Applying Evolutionary Search To Generate Robust Constraint Programming Search Strategies

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Abstract

In this report, we present an evolutionary search strategy for constraint programming. The goal of this metaheuristic is to provide an easy way to improve existing (and possibly brittle) tree search strategies on integer variable problems. We describe how, given a problem modeled using constraint programming, this evolutionary algorithm (EA) is able to solve feasibility as well as optimization problems by evolving a population of partial assignments.

More specifically, given a tree search method S, the EA evolves individuals whose genes denote pre-assignments to S. Each gene specifies a variable to be assigned before search and its preferred value. Then, method S is used to attempt to generate a complete assignment. If it cannot generate a solution within a certain search limit, the most complete assignment found during search is kept for potential inclusion in the population.

From an initial population formed of random individuals, the EA uses genetic operators to produce new assignment preference combinations. In addition to traditional mutation and recombination operators, a learning (Lamarckian) operator is introduced which synthesizes a new genome from assignments produced by S, thus allowing implicit domain knowledge encoded in S to be more fully exploited by the EA.

For feasibility problems, individuals are compared based on the number of assigned variables after execution of S. For optimization problems, we use the a multiobjective evolutionary algorithm which maintains a balance between partial assignment size and potential solution quality.

The above method has been implemented using ILOG Solver. We present experimental results obtained on a set of benchmark problems.