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Matteo Fischetti

matteo.fischetti@unipd.it

Department of Information Engineering, University of Padova, Italy

From Mixed-Integer Linear to Mixed-Integer Bilevel Linear Programming

Bilevel Optimization is a very challenging framework where two players with different objectives compete for the definition of the final solution. Problems of this kind arise in many important practical contexts, including critical infrastructure defense, transportation network design, pricing mechanisms in the energy/airline/telecommunication industry, optimal expansion of gas networks, and machine learning.

The exact solution of bilevel optimization problems is a difficult task that received a considerable attention in recent years [2,3]. In this talk we address the solution of a generic Mixed-Integer Bilevel Linear Program (MIBLP), i.e., of a bilevel optimization problem where all constraints and objective functions are linear, and some/all variables are required to take integer values. In doing so, we look for a general-purpose approach applicable to any MIBLP (under appropriate conditions), rather than ad-hoc methods for specific cases.

Our approach concentrates on minimal additions required to convert an effective branch-and-cut Mixed-Integer Linear Programming (MILP) code into a valid MIBLP solver, thus automatically inheriting the wide arsenal of MILP tools (cuts, branching rules, heuristics) available in modern MILP solvers. In particular, we outline the method recently proposed in [4,5], where a new class of bilevel-specific Intersection Cuts [1] is introduced and computationally analyzed on a very large class of test cases from the literature.

References

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