ABSTRACT

THE POLYTOPE OF At-least AND At-least-m-different PREDICATES

by

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One of the strengths of Constraint Programming lies in the use of predicates, or global high-level constraints, on a few variables to efficiently model complex and varied problem structures. An important predicate is the At-least predicate as it has wide applications in several fields. It bounds the number of variables in a set that may receive a specific value. This is a generalization of the standard logic condition expressed when the sum of binary variables is expressing a lower bound on the cardinality of a set. In this work we investigate the tightest convex region bounding all integer solutions of two different predicates in Constraint Programming. In particular, we completely characterize the convex hull of integer solutions of a single At-least predicate and two At-least predicates interacting. In both cases, we provide a polynomial time separation algorithm to be used in the context of a branch-and-bound optimization approach. Furthermore, we provide a new class of facet-defining inequalities for the predicate At-least-m-different. Associated to the polytope we demonstrate a separation algorithm, and suggest experimentally how it reduces the cost of pruning the solution space defined by the predicate.