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An Adaptive Sequential Monte Carlo Algorithm for Computing Permanents

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We consider the computation of the permanent of a binary n by n matrix. It is well- known that the exact computation is a #P complete problem. A variety of Markov chain Monte Carlo (MCMC) computational algorithms have been introduced in the literature whose cost, in order to achieve a given level of accuracy, is O(n^7 log^4(n)). These algorithms use a particular collection of probability distributions, the `ideal' of which, (in some sense) are not known and need to be approximated. In this paper we propose an adaptive sequential Monte Carlo (SMC) algorithm that can both estimate the permanent and the ideal sequence of probabilities on the fly, with little user input. We provide theoretical results associated to the SMC estimate of the permanent, establishing its convergence and analyzing the relative variance of the estimate, in particular computating explicit bounds on the relative variance which depend upon n. Using this latter result, we provide a lower-bound on the computational cost, in order to achieve an arbitrarily small relative variance; we find that this cost is O(n^4 log^4(n)). Some numerical simulations are also given.

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