Randomised Algorithms (RAND2) Workshop
ICMS Edinburgh, 27th–29th March 1998
List of Abstracts

Invited talks

Disagreement percolation and mixing properties of Markov fields

Jacob van den Berg (CWI, Amsterdam, The Netherlands)

ABSTRACT. Markov random fields (or finite-range Gibbs measures) have, since a long time, been studied in Statistical Physics. More recently, much interest has been shown from researchers in Image Analysis and Theoretical Computer Science. Typical examples are the Ising model, the hard-core model (independent sets) and the monomer-dimer model. We show how percolation ideas (combined with coupling arguments), can be used to obtain bounds for spatial dependencies. This is relevant for the question how efficiently (approximately) random samples can be generated.

Fast approximate singular value decomposition of a matrix

Ravi Kannan (Yale University, New Haven, USA)

ABSTRACT. Recently, there has been a flurry of "constant time" algorithms for several Graph problems, like finding the approximate maximum cut in a dense graph. The running time of these algorithms depends exponentially on the allowed relative error epsilon. Here, we present another constant time algorithm which has a running time only polynomially dependent on epsilon.

The problem, we consider arises in many practical situations. We are given an $m \times n$ matrix A and have to find a matrix D of rank at most k (k is given and $k \ll m, n$) so that $\text{norm}(A - D)$ (the sum of squares of all the entries) is as small as possible.

We describe a randomized algorithm which given k, ε, finds a D of rank at most k so that $\text{norm}(A - D)$ is at most the least possible plus $\varepsilon \,\text{norm}\, A$. If we can sample the entries of A with probabilities proportional to the square of the entry, then the algorithm works in time polynomial in k and $1/\varepsilon$ only (independent of m, n).

Joint Work with Alan Frieze and Santosh Vempala

Contributed talks

A genuinely polynomial-time algorithm for sampling two-rowed contingency tables

Catherine Greenhill (University of Leeds, UK)

ABSTRACT. We define a new Markov chain for contingency tables with two rows. The chain is shown to be rapidly mixing using the path coupling method. The mixing time of the chain is quadratic in the number of columns and linear in the logarithm of the table sum. Two extensions of the new chain are discussed: one for three-rowed contingency tables and one for

m-rowed contingency tables. Unfortunately, it is not possible to prove rapid mixing for these chains by simply extending the path coupling approach used in the two-rowed case.

Joint work with Martin Dyer.

Some upper and lower bounds on randomized branching programs

Marek Karpinski (Universität Bonn, Germany)

ABSTRACT. We survey both upper and lower bounds established recently on the sizes of randomized read-once branching programs computing explicit boolean functions, like the middle bit of integer multiplication or the graph of integer multiplication. The underlying proof techniques are based on the randomized communication complexity of certain functions, and display for the first time exponential gaps in the randomized, deterministic, and nondeterministic size complexities of computing explicit boolean functions by ordered read-once branching programs (OBDDs).

On probabilistic model checking

Marta Kwiatkowska (University of Birmingham, UK)

ABSTRACT. Model checking tools and techniques have seen increased industrial use in recent years, particularly in hardware design: given a formula of temporal or modal logic and a model of the system, one can algorithmically check whether the formula is satisfied in the model or not, and if not a counter-example can also be produced. Probabilistic model checking allows to verify systems containing probability information, such as Markov chains and randomized distributed algorithms, where instead of satisfiability checking the model checker outputs and estimate of the probability of the formula being satisfied. In this talk we will will propose a logic and a method applicable in the context of randomized ditributed algorithms, and also discuss ways for making probabilisty calculations more efficient.

Bounds on constructing phylogenetic trees using balanced randomized splitting

Andrzej Lingas (Lund University, Sweden)

ABSTRACT. We present new upper and lower bounds on the problem of constructing a phylogenetic tree from experiments, and a new lower bound on the problem of constructing a tree from an ultrametric distance matrix. The upper bound relies on a new technique called *balanced randomized tree splitting* that can be used to construct trees recursively by querying.

Joint work with Ming-Yang Kao and Anna Östlin

On approximation intractability of the bandwidth problem

Jürgen Wirtgen (Universität Bonn)

ABSTRACT. The bandwidth problem is the problem of enumerating the vertices of a given graph G such that the maximum difference between the numbers of adjacent vertices is minimal. The problem has a long history and a number of applications. There was not much known about approximation hardness of this problem till recently. In this talk we show, that there is no PTAS for the bandwidth problem unless P = NP, even for the trees. More precisely we prove that there are no polynomial time approximation algorithms for general graphs with an approximation ratio better than 1·5, and for the trees with an approximation ratio better than 4/3.

(Joint work with Gunter Blache and Marek Karpinski.)