

Department of Computer Science

LSU CS Seminar Series 2010

Natively Probabilistic Computation

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NAVIA SYSTEMS, BERKELEY

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Time: 3:00- 4:00 PM

Place: 256, Coates Hall

Abstract

Complex probabilistic models and Bayesian inference are becoming increasingly critical across science and industry, especially in large-scale data analysis. They are also central to our best computational accounts of human cognition, perception and action. However, all these efforts struggle with the infamous curse of dimensionality. Rich probabilistic models can seem hard to write and even harder to solve, as specifying and calculating probabilities often appears to require the manipulation of exponentially (and sometimes infinitely) large tables of numbers.

We argue that these difficulties reflect a basic mismatch between the needs of probabilistic reasoning and the deterministic, functional orientation of our current hardware, programming languages and CS theory. To mitigate these issues, we have been developing a stack of abstractions for natively probabilistic computation, based around stochastic simulators (or samplers) for distributions, rather than evaluators for deterministic functions. Ultimately, our aim is to produce a model of computation and the associated hardware and programming tools that are as suited for uncertain inference and decision-making as our current computers are for precise arithmetic.

In this talk, I will give an overview of the entire stack of abstractions supporting natively probabilistic computation, with technical detail on several hardware and software artifacts we have implemented so far. I will also touch on some new theoretical results regarding the computational complexity of probabilistic programs. Throughout, I will motivate and connect this work to some current applications in biomedical data analysis and computer vision.

This talk includes joint work with Eric Jonas, Keith Bonawitz, Beau Cronin, Cameron Freer, Daniel Roy and Joshua Tenenbaum.

Brief Biography

Vikash Mansinghka is a co-founder and the CTO of Navia Systems, a venture-funded startup company building natively probabilistic computing machines. He received an SB. in Mathematics, an SB. in Computer Science, an MEng in Computer Science, and a PhD in Computation, all from MIT, where he held graduate fellowships from the NSF and MIT's Lincoln Laboratories. His PhD dissertation on natively probabilistic computation won the 2009 MIT George M. Sprowls award for best dissertation in computer science. He currently serves on DARPA's Information Science and Technology (ISAT) Study Group.