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On the relations between intelligent backtracking and failure-driven explanation-based learning in constraint satisfaction and planning. (English) [Zbl 0909.68139]


Summary: The ideas of intelligent backtracking (IB) and explanation-based learning (EBL) have developed independently in the constraint satisfaction, planning, machine learning and problem solving communities. The variety of approaches developed for IB and EBL in the various communities have hitherto been incomparable. In this paper, I formalize and unify these ideas under the task-independent framework of refinement search, which can model the search strategies used in both planning and constraint satisfaction problems (CSPs). I show that both IB and EBL depend upon the common theory of explanation analysis—which involves explaining search failures, and regressing them to higher levels of the search tree. My comprehensive analysis shows that most of the differences between the CSP and planning approaches to EBL and IB revolve around different solutions to: (a) how the failure explanations are computed; (b) how they are contextualized (contextualization involves deciding whether or not to keep the flaw description and the description of the violated problem constraints); and (c) how the storage of explanations is managed. The differences themselves can be understood in terms of the differences between planning and CSP problems as instantiations of refinement search. This unified understanding is expected to support a greater cross-fertilization of ideas among CSP, planning and EBL communities.

MSC:

68T05 Learning and adaptive systems in artificial intelligence

Keywords:

explanation-based learning; dependency directed backtracking; constraint satisfaction; planning; regression; propagation; flaw resolution; nogood learning; dynamic backtracking

Software:

Graphplan

Full Text: DOI

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