GSAT distribution

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Abstract

The GSAT procedure (Selman, Levesque, & Mitchell 92) is a greedy local search procedure. Its aim is to find a satisfiable instanciation of logical formula under conjunctive normal form. Infinite by nature, this algorithm has showed all its ability to deal with formulas of large dimensions which are not accessible to classical exhaustive methods. These formulas can be used for encoding any constraint satisfaction problem (CSP). The purpose of this paper is the presentation of a fully distributed version of the GSAT procedure. Our aim is to provide a new version of the algorithm for taking advantage of future hardware. Massively parallel machines will permit faster convergence for our distributed algorithm.

Keywords: Distributed Local Search Procedure, Constraints Satisfaction Problems.

Introduction

The GSAT procedure presented by Selman in (Selman, Levesque, & Mitchell 92) is both surprising in simplicity and effectiveness. It deals with satisfaction of logical formulae under normal conjunctive form. The procedure makes a global search intended to provide an instanciation of all propositional variables satisfying a set of propositional clauses. The search made by the algorithm is global because it looks for all the variables of the formula, and local because only one variable is flipped in an iteration so the exploration is confined to one adjacent configuration. The current work propose a multi-agent based model for the algorithm, our ambition was to authorize faster convergence and noise resistance during the resolution process.

Our distribution

At first glance, the algorithm does not appear to be very efficient at distribution because of the repeated global choices. But after reflexions, we adopt the following system which is defined in *Eco-resolution* terms (Ferber 89): Search locality is lost, one agent for one clause, a clause has for acquaintances the ones that share some variables. Each entity deals with its acquaintances the flip of a shared variable. All the heuristics made for the classic version of GSAT and especially those that exploit informations resulting from the last failure are still available in our distributed version of the algorithm. The locality of the search disappears because it is now possible to flip various variables at the same time (speed-up in resolution). Globality is limited to the acquaintances of the clause that make the change of state. While the central version makes one flip at a time, this third version allows simultaneous flips of variables.

Conclusion

We have presented a model for the GSAT distribution. This distribution presents real interest if we consider the good results that the algorithm allows in the NP-hard problem resolution. For this purpose, we made an adaptation of several heuristics initially developped for the central algorithm. From a general point of view, we can say that the future heuristics created for GSAT can be easily adapted for our model. Our tests confirm the good behaviour of our system (we used hard-formulas). The distributed system allow simultaneous flips but the efficiency is bounded by the connexity of the agent's society. A hard connexity is synonymous of *wait-state* for many agents. Nevertheless in the worst case the model makes one flip at a time which is equivalent to the central model.

References

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