

Sensitivity Analysis of ACO Start Strategies for Subset Problems

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The difficulties associated with using mathematical optimization on large-scale engineering problems, have contributed to the development of alternative solutions. Linear programming and dynamic programming techniques, for example, often fail in solving NP-hard problems with large number of variables. To overcome these problems, researchers have proposed metaheuristic methods for searching near-optimal solutions to problems. One of the most successful metaheuristic is Ant Colony Optimization (ACO).

Real ants foraging for food lay down quantities of pheromone (chemical cues) marking the path that they follow. An isolated ant moves essentially at random but an ant encountering a previously laid pheromone will detect it and decide to follow it with high probability and thereby reinforce it with a further quantity of pheromone. The repetition of the above mechanism represents the auto-catalytic behavior of a real ant colony where the more the ants follow a trail, the more attractive that trail becomes. ACO is inspired by real ant behavior to solve hard combinatorial optimization problems. The ACO algorithm uses a colony of artificial ants that behave as cooperative agents in a mathematical space where they are allowed to search and reinforce pathways (solutions) in order to find the optimal ones. The problem is represented by graph and the ants walk on the graph to construct solutions. The solutions are represented by paths in the graph. After the initialization of the pheromone trails, the ants construct feasible solutions, starting from random nodes, and then the pheromone trails are updated. At each step the ants compute a set of feasible moves and select the best one (according to some probabilistic rules) to continue the rest of the tour.

The novelty in this work is the use of estimation of start nodes with respect to the quality of the solution and thus to better manage the search process. Various start strategies and their combinations are offered. Sensitivity analysis of the algorithm according strategy parameters is made. Our ideas is applied on Multiple Knapsack problem like a representative of the subset problems.