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Heuristics for Determining the Elimination Ordering in the Influence Diagram Evaluation with Binary Trees

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Abstract. Finding an optimal elimination ordering is a NP-hard problem of crucial importance for the efficiency of the Influence Diagrams evaluation. Some of the traditional methods for determining the elimination ordering use heuristics that consider that potentials are represented as tables. However, if potentials are represented using binary trees traditional methods may not offer the best results. In the present paper, two new heuristics that consider that potentials are represented as binary trees are proposed. As a result, the storage requirements for evaluating an ID with binary trees is reduced.

Keywords. Influence Diagrams, elimination ordering, heuristics, binary trees, variable elimination

Introduction

An Influence Diagram (ID) [7] is a Probabilistic Graphical Model for decision analysis under uncertainty. Probability and utility functions attached to an ID represent, respectively, the uncertainty and the user preferences in the decision problem. In general, we will talk about potentials (not necessarily normalized). The evaluation of IDs related to complex decision problems becomes infeasible due to its computational cost: The set of information states exceeds the storage capacity of PCs or the optimal policy cannot be determined sufficiently fast. Some of the approximate methods use alternative representations for potentials such as *binary trees* (BTs). This kind of trees offers the possibility of taking advantage of *contextual-weak independencies* [2,17], allowing a smaller representation for the potential. Moreover, if BTs are too large, they can be pruned and converted into smaller trees, thus leading to approximate and more efficient algorithms.

Several approaches have been proposed to evaluate IDs such as *Variable Elimination* [8,16]. This method starts with a set of potentials and it eliminates one variable at