Title: Opening Pandora's Box: the Correlated Case

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Abstract: The Pandora's Box problem and its extensions capture optimization problems with stochastic input where the algorithm can obtain the exact instantiations of input random variables at some cost. All previous work on this class of problems makes the, somewhat unrealistic, assumption that different random variables in the input are distributed independently. Removing this assumption, we present the first approximation algorithms for Pandora's Box-type problems with correlations. Algorithms for these problems must determine an order in which to probe random variables, as well as when to stop and return the best solution found so far. In general, an optimal algorithm may make both decisions adaptively based on instantiations observed previously. Such ``fully adaptive" (FA) strategies cannot be efficiently approximated to within any sub-linear factor with sample access.
We initially focus on the simpler objective of approximating ``partially adaptive" (PA) strategies that probe random variables in a fixed predetermined order but decide when to stop based on the instantiations observed. We consider a number of different feasibility constraints and provide simple PA strategies that are approximately optimal with respect to the best PA strategy for each case.
Shifting our attention back to FA strategies, with explicitly given distributions, we connect Pandora's Box to the well studied Optimal Decision Tree. Specifically, we show via a reduction to a simpler version of Pandora's Box, that the problem is equivalent (up to constant factors) to the Uniform Decision Tree problem, making it strictly easier than ODT.

This talk is based on [CGT+20] and [CGMT21]

References

[CGMT21] Shuchi Chawla, Evangelia Gergatsouli, Jeremy McMahan, and Christos Tzamos. Approximating Pandora's box with correlations. CoRR, abs/2108.12976, 2021.
[CGT+20] Shuchi Chawla, Evangelia Gergatsouli, Yifeng Teng, Christos Tzamos, and Ruimin Zhang. Pandora's box with correlations: Learning and approximation. In 61st IEEE Annual Symposium on Foundations of Computer Science, FOCS 2020, Durham, NC, USA, November 16-19, 2020, pages 1214–1225. IEEE, 2020.