

Heuristics for the Distributed Breakout Algorithm

Adrian Petcu

Ecole Polytechnique Federale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland
adrian.petcu@epfl.ch
<http://liawww.epfl.ch/>

Extended Abstract

Distributed Constraint Satisfaction Problems (DisCSP) is a very powerful paradigm applicable for a wide range of coordination and problem solving tasks in distributed artificial intelligence.

There are a number of distributed algorithms that were developed for this kind of problems. One of these, the Distributed Breakout Algorithm (DBA), is an extension of the original centralized Breakout Algorithm. This algorithm is a local search method, with an innovative technique for escaping from local minima: the constraints have weights, which are dynamically increased to force the agents to adjust their values while in a local minimum. While having a number of interesting properties, local search algorithms also have a common drawback: choosing indiscriminately between the possible values of the local variable (only considering the cost of the immediate improvements) can lead to “chain-reactions” (one conflict originating in one part of the constraint graph needlessly propagates throughout the whole graph, only to (hopefully) be resolved in a completely different part of the graph).

We developed techniques that can determine what values from the local domain will not cause such conflict propagations, and use one of those values as the next variable assignment. In this way, we look for a “local resolution” to all conflicts, in the sense that we keep them contained as much as possible, and involve “external parties” only when there is no other way.

We see from the experimental results that such techniques can yield significant improvements in terms of the number of cycles required to solve the problem (and therefore improvements in terms of communication and time requirements), especially when the problems are very difficult. Moreover, these techniques are able to guide the search towards a solution even in many cases where the standard DBA will cycle forever.

In the following, we will concentrate on the problem of *distributed constraint optimization* (DCOP), as a paradigm that is more useful for real-world problems. DCOP is a generalization of the Distributed Constraint Satisfaction Problems (DisCSP) framework, where the constraints are valued (functions returning a range of values, not just true or false). As such, solutions have varying degrees of quality or cost, and the objective is to minimize/maximize these costs.