Stochastic Binary Decision Diagrams

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Abstract

This talk introduces a concept of stochastic binary decision diagrams (stochastic BDDs). A BDD is a graphical representation of a Boolean function. Deterministic BDDs are well known in computer science, and weighted BDDs (in which arcs have costs) have been successfully applied to discrete optimization. We extend the concept to stochastic BDDs by associating each arc of the BDD with a probability as well as a control and a cost. Each control at a given node of the BDD results in several possible outcomes, each with a specified probability. We show that relaxation techniques that have been used for deterministic BDDs can be extended to stochastic BDDs. In particular, we develop sufficient conditions under which a node merger operation applied during top-down compilation yields a relaxed BDD of any desired size. This results in a general and completely novel method for deriving optimization bounds for stochastic dynamic programming models in which controls are state-dependent. We report computational experience with a stochastic maximum clique (maximum independent set) problem.