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Submodular stochastic probing on matroids. (English) Zbl 1359.90111

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Summary: In a stochastic probing problem we are given a universe E, where each element $e \in E$ is active independently with probability $p_e \in [0,1]$, and only a *probe* of e can tell us whether it is active or not. On this universe we execute a process that one by one probes elements – if a probed element is active, then we have to include it in the solution, which we gradually construct. Throughout the process we need to obey inner constraints on the set of elements taken into the solution, and outer constraints on the set of all probed elements. This abstract model was presented in [*A. Gupta* and *V. Nagarajan*, Lect. Notes Comput. Sci. 7801, 205–216 (2013; Zbl 1372.90091)], and provides a unified view of a number of problems. Thus far all the results in this general framework pertain only to the case in which we are maximizing a linear objective function of the successfully probed elements. In this paper we generalize the stochastic probing problem by considering a monotone submodular objective function. We give a $(1-1/e)/(k^{\text{in}}+k^{\text{out}}+1)$-approximation algorithm for the case in which we are given $k^{\text{in}} \geq 0$ matroids as inner constraints and $k^{\text{out}} \geq 1$ matroids as outer constraints. There are two main ingredients behind this result. First is a previously unpublished stronger bound on the continuous greedy algorithm due to Vondrák. Second is a rounding procedure that also allows us to obtain an improved $1/(k^{\text{in}}+k^{\text{out}})$-approximation for linear objective functions.

For the entire collection see [Zbl 1294.68025].

MSC:

90C27	Combinatorial optimization
68W25	Approximation algorithms
90C15	Stochastic programming
90C59	Approximation methods and heuristics in mathematical programming

Keywords:

approximation algorithms; stochastic optimization; submodular optimization; matroids; iterative rounding

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