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A COMPARATIVE STUDY ON THE EFFICIENCY OF ASYNCHRONOUS SEARCH TECHNIQUES

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Abstract:There are many asynchronous searching techniques available for the modeling of DCSP, which would allow resolving a problem on the basis of a search in the network of constraints. Various authors use, for the asynchronous techniques, certain criteria to evaluate the efficiency of these algorithms, but without having a general criterion used to evaluate all asynchronous techniques. In this article the author tries to analyze the various evaluating criteria regarding the "efficiency" of these asynchronous techniques. Relating to these criteria, one can make a hierarchy out of them, regarding the experimentally obtained performances. We will keep in mind the experiments made by the authors of the very techniques, but will also rely on our own experiments realized by implementing the algorithms obtained this way. On the basis of this study, also viewing the practical situations, one would be able to choose the right method for resolving certain practical problems, so that the solution could be gained as fast as possible.

Keywords: Distributed programming, Artificial intelligence, constraints, agents.

1. INTRODUCTION

The constraint programming is a model of the software technologies, used to solve large classes of problems. The idea of sharing various parts of the problem between agents that act independently and that collaborate between them using messages, as it conducted to obtaining a new modeling type called Distributed Constraint Satisfaction Problem.

There are very many evaluating criteria for the distributed techniques efficiency, generally. We will try, to analyze the existent criteria, to search for more general criteria, measure units for the algorithms' efficiency as objective as they can be.

2. EVALUATING CRITERIA.

2.1. Costs due to the communication.

The first criterion, is the one of the *costs due to data communication* between different parts of the algorithm. Out of the analysis of the asynchronous algorithms one can observe a very large messages flux, especially *ok or nogood* type [1] [2].

2.2. Time costs.

Asynchronous techniques are evaluated using for the time complexity, as a measure unit, the ***cycle***. A cycle is formed by those necessary activities that all the agents use to read the arriving messages, to execute their local calculations and to send messages.

2.4.Costs regarding the DCSP modeling.

We will stress on the various particular criteria used by the DCSP techniques authors:

- The total messages number is noted **TM**. It is a measure of the global net loading.
- The total number of constraints is noted **TC**.
- The total number of nogood generated values is noted **TNG**. We will contour the total number of nogood generated values, noted **TNGR**. These units are used in [1]**.**

3. THE EFFICIENCY OF THE ASYNCHRONOUS TECHNIQUES.

3.1 The evaluation regarding the number of cycles

The asynchronous techniques are evaluated by certain authors, especially by Yokoo, using for the time complexity as a measure unit, the cycle.

3.1.1 The comparative evaluation of the efficiency for ABT and AWCS

The first comparison that we will make is that between ABT and AWCS. As results from these experimental tests, the AWCS algorithm proved to be very efficient.

3.1.2. The comparative evaluation of the efficiency for the AWCS and DB

There are taken into consideration 2 algorithms, supposedly evolved. We're talking about DB and AWCS. As a conclusion, the DB algorithm is efficient.

3.1.3. The Evaluation of the efficiency after the number of the nogood

We will present our own experimental results for the estimation of the quantity of nogood recorded. In order to make such estimation, we implemented these techniques in NetLogo1.3, a distributed environment. These three techniques were used in order to make estimation to a classical problem (distributed variant) the problem of the n queens. The obtained results are visualized in figure 1.

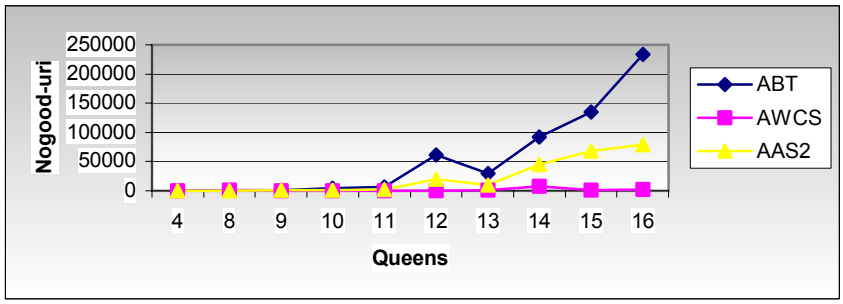

Figure 1. The Evaluation of the efficiency after the number of the nogood

Studying the effect of elimination or reducing the nogood, we notice that there is a connection between the quantity of nogood and efficiency of the DCSP algorithm.

4. CONCLUSIONS

The general conclusion is that this efficiency depends on the characteristics of the distributed system.

ABT technique, considered to be the first asynchronous distributed technique, is the less efficient; it only has a theoretical role.

AWCS technique remains the most effective searching technique out of the complete techniques. The experimental results show a greater efficiency for the AWCS technique combined with the learning schemes.

5. REFERENCES

[1] Muscalagiu Ionel, Abrudean C. (2003): *Nogood elimination in the algorithms distributed within the DCSP modeling.* ISSIR 2003, Section V.

[2] Yokoo Makoto (2001): *Distributed Constraint Satisfaction- Foundation of Cooperation in Multi-agent Systems*. Springer.