



ARTIFICIAL INTELLIGENCE

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HOMEWORK 3 ANT COLONY SYSTEM FOR TRAVELLING SALESMAN PROBLEM

Grade

The project grade, corresponding to 30% of your final grade, is given by a weighted average of your performance in the homeworks (10%, 25%, **30%** and 35%).

Deadline

This homework must be submitted **Tuesday 13 December 2022 at 23:59** (time in Lugano).

Instructions

Starting from the notebook [ACS_for_the_TSP.ipynb](#), solve the Travelling Salesman Problem using an Ant Colony System (ACS). More details on the implementation can be found in the papers “[Ant Colony System: A Cooperative Learning Approach to the Traveling Salesman Problem](#)” and “[MACS-VRPTW: A multiple Ant Colony System for vehicle routing problems with time windows](#)”.

Implement the following *variants*, from the simplest and adding enhancements:

1. The simple Ant colony System (ACS)
2. ACS + 2opt

Use the following *parameters*:

1. $m = 10$
2. $\beta = 2$
3. $\alpha = \rho = 0.1$
4. $\tau_0 = (n \cdot L_{nn})^{-1}$
5. $q_0 = 0.5, 0.98, (1 - \frac{13}{n})$
6. $cl = 15$ or without candidate list
7. global updating with the global best
8. use 2opt just for the best ant at each iteration

Evaluate your implementation with at least 3 *seeds*, and for the following *problem instances*:

1. eil76 (small size problem)
2. ch130 (small size problem)
3. d198 (small size problem)

The implementation has a limit of 3 minutes to run on each combination of: ACS variant — instance — seed. For each combination show:

1. For each run:
 - a. The best gap and cost you achieve
 - b. The number of tours generated to achieve the best tour
2. For each variant

- a. A table showing the same results of TABLE IV in the paper “ACS”
3. For each problem instance
 - a. A plot showing the average of the three runs and the best gap you achieve for each run. Along the y-axis shows the gap, while the x-axis shows the iteration.

Submission

Deliver your code as a **Python Jupyter notebook file** and briefly discuss your results and concisely provides evidence that you have accomplished each of the tasks listed above. Please do not include in the submission images of your plots nor the files in the AI2022MA folder.

Before submitting, rename your file as: <Name Surname>_MSCAI22_hw3.ipynb.

If you wish to deliver more than one file (code and report), please submit them in a single compressed folder with the same file name format: <Name Surname>_MSCAI22_hw3.zip.