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The Capacitated Team Orienteering Problem

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Freight transportation and the delivery of services to customers are focal operations of great importance for industrial and economic activities. For that reason, modern companies focus on effective distribution logistics. One of the major operations lying at the heart of distribution logistics is the Vehicle Routing Problem (VRP). VRP takes for granted that available corporate resources are adequate to service all customers. However, this is not case in many real-life applications where the available fleet of vehicles cannot meet the customers' demands. Therefore, decisions on the subset of customers to be serviced have to be made. As a result, a new family of problems, known as Orienteering Problems, has arisen.

The Capacitated Team Orienteering Problem (CTOP) is an NP-hard combinatorial optimization problem that involves the design of maximum profit routes to service a set of potential customers with predefined profits [1]. A fixed fleet of identical capacitated vehicles travels along routes that begin and end at a central depot, in order to maximize the total collected profit. Each customer must be visited only once by exactly one vehicle. The objective is to determine the subset of customers that maximizes the overall profit such that the route duration and vehicle capacity constraints are satisfied. An example of a possible solution to the problem is the following:

In broad terms, CTOP can be used to model a variety of real-life applications such as home fuel delivery, routing of technicians, carrier services and other logistics applications. Market expansion and economy globalization combined with the necessity of cost reduction imposed by the competition indicate the need of companies to decide on the customers that will be serviced. For this reason, Orienteering problems blossomed in the last decade and they are expected to play a dominant role in future developments of many fields such as logistics and tourist planning [3].

CTOP is an NP-hard combinatorial optimization problem, as a generalization of Team Orienteering Problem (TOP) [2]. Computationally complex combinatorial optimization problems appear in a plethora of real-world applications of great economic, industrial and scientific importance and usually as large-scale problems. Thus, the development of efficient and effective algorithms is a challenging task of obvious importance.

Computationally intelligent approaches that explore the solutions space with strategic guidance is a very promising research area. For this purpose, hybrid algorithms and intelligent frameworks that combine several metaheuristic algorithms are developed. The development of hybrid optimization algorithms is a new trend of research and is based on collaborative combinations. In collaboration scheme algorithms exchange information among independent procedures executed in a sequential, intertwined or parallel fashion. Thus, an intelligent framework may incorporate metaheuristic algorithms with complementary characteristics in order to effectively search the solutions space in reasonable computational time.

References

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