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COOPERATING MEMES FOR VEHICLE ROUTING PROBLEMS

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Abstract. *To date, algorithms that are designed for solving different Vehicle Routing Problem (VRP) benchmarks usually incorporate domain driven biases of various forms. This makes an algorithm effective and efficient for some VRP benchmark sets but not necessarily on others. This paper presents a memetic algorithm for Capacitated Vehicle Routing Problems (CVRPs), which is specially designed for applying intense local search methods or memes. The main contribution of this work is a VRP domain-specific cooperating* multi-strategy *individual learning procedure. The MA finds high-quality solutions by using cooperating individual learning strategies or memes, each having different learning roles and search features. Experiments on several sets of VRP benchmarks of various problem characteristics showed that the algorithm is better or more competitive when compared with a number of state-of-the-art memetic algorithms and metaheuristics for CVRPs.*

Keywords: Memetic algorithms, Cooperating memes, Vehicle routing problems, Metaheuristics, Combinatorial optimization

1. **Introduction.** The Vehicle Routing Problems (VRPs) represent the cornerstone of optimization for distribution networks. Being one of the most important practical problems of operation research, VRP is considered as one of the most difficult problems due to its complex combinatorial nature; it is the fusion of two NP-hard problems, namely the Traveling Salesman Problem (TSP) and the Bin Packing Problem (BPP). For VRP instances with few nodes, the branch and bound methods are deemed to be effective and known to provide the best solution to date [4]. However, exact methods such as branch and bound are not viable for large-scale VRP. Classical VRP of medium scale dimension remains computationally intractable using the exact enumeration methods [38]. As a result, most researchers have turned to metaheuristics for solving real world VRPs. The drawback is that generic metaheuristics do not guarantee convergence to global optimum [13, 43]. Genetic algorithms [16, 40, 44], Simulated Annealing (SA) [1, 7, 27], Tabu Search (TS) [7, 11], Ant Colony Optimization [10] and constraint programming [35], represent some of the popular metaheuristics algorithms that have been developed for handling real-life VRPs, with reasonably high degree of success. Gendreau et al. [13] reported that Tabu Search (TS) with specialized mechanisms and data structures were among some of the most successful metaheuristic algorithms currently available for dealing with large-scale VRPs. Evolutionary algorithms (EAs), such as GAs, have also shown very promising