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On SPI-Lazy Evaluation of Influence Diagrams

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Abstract. Influence Diagrams are an effective modelling framework for analysis of Bayesian decision making under uncertainty. Improving the performance of the evaluation is an element of crucial importance as real-world decision problems are more and more complex. Lazy Evaluation is an algorithm used to evaluate Influence Diagrams based on message passing in a strong junction tree. This paper proposes the use of Symbolic Probabilistic Inference as an alternative to Variable Elimination for computing the clique-to-clique messages in Lazy Evaluation of Influence Diagrams.

Keywords: Influence Diagrams, Combinatorial Factorization Problem, Exact Evaluation, Heuristic Algorithm, Lazy Evaluation, Junction Tree.

1 Introduction

Influence Diagrams (IDs) [1] are a tool to represent and evaluate decision problems under uncertainty. A technique used to evaluate IDs is Lazy Evaluation (LE) [2,3]. Its basic idea is to maintain a decomposition of the potentials and postpone computations for as long as possible. Thus it is possible to exploit barren variables and independence induced by evidence.

LE is based on message passing in a strong junction tree, which is a representation of a decision problem represented as an ID. Computing the messages involves the removal of variables. In the original proposal, the method used is *Variable Elimination* (VE) [3]. An alternative method for removing a set of variables from a set of potentials is *Symbolic Probabilistic Inference* algorithm (SPI) [4,5,6], which considers the removal as a combinatorial factorization problem. That is, SPI tries to find the optimal order for the combinations and marginalizations (i.e. max-marginalization and sum-marginalization). In a previous paper [7], the basic version of the SPI algorithm was described for the direct evaluation of IDs. This algorithm was also proposed as an alternative for computing clique-to-clique messages in LE of Bayesian Networks (BNs) [8]. Our contribution is

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