *Evaporation* method, if no ants walk on the path for some time, the pheromone will evaporate using the *evaporation rate*.

The pheromone is calculated by:

$$\tau_{rs}(t) = (1 - p) * \ \tau_{rs}(t - 1) + \sum_{k=1}^{m} \Delta\tau_{rs}^{k}$$

The first part in this equation is the *Evaporation*, where I take 1 – *evaporation rate*, which in my solution is 0,2. The rest of the equation is the calculation of the new pheromone.

m – number of ants

$\Delta\tau_{rs}^{k} = \frac{1}{C(S_k)}$

$C(S_k)$ = is the cost for a solution built by one ant **k**, which mean the total distance for the whole route ant **k** made

Another operation used by the ants is the *probabilistic transition rule*. This is used when the ant moves between two cities. It gives a probability for ant **k** to move between city **r** and city **s**. It is calculated by:

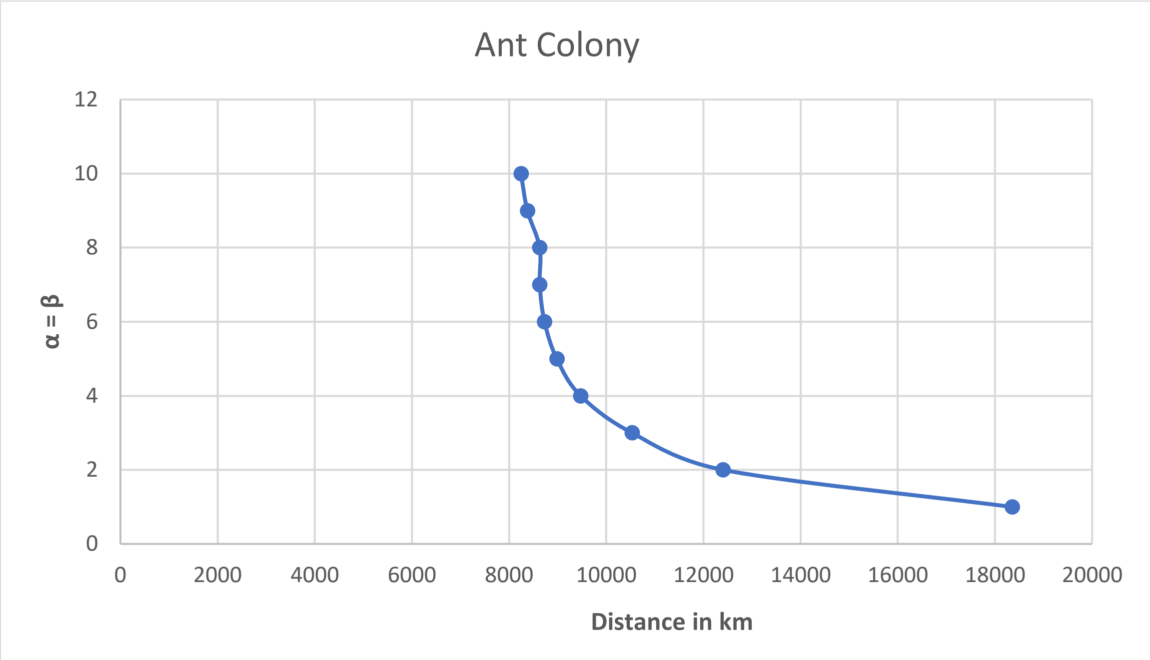
$$P_k(r, s) = \begin{cases} \frac{[\tau_{rs}]^{\alpha} * \ [\eta_{rs}]^{\beta}}{\sum u \in J_k(r)\, [\tau_{rs}]^{\alpha} * \ [\eta_{rs}]^{\beta}} \ if \ s \ \in J_k(r), in \ other \ case \ 0 \end{cases}$$

τ_{rs} – the pheromone on the path between city **r** and city **s**

η_{rs} – is the heuristic information about city **r** and city **s** and is calculated by:

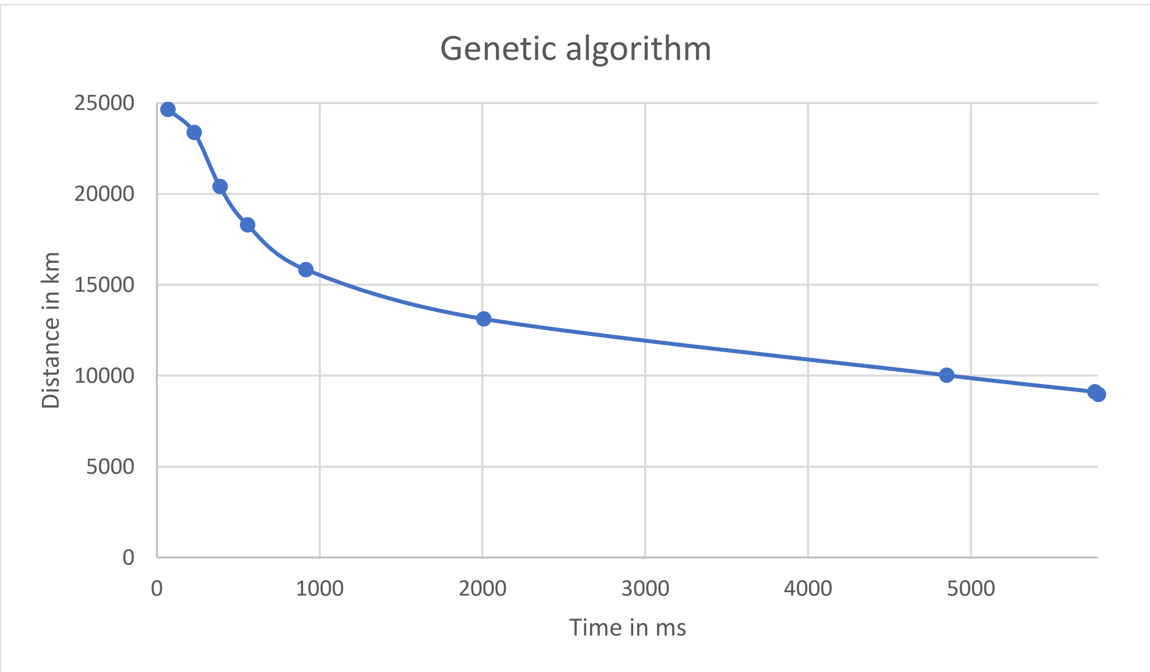
$\frac{1}{d_{rs}}$ where *d* is the distance between city **r** and city **s**

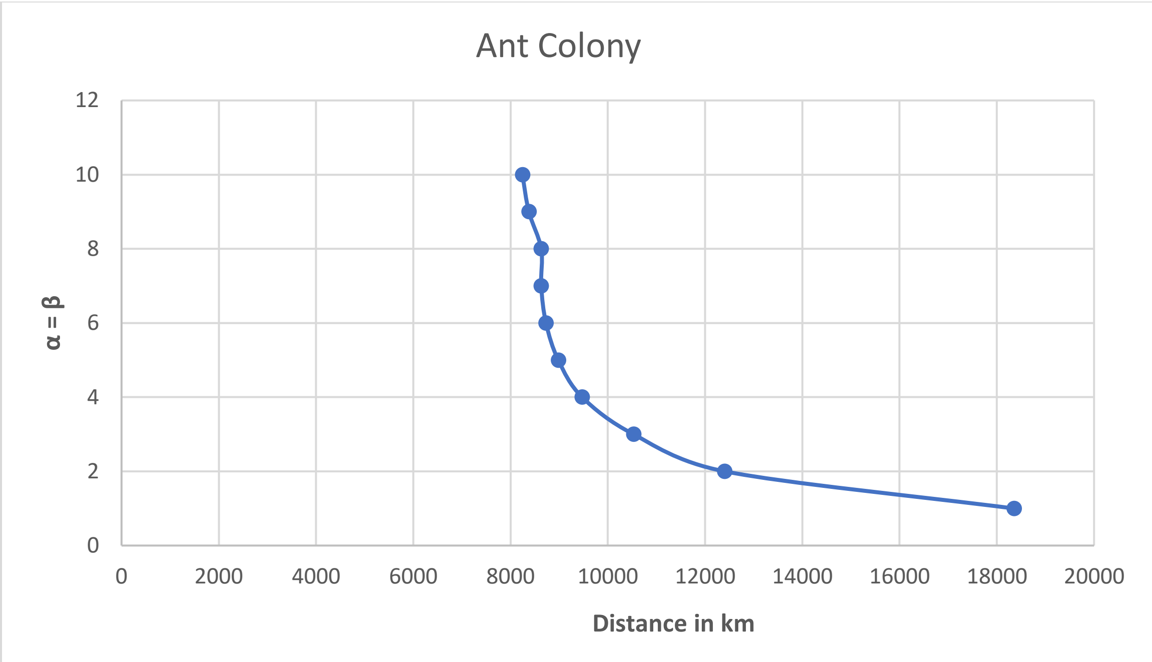
Illustrate the performance



The problem that occurred in my solution was that the ants did not learn the behavior they should. The result was always the same from start to end. It was beta and alpha that gave better results. The higher value they had, the shorter distance would the algorithm provide.

Compare the results from the genetic algorithm with this algorithm. Analyze the difference.





It would be difficult to measure a difference here since the Ant Colony algorithm does not behave the way I wished. If it would, I would be able to measure the time over generations too, as I did for the Genetic algorithm in figure 2.

While looking at the implementations of the two algorithms it is obvious that the genetic algorithm depends on mutate and crossover and Ant Colony depend on more math calculations with the pheromone and the probabilistic rule. With mutate and crossover, the algorithm can probably find many different ways through the problem since it throws cities around while in ant colony the ant will most likely continue on the same path as other ants as soon one ant has found a good path.