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The algebra IA^{fuz}: a framework for qualitative fuzzy temporal reasoning. (English)

Zbl 1131.68530
Artif. Intell. 170, No. 10, 872-908 (2006).

Summary: The aim of this work is to integrate the ideas of flexibility and uncertainty into Allen's interval-based temporal framework, defining a new formalism, called IA^{fuz}, which extends classical Interval Algebra (IA), in order to express qualitative fuzzy constraints between intervals. We generalize the classical operations between IA-relations to IA^{fuz}-relations, as well as the concepts of minimality and local consistency, referring to the framework of Fuzzy Constraint Satisfaction Problem. We analyze the most interesting reasoning tasks in our framework, which generalize the classical problems of checking consistency, finding a solution and computing the minimal network in the context of IA. In order to solve these tasks, we devise two constraint propagation algorithms and a branch and bound algorithm. Since these tasks are NP-difficult, we address the problem of finding tractable sub-algebras of IA^{fuz}, by extending to our fuzzy framework the classical pointizable sub-algebras SA_c and SA, as well as the maximal tractable subalgebra $\mathcal{H}$ introduced by Nebel. In particular, we prove that the fuzzy extension of the latter, called $\mathcal{H}^{fuz}$, shares with its classical counterpart a maximality property, in that it is the unique maximal subalgebra of IA^{fuz} which contains the fuzzy extensions of Allen's atomic relations.

MSC:

68T27 Logic in artificial intelligence
68T20 Problem solving in the context of artificial intelligence (heuristics, search strategies, etc.)
68T37 Reasoning under uncertainty in the context of artificial intelligence

Keywords:

temporal reasoning; fuzzy constraints; interval algebra

Full Text: DOI

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