SNAIL

SEMINAR ON ARTIFICIAL INTELLIGENCE AND LOGICS

HyBit: Bit Blasting for Hybrid Probabilistic Programs

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Probabilistic programming languages (PPLs) are an expressive means for creating and reasoning about probabilistic models. Unfortunately hybrid probabilistic programs, involving both continuous and discrete structures, are not well supported by today's PPLs. In this paper we develop a new approximate inference algorithm for hybrid probabilistic programs that first discretizes the continuous distributions and then performs discrete inference on the resulting program. The key novelty is a form of discretization that we call bit blasting, which uses a binary representation of numbers such that a domain of $2\wedge b$ discretized points can be succinctly represented as a discrete probabilistic program over poly(b) Boolean random variables. Surprisingly, we prove that many common continuous distributions can be bit blasted in a manner that incurs no loss of accuracy over an explicit discretization and supports efficient probabilistic inference. We have built a probabilistic programming system for hybrid programs called HyBit, which employs bit blasting followed by discrete probabilistic inference. We empirically demonstrate the benefits of our approach over existing sampling-based and symbolic inference approaches.

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