January 1998 Seminars & Colloquia

January 8

Mathematics Colloquium

Zhong-ci Shi, Chinese Academy of Science
``Discontinuous Finite Element Method''
4:30pm in Skiles 269

ABSTRACT: The discontinuous finite element method is widely used in scientific and engineering computing. The approximation space here many have some discontinuities along interelement boundaries. It does not need to satisfy certain restrictive continuity requirements as usual finite element methods. Therefore, the method is flexible in the construction of stiffness matrices. Moreover, it gives more accurate numerical results in many practical cases than the standard method. Since the relevant finite element space is not included in the solution space, the validity of the method has to be justified through a rigorous convergence analysis. The talk will discuss some aspects of discontinuous FEM, including: convergence studies of certain important classes of elements in engineering applications; description of some new elements with high accuracy; and general framework of convergence criteria.

January 15

Invited Talk

Tim Chow, University of Michigan
``Combinatorial Conundrums Can Conceal Continued Fractions''
2:00 pm in Skiles 269

January 16

Combinatorics Seminar

Lisa McShine, Georgia Tech
``Combinatorial and Probabilistic Properties of Catalan Structures''
4:00pm in Skiles 269

ABSTRACT: There are several combinatorial objects whose counting function is the n^{th} Catalan number. We refer to each of these as a Catalan structure. We associate an interchange graph with each set of Catalan structures, by defining a natural move transforming one object into another in the same set. We obtain bounds on the diameters of these graphs, and in joint work with **Prasad Tetali** bounds on the mixing rates of the Markov chains associated with the interchange graphs.

January 20

Mathematical Biology Seminar

Tim Howard, Columbus State University
``A Discrete Model for Genetic Recombination''
12:30 - 2:00 pm in Skiles 269

January 22

Invited Talk

Stavros Garoufalidis, Brandeis University
``An Introduction to 3-Dimensional Topology and Its Relation to Quantum Field Theory''
2:00 pm in Skiles 269

Colloquium

Eric Brussel, Emory University
``Modern Division Algebras''
4:30 pm in Skiles 269 [Refreshments in Skiles 236 at 4:00 pm]

ABSTRACT: The modern theory of division algebras draws on results and techniques from areas of pure math such as K-theory, algebraic geometry, number theory, and valuation theory. For example, results on the Galois embedding problem and local-global theorems of Grunwald-Wang type in algebraic number theory were used by the speaker to construct division algebras (``non-crossed products'') which once seemed to be inherently non-constructible. In this talk the speaker will discuss in very general terms some basic problems, relatively recent solutions, and modern approaches.

January 23

Combinatorics Seminar

John Caughman, University of Wisconsin-Madison
``The Terwilliger Algebras of Bipartite P- and Q-polynomial Association Schemes''
4:00 pm in Skiles 269

ABSTRACT: The Terwilliger algebra T of a commutative association scheme is a finite dimensional, semisimple C-algebra, and is noncommutative in general. T has been used to study P- and Q-polynomial schemes, group schemes, strongly regular graphs, and more. In this talk, we consider T for a bipartite P- and Q-polynomial scheme. We determine the irreducible modules for T. Specifically, for any irreducible T-module W, we consider two natural bases and describe the action of T on these bases. We show that the isomorphism class of W is determined by just two integer parameters, the endpoint and diameter. We obtain a recurrence which gives the multiplicities with which the irreducible modules occur in the standard module for T. We close by indicating several combinatorial implications of our results for the study of bipartite distance-regular graphs.

January 26

ACO Colloquium

Gerard Cornuejols, Carnegie-Mellon University
``Perfect, Ideal and Balanced Matrices''
4:30 pm in Skiles 146 [Refreshments in Skiles 236 at 4:00 pm]

ABSTRACT: The set packing and set covering models are two useful models in integer programming. Sometimes, due to the special structure of the constraint matrix, the natural linear programming relaxation yields an optimal solution which is integral, thus solving the problem. Perfect, ideal and balanced matrices are three classes of constraint matrices with such integrality properties (for the set packing problem, the set covering problem and for both problems, respectively). In this talk, we survey recent results and open problems in this area.

January 27

Combinatorics Seminar

Gerard Cornuejols, Carnegie-Mellon University
``Even Holes in Graphs''
11:00 am in Skiles 269

ABSTRACT: A hole in a graph is a chordless cycle of length greater than three. In this talk, we present a decomposition theorem for graphs that contain no even hole. This theorem yields a polytime algorithm to recognize whether a graph contains an even hole, and to find an even hole when one exists. The talk is based on four papers by **Conforti**, **Cornuejols**, **Kapoor** and **Vuskovic**.

January 29

Mathematics Colloquium

Johan Belinfante, Georgia Tech
``Experience With Computer-Assisted Reasoning In Set Theory''
4:30 pm in Skiles 269

ABSTRACT: I will summarize my experience proving over a thousand theorems in set theory using **Bill McCune**'s program OTTER. I will also talk about my Mathematica program GOEDEL to convert expressions involving class-formation to a form suitable for use with G�del's finite axiomatization of set theory.

January 30

Combinatorics Seminar

Bertrand Guenin, Carnegie-Mellon University
``A characterization of weakly bipartite graphs''
4:00 in Skiles 269

ABSTRACT: **Grotchel** and **Pulleyblank** showed that for planar graphs there is a simple description of the convex hull of the incidence vectors of the bipartite subgraphs. They coined the term weakly bipartite for the class of all graphs with the aforementioned description. The Max-Cut Problem can be solved in polynomial time (using the ellipsoid method) for these graphs. Graphs which contain no subdivision of K_5 are weakly bipartite. However, this is not a characterization since the graph obtained by replacing an edge of K_5 by two consecutive edges is weakly bipartite. An odd subdivision of K_5 is a subdivision of K_5 wherein every triangle of K_5 corresponds to an odd cycle of the subdivision. I prove that a graph is weakly bipartite if and only if it does not contain an odd subdivision of K_5. This result was conjectured by **Seymour** as part of a more general conjecture on ideal binary matrices. I give this result in the more general setting of signed graphs. An extension of this result and connections with multi-commodity flows will also be discussed.

ACO Home

February 1998 Seminars & Colloquia

February 2

Invited Talk

Dhruv Mubayi, University of Illinois, Urbana-Champaign, email: mubayi@math.uiuc.edu
``Variations of the Classical Ramsey Problem''
4:00 pm in Skiles 153

ABSTRACT: Let f (n,p,q) be the minimum number of colors required to color the edges of K_n such that the edges of every K_p receive at least q colors. We investigate this function, focusing on the case p = 4, q = 3. We construct an edge-coloring of K_n that greatly improves upon the previous best bound (due to **Erd�s** and **Gy�rf�s**). We also consider a bipartite version of this problem.

February 5

Combinatorics Seminar

Donniell Fishkind, Johns Hopkins University
``Affine Isomorphism for Partially Ordered Sets''
2:00 pm in Skiles 269

ABSTRACT: Let A and B be the adjacency matrices of graphs G_1 and G_2 (or the strict zeta matrices of posets P_1 and P_2). Associated with A and B is a particular affine space of matrices, denoted $W_{\{A,B\}}$, such that G_1 is isomorphic to G_2 (resp., P_1 is isomorphic to P_2) if and only if there is a 0-1 matrix in $W_{\{A,B\}}$. Solving this integer programming problem is (notoriously) of unknown complexity, and researchers have considered its relaxation; if there is a nonnegative member of $W_{\{A,B\}}$, then one says that G_1 is *fractionally isomorphic* to G_2 (resp., P_1 is *fractionally isomorphic* to P_2). Several combinatorial characterizations of fractional isomorphism for graphs are known. In this talk we note that fractional isomorphism is not an equivalence relation for posets and introduce a further relaxation by defining P_1 to be *affinely isomorphic* to P_2 if $W_{\{A,B\}}$ is nonempty. We prove that affine isomorphism is indeed an equivalence relation on posets and that two posets are affinely isomorphic if and only if the f-vectors of their order complexes are the same.

February 9

ACO Colloquium

Madhu Sudan, Massachusetts Institute of Technology
``The Approximability of Boolean Constraint Satisfaction Problems''
4:00 pm in Skiles 140

ABSTRACT: The last decade had seen tremendous advance in the classification of optimization problems in terms of their approximability. While the resulting improvement in our understanding of optimization problems has been significant, it is also accompanied by a realization that optimization problems are very diverse and there is little hope for a unified study. We describe our attempt to find some unifying elements by studying a restricted class of optimization problems that can be presented as Boolean constraint satisfaction problems. On the one hand, the restriction allows us to make some very general observations about the nature of approximability. At the same time the restrictions still allow us to capture a spectrum of optimization problems, thereby retaining their diversity. Joint work with **Sanjeev Khanna** (Lucent), **Luca Trevisan** (U. Geneve) and **David P. Williamson** (IBM). (Copies of the paper presented at this seminar are available here; this is Sudan's webpage.)

February 13

ACO Colloquium

Graham Brightwell, University of Memphis and The London School of Economics
``Gibbs Measures and Dismantleable Graphs''
4:00 pm in Skiles 269

ABSTRACT: We model physical systems with ``hard constraints'' by the space Hom (G,H) of homomorphisms from a locally finite graph G to a fixed finite ``constraint graph'' H. Two homomorphisms are deemed to be adjacent if they differ on a single site of G. We investigate what appears to be a fundamental dichotomy of constraint graphs, by giving various characterizations of a class of graphs that we call *dismantleable*. For instance, H is dismantleable if and only if, for every G, any two homomorphisms from G to H which differ at only finitely many sites are joined by a path in Hom (G,H). If H is dismantleable, then, for any G of bounded degree, there is some assignment of activities to the nodes of H for which there is a unique Gibbs measure on Hom (G,H). On the other hand, if H is not dismantleable (and not too trivial), then there is some r such that, whatever the assignment of activities on H, there are uncountably many Gibbs measures on Hom (T_r,H), where T_r is the (r+1)-regular tree. This is joint work with **Peter Winkler** (Bell Labs).

February 20

Combinatorics Seminar

Dan Klain, Georgia Tech
``A Reciprocity Theorem for Valuations on Polytopes''
4:00 pm in Skiles 269

ABSTRACT:This talk will present a general reciprocity theorem for valuations on polytopes, leading in turn to formulas for the computation of valuations on a polytope P via the enumeration of polytopes contained in P that are free with respect to a given locally finite set of points in Euclidean space. (The concept of ``free polytope'' will be discussed in detail.) Special cases include reciprocity formulas for volume, surface area, the Euler characteristic, and integer lattice point enumeration, as well as the Dehn-Sommerville equations and Macdonald reciprocity for compact simplicial manifolds. In this talk I will focus initially on the case of lattice polygons, where the main results are especially clean, and the proofs purely combinatorial. I will then sketch the ideas and machinery involved for the general case of locally finite families of polytopes in n-dimensional Euclidean space. The bulk of the talk will be presented at a level accessible to graduate students.

February 27

Combinatorics Seminar

Barrett Walls, Georgia Tech
``3-Coloring the Klein Bottle''
4:00 pm in Skiles 269

ABSTRACT: We prove that every graph on the Klein Bottle which does not contain contractible cycles of length 3 or 4 is either 3-colorable or has a subgraph isomorphic to a member of a particular family of non-3-colorable graphs. Every member of this family has triangles, and hence graphs on the Klein Bottle without quadrilaterals or triangles are 3-colorable. This solves a problem raised by Woodburn in 1989.

ACO Home

March 1998 Seminars & Colloquia

March 3

Umesh Vazirani, U. C. Berkeley
``Quantum Computers''
4:00 - 5:30 pm in MiRC 102

ABSTRACT: Quantum computation is a fascinating new area that touches upon the foundations of both quantum physics and computer science. Quantum computers can perform certain tasks, such as factoring, exponentially faster than classical computers. This talk will survey the principles underlying quantum computers and algorithms, as well as describe experiments currently underway to realize quantum computation in the laboratory. The talk is intended for a general audience.

March 4

ACO Colloquium

Michael Krivelevich, Institute for Advanced Study
``Finding a Large Hidden Clique in a Random Graph''
4:30 pm in Skiles 168

ABSTRACT: It is well known for a long time that a maximum clique (complete subgraph) in almost all labeled graphs on n vertices (that is, in the random graph model G(n,½)) has size asymptotically equal to $2 \log_2 n$. However, there is no known polynomial time algorithm that finds almost surely a clique of size (1+a)log n for any a > 0. We consider a closely related algorithmic problem addressing the following probabilistic model of a graph on n labeled vertices. First choose a random graph G(n,½) and then choose randomly a subset Q of vertices of size k and force it to be a clique by joining every pair of vertices of Q by an edge. The problem is to give a polynomial time algorithm for finding this hidden clique almost surely for various values of k. This question was posed independently, in various variants, by Jerrum and by Kucera. In this talk I will present an efficient algorithm for all $k > cn^{0.5}$, for any fixed c > 0, thus improving the trivial case $k > c\, n^{0.5} (\log n)^{0.5}$. The algorithm is based on the spectral properties of the graph. This is a joint work with **Noga Alon** and **Benny Sudakov**, Tel Aviv University.

March 6

Combinatorics Seminar

Kamal Jain, Georgia Tech
``A Factor 2 Approximation Algorithm for the Steiner Network Problem''
4:00 pm in Skiles 269

ABSTRACT: The Steiner network problem generalizes the Steiner tree problem to higher connectivity requirements. The first approximation algorithm for this problem, due to **Williamson**, **Goemans**, **Mihail** and **Vazirani**, achieved factor 2 k, where k is the largest connectivity requirement. Subsequently, a factor $2\, H_k$ algorithm was given by **Goemans**, **Goldberg**, **Plotkin**, **Shmoys**, **Tardos** and **Williamson**. We present a factor 2 algorithm using LP-rounding.

March 9

David Zuckerman, University of Texas at Austin
``Hyper-Fast Leader Election Protocols in the Full Information Model''
4:30 pm in Skiles 146

ABSTRACT: Leader election is a generalization of collective coin flipping. In this latter problem, n players wish to generate a random bit. The difficulty is that some subset of players collude to bias the output of the bit. In the full information model, all communication is by broadcast, and the bad players have unlimited computational power and may wait to see the inputs of the good players. Thus, for example, `PARITY` can be broken by any coalition of 1 player, while in `MAJORITY` no coalition of O(sqrt n) players can cause a particular output with probability 1-o(1). In leader election, the goal is to elect a good leader with probability bounded away from 0. We give a simple leader election protocol that is resilient against coalitions of size ßn, for any ß < ½. Our protocol takes $\log^* n + O(1)$ rounds, where each player sends at most O(log n) bits per round. For any constant k, our protocol can be modified to take k rounds and be resilient against coalitions of size $e\, n / (\log^{(k)} n)^3$, where e is a small enough constant and $\log^{(k)}$ denotes the logarithm iterated k times. Joint work with **Alex Russell**.

March 13

Combinatorics Seminar

Dan Klain, Georgia Tech
``The Möbius Function of a Partially Ordered Set''
4:00 pm in Skiles 269

ABSTRACT: This will be an elementary and purely expository talk on the theory of Möbius functions. We will define the incidence algebra of a locally finite partially ordered set (poset), focusing on important invariants such as the zeta function, incidence function, and Möbius function of a poset. The Möbius inversion formula will be treated, and it will be seen both as a generalization of the Möbius inversion formula of classical number theory and of the inclusion-exclusion formula used for combinatorial enumeration. Some techniques for computing the Möbius function will be introduced, and some classical examples will be considered from enumerative combinatorics. If time permits, we will explore the connection between the Möbius function of a poset and the Euler characteristic on its lattice of order ideals. No special background will be needed to follow this material.

ACO Home

April 1998 Seminars

April 17

Combinatorics Seminar

Yang Wang, Georgia Tech
``Dragons and Other Reptiles''
Cancelled due to Freaknik; re-scheduled for May 22

April 21

Kamal Jain, Georgia Tech
``A Factor 2 Approximation Algorithm for the Steiner Network Problem''
4:00 pm in ISyE 404

ABSTRACT: The Steiner network problem generalizes the Steiner tree problem to higher connectivity requirements. The first approximation algorithm for this problem, due to **Williamson**, **Goemans**, **Mihail** and **Vazirani**, achieved factor 2 k, where k is the largest connectivity requirement. Subsequently, a factor 2 H_k algorithm was given by **Goemans**, **Goldberg**, **Plotkin**, **Shmoys**, **Tardos** and **Williamson**. We present a factor 2 algorithm using LP-rounding.

April 24

Combinatorics Seminar

Petr Hlineny, Georgia Tech
``Contact Graphs Of Curves''
Cancelled due to a lecture by **Szemeredi** at Emory University; re-scheduled for May 1

April 30

Probability and Statistics Seminar

Lisa Bloomer, Georgia Tech
``Construction of Random Probability Measures''
3:00 pm in Skiles 269

ABSTRACT: This will be an overview of several different methods of constructing random probability measures in a natural way. These methods include the Dirichlet process, choosing moment sequences, choosing barycenter arrays, and the Dubins and Freedman method of choosing distribution functions. Known results and open problems will be presented.

ACO Home

May 1998 Seminars

May 1

Combinatorics Seminar

Petr Hlineny, Georgia Tech
``Contact Graphs Of Curves''
4:00 pm in Skiles 269

ABSTRACT: Contact graphs are a special kind of intersection graphs of geometrical objects in which we do not allow the objects to cross but only to touch each other.

Contact graphs of simple curves (and of line segments as a special case) in the plane are considered. Several classes of curve contact graphs are introduced, and their properties and inclusions among them are studied. Also, a relation between planar and contact graphs is mentioned.

Finally (probably in the second talk), it is proved that recognition of contact graphs of curves (of line segments) is NP-complete, even for planar graphs.

May 5

ACO Colloquium

Milena Mihail, Bell Communications Research
``On the Expansion of Combinatorial Polytopes''
4:30 pm in Skiles 269

ABSTRACT: With every set system we can associate a polytope whose vertices are the characteristic vectors of the members of the set system. The 1-skeleton of such a polytope is a graph whose vertex-set is the set of vertices of the polytope and whose edge-set corresponds to the 1-dimensional faces of the polytope. The 1-skeletons of the polytopes associated with several combinatorial populations express interesting structural information.

We show that the 1-skeleton of the polytopes of matchings, order ideals, independent sets and the class of balanced matroids (this class includes graphic and regular matroids) posses the following strong expansion property: for any bipartition of their vertices, the number of edges incident to both partition classes is at least as large as the size of the smaller partition class. We conjecture that the above expansion property holds for the 1-skeleton of the polytope of any set system.

The algorithmic significance of such expansion properties is that they yield efficient sampling and approximate counting schemes for the underlying set systems via rapidly mixing Markov chains and Monte Carlo techniques, under certain further well known conditions (satisfied, for example, by all matroids).

May 8

Combinatorics Seminar

Yue Zhao, Benedict College
``On the Edge Reconstruction Conjecture''
4:00 pm in Skiles 269

ABSTRACT: In this talk, a brief survey about the Edge Reconstruction Conjecture will be given. Then we will prove that if a connected graph G embeddable in a surface S of characteristic c(S) satisfies:

(1) The minimum degree of G is at least 4, and
(2) G has more than -43 c(S) vertices,
then G is edge reconstructible. A direct consequence of this result is that a triangulation G of a surface S of characteristic c(S) is edge reconstructible if G has more than -43 c(S) vertices.

May 12

Mathematics Colloquium

David Riley, University of Alabama
``Burnside-Type Problems in Groups and Rings''
4:30 pm in Skiles 269

ABSTRACT: In 1994, **Efim Zelmanov** won a Fields Medal for his solution of the so-called Restricted Burnside Problem for Groups. This problem asks: given any natural numbers d and n, is there a bound on the order of d-generated finite group G of exponent n? The exponent of G is the minimal n (possibly infinity) such that $x^n=1$ for all x in G. Group-theoretic problems of this type were first proposed by **William Burnside** in 1902. Shortly thereafter, **A.G. Kurosh** and **J. Levitzki** proposed the ring-theoretic analogues. Much of modern algebra was developed in an attempt to answer these problems. Zelmanov's approach was to first solve a corresponding Lie ring-theoretic Burnside-Type problem and then to deduce from it the Restricted Burnside Problem for Groups. In my talk, I shall concentrate on the related associative ring-theoretic Burnside-Type problems and their solutions.

May 14

Mathematics Colloquium

Yuval Peres, U. C. Berkeley
``Percolation on Groups''
4:30 pm in Skiles 269

ABSTRACT: A finitely generated group G has a natural graph structure, obtained by connecting any two elements which differ by a generator. Good examples to keep in mind are the lattices Z^d, regular trees (that represent free groups) and a product of a regular tree and Z. A crucial difference between the lattice and the other 2 examples is that Z^d is amenable: it is exhausted by boxes with surface/volume ratio going to 0. When each edge in G is independently open with probability p, percolation is obtained. There is a critical parameter p_c so that all connected components of open edges (``clusters'') are finite for $p < p_c$, while infinite clusters exist for $p > p_c$.

Question: Are there infinite open clusters at the critical parameter? (This is still open even in Z^3!)

After giving some background, I will sketch the solution of this problem for nonamenable G, obtained recently in joint work with **I. Benjamini**, **R. Lyons** and **O. Schramm**.

Other tantalizing open problems in this rapidly developing area will also be described.

May 15

Combinatorics Seminar

Petr Hlineny, Georgia Tech
``Contact Graphs of Curves and of Line Segments: Recognition''

4:00 pm in Skiles 269

Conclusion of the talk from May 1.

May 22

Combinatorics Seminar

Yang Wang, Georgia Tech
``Dragons and Other Reptiles''
4:00 pm in Skiles 269

ABSTRACT: A set is self-similar if the set can be decomposed into several smaller sets, each of which is similar to the original set. Self-similarity is the foundation of fractal geometry, and most people are familiar with it from the Cantor set and the Sierpinski Gasket. Self-similarity often occurs also in nature, and a fern is a classic example.

This talk focuses on a less familiar aspect of self-similarity and fractal geometry, namely fractal tiles and self-replicating tilings. I will illustrate how self-similarity can be used to generate a class of ``exotic'' tiles (called rep-tiles) and tilings, including the famous Dragon tile and the Penrose aperiodic tiles. These reptiles typically have fractal boundaries. I will discuss some fundamental properties concerning these tiles and their tilings. Several open problems will also be presented.

May 28

Mathematics Colloquium

Russell Lyons, Indiana University, Bloomington
``Random Spanning Trees, Random Walks, and Electric Networks''
4:30 pm in Skiles 269

ABSTRACT: The topics of the title are intimately connected to each other in beautiful ways. It has been known since the time of Kirchhoff (1847) that one can solve electrical network problems by using various probabilities associated to choosing a spanning tree at random (uniformly) from a finite graph. Algorithms for generating a random spanning tree are connected to generation and counting of states in arbitrary Markov chains. Because of connections to other areas such as domino tilings, amenability, percolation, hyperbolic spaces, and conformal maps, there are still an enormous number of fascinating open questions.

May 29

Combinatorics Seminar

Jeff Burdges, Georgia Tech
``Lie Algebras and the Four Color Theorem''
4:00 in Skiles 269

ABSTRACT: We present a result due to **Dror Bar-Natan**. The abstract of the original paper reads, ``We present an appealing statement about Lie algebras that is equivalent to the Four Color theorem.'' No prior knowledge of Lie algebras is needed.

ACO Home

June 1998 Seminars

June 3

ACO Colloquium

Jeff Lagarias, AT&T
``Much Ado About Knotting (The Complexity of Unknotting)''
4:30 pm in Skiles 269

ABSTRACT: The problem of distinguishing knotted curves from unknotted ones has a long history. However only in 1961 did **Wolfgang Haken** give an explicit decision procedure to recognize unknottedness, based on normal surface theory. This talk reviews the history of problems in computational topology and knot theory. It then describes explicit complexity bounds for the unknotting problem, obtained using the Haken approach. Recognizing if a knot diagram with n crossings is unknotted is in the complexity class NP. There is an algorithm to decide unknottedness which halts in at most $O(2^{cn})$ bit operations. If a knot diagram is unknotted, then there is an explicit unknotting that takes at most $O(2^{cn})$ Reidemeister moves, with $c=10^{12}$. (The first two results are joint work with **Joel Hass** (University of California-Davis) and **Nick Pippenger** (University of British Columbia); the last with **Joel Hass**.)

June 5

Combinatorics Seminar

Jeff Lagarias, AT&T
``Number Theory Zeta Functions and Dynamical Zeta Functions''
4:00 pm in Skiles 269

ABSTRACT: This talk describes analogies between number theory zeta functions, dynamical zeta functions and statistical mechanics zeta functions. These analogies are used to ``explain'' the existence of two independent theories for zeta functions for function fields over a finite field. A similar analogy is then applied to the Riemann zeta function with interesting consequences and open problems.

ACO Home

Summer 1998 Seminars

July 23

Moshe Lewenstein, Bar Ilan University
``Pattern Matching with Swaps''
11:00 am in CoC 201

ABSTRACT: String Matching is one of the most widely studied problems in computer science. The classical pattern matching problem was followed by a myriad of other problems in string matching, many with direct applicability to ``real world'' problems (e.g. `grep` in *UNIX* and `s` in *emacs*). One of the important, relatively new, fields of string matching is pattern matching with errors. In this talk I will consider the case where the errors are swaps.

Let a text string T of n symbols and a pattern string P of m symbols from alphabet S be given. A *swapped version* T' of T is a length n string derived from T by a series of *local swaps*, (i.e., $t'_k = t_{k+1}$ and $t'_{k+1} = t_k$) where each element can participate in *no more than one swap*.

The *Pattern Matching with Swaps* problem is that of finding all locations i for which there exists a swapped version T' of T where there is an exact matching of P in location i of T'. It has been an open problem whether swapped matching can be done in less than O(mn) time.

In this talk I will present the first algorithm that solves the pattern matching with swaps problem in time o(mn). The algorithm has time complexity is $O(n\, m^{1/3} \log m \log s)$ for a general alphabet S, where $s = \min(m, \text{size}(S))$.

This is joint work with **Amihood Amir**, **Yonatan Aumann**, **Gad Landau**, and **Noa Lewenstein**.

August 10

PhD Thesis Defense

Gruia Calinescu, Georgia Tech
``Approximation Algorithms for Graph-Theoretic Problems: Planar Subgraphs and Multiway Cut''
10:00 am in CoC 155

ABSTRACT: The objective of this work is to develop good approximation algorithms for two NP-hard graph-theoretic problems: Multiway Cut and Maximum Weight Planar Subgraph. Connectivity and planarity are important concepts in graph theory. Graphs are used to model many real-world situations. The problems addressed in this thesis have applications in parallel and distributed computing, chip design, graph drawing, circuit layout, and facility layout.

Multiway Cut is the following problem: given an undirected graph with edge costs and a subset of k nodes called terminals, find a cheapest multiway cut, i.e., a subset of the edges whose removal disconnects each terminal from the other terminals. The best previous polynomial-time algorithm gave a performance guarantee of $2(1 - 1/k)$. In this thesis, a new approximation algorithm is presented. The performance guarantee of the new algorithm is at most $1.5 - 1/k$.

Maximum Weight Planar Subgraph is the following problem: given an undirected graph G with edge costs, find a planar subgraph of G of maximum weight. A performance ratio of $1/3$ is not hard to achieve. However, no previous algorithm was known to do better. In this thesis, the first algorithm with a nontrivial approximation ratio for Maximum Weight Planar Subgraph is presented. Based on

the Berman-Ramaiyer Steiner tree algorithm, the new algorithm breaks the $^{1}/_{3}$ threshold.

September 25

Polyhedral Combinatorics Workshop

George Nemhauser, Georgia Tech
``Historical Perspectives''
3:00 pm in Skiles 255

Ellis Johnson, Georgia Tech
``Matchings, Postman Tours, and Binary Groups''
4:30 pm in Skiles 255

September 26

Polyhedral Combinatorics Workshop

James Oxley, Louisiana State University
``Matroids in Optimization''
9:00 am in Skiles 255

Robin Thomas, Georgia Tech
``Perfect Graphs''
10:30 am in Skiles 255

Bertrand Guenin, Carnegie Mellon University
``Ideal Matrices''
1:00 pm in Skiles 255

Renato Monteiro, Georgia Tech
``Ellipsoid Algorithm in Optimization''
2:15 pm in Skiles 255

Martin Savelsbergh, Georgia Tech
``Computational Integer Programming''
3:30 pm in Skiles 255

September 30

Joint SAAC-ACO Colloquium

Ralph Gomory, Sloan Foundation
``Cutting Planes and Group Polyhedra''
4:00 pm in Skiles 269

Ralph Gomory pioneered cutting plane methods for integer programming. His work with **Gilmore** on the cutting stock problem was an early column generation method. In this talk he will show how the cutting plane method and solving the knapsack problem led to his group relaxation for integer programming and to an asymptotic theorem for ``rounding'' LP solutions to get integer solutions.

Research Activities	Summer 1998

ACO Home

October 1998 Seminars

October 9

Combinatorics Seminar

Drhuv Mubayi, Georgia Tech
Flashes, rainbows, and Ramsey theory
4 pm in Skiles 269

Let f(l,k) be the minimum n with the property that every coloring c of \binom{[n+1]}{2} with natural numbers yields either x_0 < ... < x_l with c(x_o, x_1)= ... =c(x_{l-1}, x_l), or y_0 < ... < y_k with c(y_0, y_1), ..., c(y_{k-1}, y_k) all distinct. We prove that if k=o(\sqrt l), then f(l,k) is asymptotic to l^{k-1} as l tends to infinity. This supports the conjecture of Lefmann, R�dl, and Thomas that f(l,k)=l^{k-1}.

October 16

Combinatorics Seminar

Rod Canfield, University of Georgia, Athens
Problems and results on integer partitions
4 pm in Skiles 269

A partition of an integer n is a multiset of positive numbers whose sum is n. For example, 4, 3+1, 2+2, 2+1+1, and 1+1+1+1 are the five partitions of 4. Partition x is a refinement of partition y if x can be obtained by further partitioning one or more part(s) of y. The partitions of n form a partially ordered set with respect to refinement, and the talk will present progress on the question of whether this partially ordered set has the Sperner property. If time permits, I will also talk about D(n,k), the number of partitions of n whose Durfee square size is k. (Each partition has a graphical representation, the Ferrers diagram, in which parts are displayed as left justified rows of dots; the Durfee square is the largest square contained in this diagram.)

October 23

Combinatorics Seminar

Neil Calkin, Clemson University
Too many 1's, or over-represented binary representations
4 pm in Skiles 269

Abstract: We consider the problem of representing integers as sums of powers of 2, each part appearing at most twice, obtaining analytic and algebraic expressions for the number of representations of n, the asymptotics for the summatory function, and connections with other areas of combinatorics, such as Stern-Brocot trees.

October 30

Combinatorics Seminar

Robin Thomas, Georgia Tech
Clique minors in graphs and their complements
4 pm in Skiles 269

Abstract: Kostochka conjectures that for every integer t there exists a constant c=c(t) such that for every graph G on n vertices, either G can be contracted onto the complete graph on t+1 vertices, or the complement of G can be contracted onto a complete graph on at least (1+1/t)n/2-c vertices. We prove that Kostochka's conjecture is equivalent to the assertion that every graph that cannot be contracted onto the complete graph on t+1 vertices has an independe nt set of size at least n/t, and deduce that the conjecture holds for t<6. We also deduce the weaker statement that Kostochka's conjecture holds with (1+1/t)n/2-c replaced by (1+1/(2t))n/2-c.

This is joint work with Bruce Reed.

Research Activities	October 1998	November 1998	December 1998

ACO Home

November 1998 Seminars

November 6

NO Combinatorics Seminar

November 13

Combinatorics Seminar

Bertrand Guenin, Georgia Tech
Multicommodity flows and ideal clutters
4 pm in Skiles 269

A family of sets F is said to be ideal if the polyhedron {x >= 0 | x(S) >= 1, for all S in F} is integral. Given a binary matroid M and a subset S of its elements, the circuits of M which intersect S with odd parity are said to be odd. F is called binary if its elements correspond to the set of odd circuits of some pair (M,S). There exists several correspondences between ideal binary families and the existence of multi-commodity flows for some associated matroids. We use these relations to derive sufficient conditions for binary families to be ideal. In graphs there is a min-max equality for the case of a single commodity flow problem. This is no longer true when we consider binary matroids. The matroids for which the corresponding min-max equality holds are called 1-flowing. We show how weakly bipartite graphs and T-cuts can be used to construct 1-flowing matroids and conjecture that all 1-flowing matroids can be constructed from these classes and some sporadic elements. This is joint work with Gerard Cornuejols.

November 20

Combinatorics Seminar

Ellis Johnson, Georgia Tech (ISYE)
TBA

November 27

NO Combinatorics Seminar

Research Activities	October 1998	November 1998	December 1998
