Constrained Counting and Sampling: Bridging the Gap between Theory and Practice

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4/6/2017 at 10:30 am
CoRE A 301

Abstract

Constrained counting and sampling are two fundamental problems in Computer Science with numerous applications, including network reliability, privacy, probabilistic reasoning, and constrained-random verification. In constrained counting, the task is to compute the total weight, subject to a given weighting function, of the set of solutions of the given constraints . In constrained sampling, the task is to sample randomly, subject to a given weighting function, from the set of solutions to a set of given constraints. In this talk, I will introduce a novel algorithmic framework for constrained sampling and counting that combines the classical algorithmic techniq ue of universal hashing with the dramatic progress made in Boolean reasoning over the past two decades. This has allowed us to obtain breakthrough results in constrained sampling and counting, providing a new algorithmic toolbox in machine learning, probabilistic reasoning, privacy, and design verification. I will demonstrate the utility of the above techniques on various real applications including probabilistic inference, design verification and our ongoing collaboration in estimating the reliability of critical infrastructure networks during natural disasters.

Bio

Kuldeep Meel is a final year PhD candidate in Rice University. His research broadly lies at the intersection of artificial intelligence and formal methods. He is the recipient of a 2016-17 IBM PhD Fellowship, the 2016-17 Lodieska Stockbridge Vaughn Fellowship and the 2013-14 Andrew Ladd Fellowship. His research won the best student paper award at the International Conference on Constraint Programming 2015. He obtained a B.Tech. from IIT Bombay and an M.S. from Rice in 2012 and 2014 respectively. He co-won the 2014 Vienna Center of Logic and Algorithms International Outstanding Masters thesis award. Webpage: www.kuldeepmeel.com

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