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Nested resource allocation, speed optimization, and other related problems.

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Abstract:

We propose an exact polynomial algorithm for a nested resource allocation problem with convex costs and constraints on partial sums of resource consumptions, in the presence of either continuous or integer variables. No assumption of strict convexity or differentiability is needed. This resource allocation problem, albeit extremely simple to formulate, appears prominently in a variety of applications related to production and resource planning, lot sizing, assortment problems, speed optimization in vehicle routing and telecommunications, among others. The fastest current method [D.S. Hochbaum. *Mathematics of Operations Research*, 19(2):390-409, 1994] is based on a greedy algorithm and scaling concepts.

The proposed new decomposition algorithm has been implemented as well as four other recent methods. Extensive experimental analyses are conducted on various continuous problems issued from theory and practice, demonstrating the high performance of the new approach. All convex problems with up to one million variables are solved in less than one minute on a modern computer, and small-size problems of less than 100 variables are solved in a few milliseconds. This method can also significantly contribute to solve a variety of combinatorial optimization problems involving speed-optimization subproblems.