ANEXO

Workshop on Combinatorics, Algorithms, and Applications
1 a 5 de setembro de 2003
Ubatuba, SP

RESUMO DAS PALESTRAS

Union-Closed Set Systems and Geometric Lattices

Dwight Duffus

P. Frankl's conjecture regarding union-closed set systems – that some element in the underlying set is in at least half the sets in the system – has immediate translation as a natural problem for finite lattices. Attempts to solve the conjecture in this context have led, not surprisingly, to partial results for special classes of lattices. We describe one attempt to attack the conjecture using Dilworth's result on embedding lattices in geometric lattices. This is joint work with B. Sands [University of Calgary] and R. Roth [Emory University].

Random Walks on Random Graphs

Alan Frieze

We give tight estimates for the cover time of random graphs and random regular graphs. We also give estimates for the number of vertices visited in a random walk on a randomly growing "web-graph". This is joint work with Colin Cooper.

Virtual Knot Theory

Louis H. Kauffman

Virtual knot theory is a generalization of classical knot theory to the study of abstract oriented Gauss codes modulo Reidemeister moves. A diagrammatic representation of virtual knots is obtained by extending classical knot diagrams to include virtual crossings that are neither undercrossings nor overcrosssings. The theory can be characterized by a set of moves on these extended diagrams. Virtual knot theory is equivalent to the study of knots and links in thickened oriented surfaces stabilized by the addition and subtraction of empty handles. Many classical invariants generalize to invariants of virtual knots and links, with interesting variations. The talk will discuss virtual knots with unit Jones polynomial, detecting classicality of virtual knots, quantum invariants of virtual knots, quandles and biquandles, Vassiliev invariants and the structure of virtual three-manifolds.

Social networks in knowledge management

Prabhakar Raghavan

Beginning with Milgram's classic "six degrees of separation" experiments in the 1960's, social network theory has evolved to study how individuals interact and disseminate information. More recently, the study has come to encompass the broader network involving people as well as the documents and information they interact with - examples include recommendation systems and the use of link analysis in web search engines. This talk will provide an overview of this evolving area and the many research problems that arise, including issues in privacy protection.

The Total Colouring Conjecture

Bruce Reed

A total colouring of a graph is a colouring of its vertices and edges so that no two adjacent vertices get the same colour. No two adjacent edges get the same colour, and no edge gets the same colour as an endpoint. A total colouring of a graph of maximum degree Delta clearly requires at least Delta + 1 colours. The Total Colouring Conjecture, formulated by Behzad and Vizing independently, states that Delta +2 colours always suffice. We present some partial evidence for this conjecture.

Components and Primes

Bruce Richmond

There is an analogy between the prime factors of the first n integers and the components of combinatorial objects of size n. The objects may be permutations which may be factored into cycles. The objects may be polynomials over a finite field which can be factored into into irreducible polynomials. The unique factorization gives an analogy between generating functions but more is true. The probability that the first n integers have largest prime factor $\leq m$ is asymptotic to the Dickman function evaluated at $\log n/\log m$ for m sufficiently small compared to n. The probability that the smallest prime factor of the first n integers is $\geq m$ is asymptotic to the Buchstab function evaluated at $\log n/\log m$ divided by $\log m$. We can obtain the corresponding probabilities for combinatorial objects by replacing $\log n$ and $\log m$ by n and m. This was pointed out by Billingsley(1972) and Knuth and Trabb-Pardo(1976). Gourdon established this analogy for the largest component using the Flajolet-Odlyzko singularity analysis for general classes of combinatorial objects. Panario and Richmond followed with the analogy for the smallest component. Recently the Buchstab and Dickman original recur! sive arguments have been adapted to combinatorial objects by Bender,Mashatan,Panario and Richmond. When the objects are 2-regular graphs new Buchstab and Dickman functions arise.These results will be surveyed.

Chromatic numbers and configurations in graphs

Carsten Thomassen

Hajos' conjecture from 1961 says that every graph of chromatic number k contains a subdivision of the complete graph on k vertices. The conjecture was disproved in by Catlin in 1979 for all k greater than 6. We relate this conjecture to other aspects of graph theory and we discuss also in detail the case $k = 4$. In this case a stronger version of the conjecture holds: Every 4-chromatic graph contains a subdivision of the complete graph on 4 vertices such that all six edges correspond to odd paths, a conjecture made by Toft in 1975 and proved independently by Wenan Zang and the present lecturer.

Certificates and Graph Algorithms

Jerry Spinrad

The notion of a certificate for a property, which is due to Edmonds, arises frequently in complexity theory. A certificate is a proof that a property holds, and the length of a certificate may be much shorter than the time needed to find such a certificate.

This talk will discuss three different areas of graph algorithms, in which certificates have played crucial roles.

The first is the notion of a robust algorithm. A robust algorithm to solve a problem on a class of inputs must solve the problem correctly if the input is in the class, and if the input is not in the class may either solve the problem correctly or answer that the input is not valid.

The second type of problem related to certificates involves using matrix multiplication to improve asymptotic running times of algorithms. Matrix multiplication is used to improve time bounds for such problems as finding minimal fill, two-pairs, asteroidal triples, and a variety of other problems on graphs.

A third area where certificates arise is a certifying algorithm, which is required to produce output such that the answer is "easy"to verify.

Analysis of Rabin's irreducibility test for polynomials over finite fields

Alfredo Viola

We give a precise average-case analysis of Rabin's algorithm for testing the irreducibility of polynomials over finite fields. The main technical contribution of the paper is the study of the probability that a random polynomial of degree n contains an irreducible factor of degree dividing several maximal divisors of the degree n. We then study the expected value and the variance of the number of operations performed by the algorithm. We present an exact analysis when $n = p_1$ and $n = p_1 p_2$ for p_1, p_2 prime numbers, and an asymptotic analysis for the general case. Our method generalizes to other algorithms that deal with similar divisor conditions. In particular, we analyze the average-case number of operations for two variants of Rabin's algorithm, and determine the ordering of prime divisors of n that minimizes the leading factor.

The emphasis of the talk will be on the combinatorial aspects of the problem. This is joint work with Daniel Panario, Boris Pittel and Bruce Richmond.