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Preface

Theory and Applications of Models of Computation (TAMC) is an international conference series with an interdisciplinary character, bringing together researchers working in different areas of theoretical computer science and mathematics. TAMC 2013 was the tenth conference in the series, held during May 20–22 in Hong Kong, China. This year, there were 70 submissions, out of which 31 papers were selected by the Program Committee. There was also a poster session for researchers to illustrate and discuss their recent research work. We are very grateful to the Program Committee for their hard work, and to the authors who submitted their work for our considerations. The conference had invited talks by two leading researchers, Sanjeev Arora from Princeton University and Avi Wigderson from the Institute of Advanced Study.

We would like to thank the Department of Computer Science, The University of Hong Kong, for organizing the conference, and the "K.C. Wong Education Foundation" for the Conference Sponsorship Programme for providing financial support to Chinese scholars to attend this conference.

May 2013

Lap Chi Lau
Luca Trevisan

Invited Talks: Turing Lectures 2013

- **Randomness and Pseudorandomness**
  Avi Wigderson, Institute for Advanced Study
  Is the universe inherently deterministic or probabilistic? Perhaps more importantly — can we tell the difference between the two?
  Humanity has pondered the meaning and utility of randomness for millennia. There is a remarkable variety of ways in which we utilize perfect coin tosses to our advantage: in statistics, cryptography, game theory, algorithms, gambling... Indeed, randomness seems indispensable! Which of these applications survive if the universe had no randomness in it at all? Which of them survive if only poor-quality randomness is available, e.g., that arises from "unpredictable" phenomena like the weather or the stock market?
  A computational theory of randomness, developed in the past three decades, reveals (perhaps counterintuitively) that very little is lost in such deterministic or weakly random worlds – indeed, most application areas above survive! The main ideas and results of this theory are explained in this talk. A key notion is pseudorandomness, whose understanding impacts large areas in mathematics and computer science.
- **Towards Provable Bounds for Machine Learning: Three Vignettes**
  Sanjeev Arora, Princeton University
  Many tasks in machine learning (especially unsupervised learning) are provably intractable: NP-hard or worse. Nevertheless, researchers have developed heuristic algorithms to solve these tasks in practice. In most cases, there are no provable guarantees on the performance of these algorithms/heuristics —neither on their running time, nor on the quality of solutions they return. Can we change this state of affairs?
  This talk suggests that the answer is yes, and cover three recent works as illustration. (a) A new algorithm for learning topic models. This concerns a new algorithm for topic models (including the Linear Dirichlet Allocations of Blei et al. but also works for more general models) that provably works in theory under some reasonable assumptions and is also up to 50 times faster than existing software in practice. It relies upon a new procedure for non-negative matrix factorization. (b) What classifiers are worth learning? (c) Provable ICA with unknown Gaussian noise.
  (Based joint works with Rong Ge, Ravi Kannan, Ankur Moitra, Sushant Sachdeva.)

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