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Using Binary Trees for the Evaluation of Influence Diagrams*

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This paper proposes the use of binary trees for representing and managing the potentials involved in Influence Diagrams. This kind of tree allows representing context-specific independencies that are finer-grained compared to those encoded using other representations. This enhanced capability can be used to improve the efficiency of the inference algorithms used for Influence Diagrams. Moreover, binary trees allow computing approximate solutions when exact inference is not feasible. In this work we describe how binary trees can be used to perform this approximate evaluation and we compare them with other structures present in the literature.

Keywords: Probabilistic graphical models; influence diagrams; approximate computation; variable elimination; context-specific independencies.

1. Introduction

Influence Diagrams (IDs)[2,3] provide a framework to model decision problems with uncertainty for a single decision maker. The goal of evaluating an ID is to obtain the best option for the decision maker (*optimal policy*) and its utility. The evaluation of IDs modelling complex decision problems becomes unfeasible due to its computational cost. It is thus necessary to use alternative methods for IDs evaluation such as *LIMIDs*,[4] or simulation techniques.[5,6] Other solutions propose using alternative representations for potentials such as *numerical trees* (NTs)[7–9] trying to offer efficient data structures for storing and managing quantitative information (probabilities and utilities). This data structure takes advantage of *context-specific independencies*[10] so that identical values can be grouped into a single one offering

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