Commentary on "Distributed Partial Constraint Satisfaction Problem" by K. Hirayama and M. Yokoo, CP-1997

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1 About CP-1997

Fig. 1. Schloss Hagenberg

CP-1997 took place at Schloss Hagenberg, a medieval, renovated castle close to Linz, Austria. It was the site of the Research Institute for Symbolic Computation (RISC).

This was the third conference of CP. It attracted 132 submissions and 37 papers were selected for presentation at the conference. The geographical distribution of submitting and accepted authors was: America (30, 12), Asia (14, 2), Australia (2, 1), Europe (106, 28). The most active country was France with 34 submitting and 14 accepted authors, followed by the USA (21, 9), the UK (17, 4) and Germany (15, 4).

I was very thrilled by the idea of having a conference at a historical castle. It was my first time to visit a castle (except for the Cinderella Castle in Disney Land). The picture looked very nice. Actually, I found that a castle looked beautiful from outside, but staying within it was not so great. Inside of a stone building was rather cold and there were not so many windows. I assume the life of medieval nobility might not be very comfortable.

2 Retrospective view of this paper

This paper <https://link.springer.com/chapter/10.1007%2FBFb0017442> is about Distributed Constraint Satisfaction Problems (DCSPs). When multiple agents are in a shared environment, there usually exist constraints among the possible actions of these agents (e.g., a shared resource can only be used by one agent). A DCSP is a problem to find a consistent combination of actions that satisfies these inter-agent constraints. We assume each agent has only a partial knowledge of the problem as a whole, i.e., it is aware of neighboring agents, but it might not know the existence of non-neighbors.

Imagine a decentralized channel allocation problem in a wireless local area network (WLAN), where each access point (agent) in the WLAN needs to allocate itself a channel to broadcast such that no two access points with overlapping

broadcast regions (neighboring agents) are allocated the same channel to avoid interference. This problem (as well as a DCSP in general) can be visualized as a graph, where nodes are agents and edges are constraints that represent interactions between neighboring agents. If we model the decentralized channel allocation problem as a DCSP, then a constraint is unsatisfied if the two agents sharing that constraint choose the same channel. The constraint is satisfied otherwise. The goal in a DCSP is to find an allocation of channels to all agents such that all constraints are satisfied.

This model is concise but powerful enough to represent many application domains, as standard CSPs. A DCSP became one of popular formal models in multi-agent system (MAS) research community, in which various application problems had previously been solved independently using different application-specific techniques. I presented my very early paper on DCSPs at CP-1995 [2]. An extended journal version of this paper [3] received the Influential Paper award, which recognizes papers that have significantly influenced the MAS research community, from the International Foundation of Autonomous Agents and Multiagent Systems (IFAAMAS).

More specifically, this paper is about distributed partial constraint satisfaction, where a CSP can be over-constrained and agents try to make compromise. This idea later led to another stream of research on Distributed Constraint Optimization Problem (DCOP). If we model the above-mentioned channel allocation problem as a DCOP, then a constraint incurs a cost of infinity if the two agents sharing that constraint choose the same channel. The constraint incurs a finite cost otherwise. Each pair of non-conflicting channels typically has a different cost to reflect the channel preferences. The goal in a DCOP is to find an allocation of channels to all agents such that the sum of the costs of all constraints is minimized. A DCOP became another popular model in MAS. For a survey article on DCSP/DCOP, please check [1].

I feel I was very lucky since I started my research career when Constraint Reasoning and MAS research communities were evolving. Thirty years ago, these two communities were very small but they keep on growing and started their own international conferences and journals. It was my honor to be a part of these communities.

References

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