Homework No. 3

Ant Colony
Optimization

Prelude

Assignment problem is a fundamental combinatorial optimization problem. In its most general form, the problem is as follows:
The problem instance has n agents and n tasks. Any agent can be assigned to perform any task, incurring some cost that may vary depending on the agent-task assignment. It is required to perform as many tasks as possible by assigning at most one agent to each task and at most one task to each agent, in such a way that the total cost of the assignment is minimized.

What to do?

Implement the  Colony Optimization with Python to "solve" the assignment problem for required test cases. Each test case only contains an $n \times n$ matrix M, which $M_{i,j}$ represents the cost of assigning the i^{th} task to the j^{th} agent. The goal is to minimize the summation of the costs of assignments whilst not leaving any job undone. In order to maximize your score, your code must be able to find an answer with the corresponding cost of less than 350 for the 2nd test case and a cost less than 750 for the 3rd test case.

Prepare a summary of what your code does. How did the parameters α, β or the pheromone evaporation rate affect your answers? How fast did your code find the answers? After what number of iterations did your code stop producing better answers? Include whatever useful facts – that you've learned when implementing the code – in your summary.

You can use the first test case – which only contains 4 agents and 4 tasks – to make sure that your code is working properly. The optimal answer for this test case is 26.

Upload a zip file containing your source code along with the summary.

Extras

Your homework will receive extra points for each of the following parts:
Extra 1. Finding an answer with corresponding cost of less than 22k for the 4th test case.
Extra π. Finding the best answer for the 5th test case among the students

Test Cases

Download the test cases here.

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