Swarm Intelligence

Ant Colony Optimization
Implementation Exercises 1

March 2, 2017

1. Implement an Ant System algorithm for solving the traveling salesman problem. You can use the template in C++ provided in the website of the course. Make sure your algorithm follows the guidelines provided in class. *Remember: the tour length is computed starting and ending in the same city.*

2. A small set of scripts to analyse your results is provided in the website, for using them you must produce an output with the following characteristics:

   (a) Boxplots: Data matrix, ":" separator field, first row is the header containing the names of the columns. First column are the different trial/instances. The rest of the matrix are the values to be plot.

   (b) Wilcoxon test: The same format as above, it provides the p-values of each test pair and performs a bonferroni correction for multiple comparisons.

   (c) Convergence: Files having the best solution each iteration or tour using the format per line: [tour:tour_length] or [iteration:tour_length]. One file per test.

   You can find small examples in the website. Feel free to use these scripts and adapt them to your needs.

3. Define default parameters that you consider adequate for your algorithm ($number\_ants$, α, β and ρ).

4. The following experiments will help you to understand the behaviour of AS and to find parameters that are good for the algorithm. Using your implementation of AS execute these experiments:

   (a) Use instance ulysses22.tsp, execute your algorithm 20 times using 2, 5, 10, 20, 50 and 100 ants. Termination condition: 500 tours.

   (b) Graph the results using boxplots. What behaviour can you observe?

   (c) Use instance ulysses22.tsp, execute your algorithm 20 times using $\{\alpha = 1,\ \beta = 0\}$ and $\{\alpha = 0,\ \beta = 1\}$. Termination condition: 500 tours.

   (d) What behaviour can you observe? is the convergence different?

(e) Use instance ulysses22.tsp, execute your algorithm 20 times using $\{\alpha = 1,\ \beta = 1,\ \rho = 0.01\}$ and $\{\alpha = 1,\ \beta = 1,\ \rho = 0.5\}$, $\{\alpha = 1,\ \beta = 1,\ \rho = 0.7\}$, $\{\alpha = 1,\ \beta = 1,\ \rho = 1\}$. Termination condition: 500 tours.

(f) Graph the results using boxplots. What behaviour can you observe?

5. For next class: Think about ways to improve the Ant System you have implemented today. You can propose changes in the way the pheromone is updated and evaporated, how to apply the transition rule, heuristics...