Combinatorics, Randomization, Algorithms and Probability
May 4-8, 2009

Organizers;
L. Addario-Berry (Université de Montréal)
L. Devroye (McGill University)
B. Reed (McGill University)

Workshop Overview

The ties between combinatorics and probability run so deep that for many deep and interesting problems, it is nonsensical to try to assign one category or the other. The subject of this workshop is these sorts of problems, many of which in fact come from the theoretical computer science and statistical physics communities. Most of the speakers straddle two or several of these areas in their research.

Participants: 52

Speakers:

Dimitris Achlioptas (UC Santa Cruz)
Nathanaël Berestycki (CMS)
Nicolas Broutin (INRIA)
Pablo Ferrari (Universidade de Sao Paulo)
Kevin Ford (The University of Illinois at Urbana-Champaign)
Nikolaos Fountoulakis (Max Planck Institut Informatik)
Alan Frieze (Carnegie Mellon University)
Christina Goldschmidt (University of Oxford)
Simon Griffiths (McGill University)
Ravi Kannan (Microsoft Research, India)
Peter Keevash (University of London)
Jean-François Le Gall (École normale supérieure)
Imre Leader (University of Cambridge)
Po-Shen Loh (Princeton University)
Gábor Lugosi (Pompeu Fabra Universitat)
Jean-François Marckert (Université Bordeaux 1)
Mike Molloy (University of Toronto)
Andrea Montanari (Stanford University)
Ralph Neininger (J.W. Goethe-University)
Lea Popovic (Concordia University)
Tibor Szabò (McGill University)
Benny Sudakov (UCLA)
Van H. Vu (Rutgers University)
Johan Wästlund (Chalmers University of Technology)
Peter Winkler (Bell Laboratories)

Summary:

Nearly every speaker gave the audience more open problems than solved ones, which is an indication that the field of probabilistic combinatorics is healthy and developing.

While no Fields medal winners attended, they were there in spirit. Jean-François Le Gall (École normale supérieure), ex-supervisor of Wendolin Werner, introduced the constructions necessary to be able to define the continuous limit of random planar maps. This is a far-reaching extension of the continuous limits for random trees found over a decade ago by Aldous and others, and which was also dealt with in presentations by Christina Goldschmidt (University of Oxford) and Jean-François Marckert (Université Bordeaux 1).

The second virtual Fields medal presentation was by Van H. Vu (Rutgers), who surveyed the major recent results on random matrix theory, most of which were obtained by himself and Terence Tao (UCLA).

By far the most frequently mentioned object was the G(n,p), or Erdös-Rényi graph. Benny Sudakov (UCLA) gave a crystal-clear view of resilience parameters of random graphs, which are related to the number edges to be added or removed from a random graph in order to obtain or destroy a certain property.   Another fruitful new avenue of research are the so-called Achlioptas processes, in which, contrary to standard random graphs, edges are added one by one, and at each step an edge must be selected from k randomly selected edges. The purpose is either to delay a certain graph property as long as possible, or to achieve it as soon as possible. Po-Shen Loh (Princeton University) presented a worked-out example.

Other aspects of random graphs were covered by Gabor Lugosi (longest minimum-weight path), Nikolaos Fountoulakis (broadcasting: an individual tells a rumour to two random neighhbors, who tell it to two random neighbors, and so forth, until everyone has heard it), Alan Frieze, and Tibor Szabó.

The organizers had scheduled one morning dedicated to the important and useful topic of concentration inequalities and related techniques. Ravi Kannan (Microsoft Research) presented some new inequalities. Devdatt Dubhashi (Göteborg University) could not attend because the Canadian Embassy in Sweden failed to grant him a visum on time, something which seems to occur more and more frequently nowadays, and which should be pointed out forcefully by the CRM and other research centers to the authorities.

Computer scientists are stumped by the computational difficulty of k-SAT for k at least 3. It is prototypical of the "hard" problems. Others include the so-called constraint satisfaction problems.
It is thus important to understand why these problems are hard. Dimitris Achlioptas (University of California Santa Cruz) explained that in a strong sense, randomly generated instances of these problems have lots of isolated solutions (or near-solutions) --- the solution set is not a blob, but rather like a set of stars in the sky.