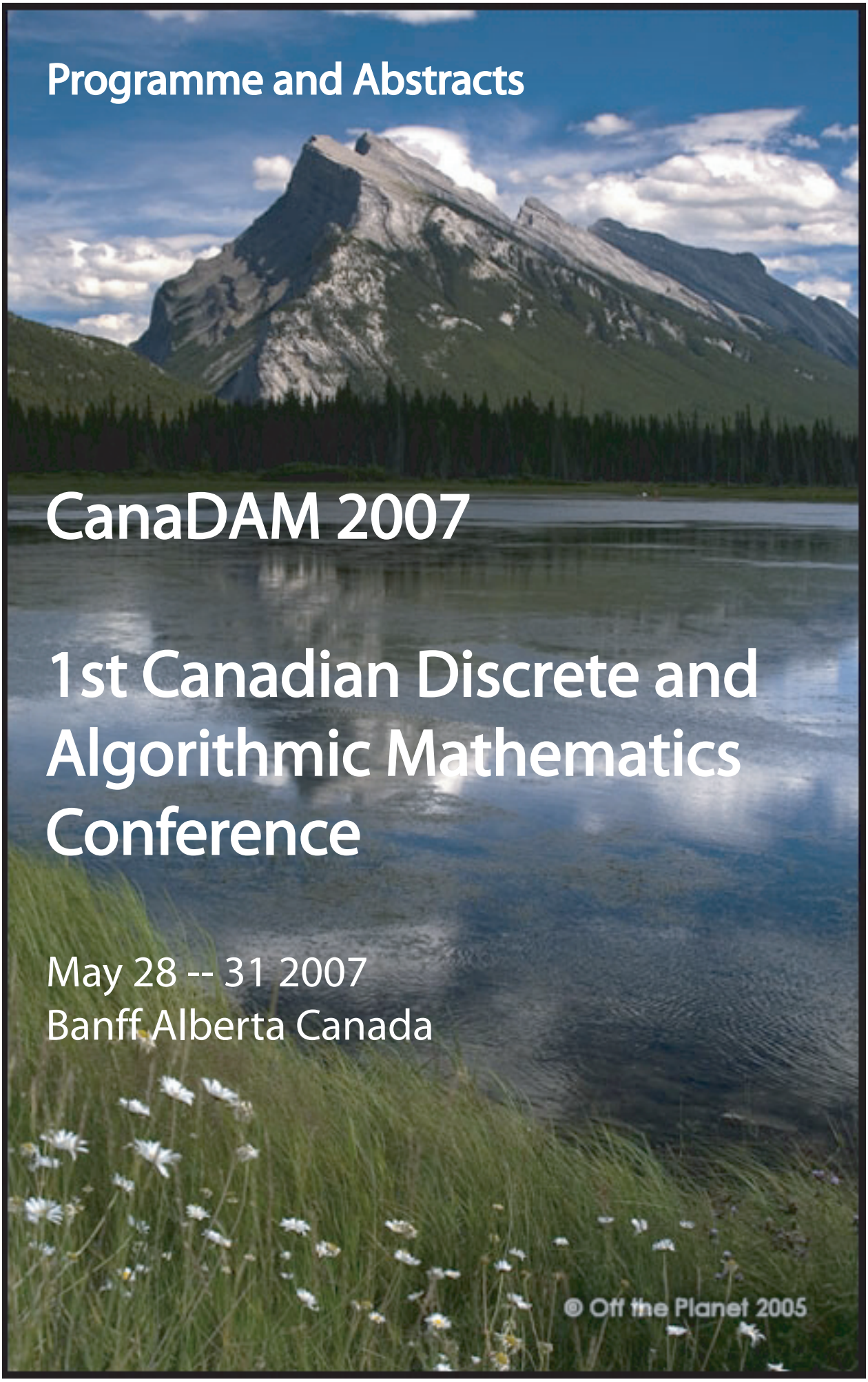
Programme and Abstracts
CanaDAM 2007
1st Canadian Discrete and Algorithmic Mathematics Conference
May 28 -- 31 2007
Banff Alberta Canada
© Off the Planet 2005

Organizing Team

Executive Committee:

- Derek Corneil (Chair), University of Toronto
- Jason Brown, Dalhousie University
- Pavol Hell, Simon Fraser University
- Ortrud Oellermann, University of Winnipeg
- Daniel Panario, Carleton University
- Bruce Reed, McGill University

Program Committee:

- Bojan Mohar (Chair), Simon Fraser University
- Bill Cook, Georgia Tech
- Pavol Hell, Simon Fraser University
- Joan Hutchinson, Macalester College
- Nati Linial, Hebrew University of Jerusalem
- Christos Papadimitriou, University of California at Berkeley
- Pavel Pevzner, University of California at San Diego
- Doug Stinson, University of Waterloo
- Éva Tardos, Cornell University
- Godfried Toussaint, McGill University
- Herb Wilf, University of Pennsylvania
- Nick Wormald, University of Waterloo

Local Organization:

- Ryan Hayward (Chair), University of Alberta
- Joe Culberson, University of Alberta
- Guohui Lin, University of Alberta
- Daniel Panario, Carleton University
- Mohammad R. Salavatipour, University of Alberta
- Lorna Stewart, University of Alberta

CanaDAM 2007

The First Canadian Discrete and Algorithmic Mathematics Conference
Banff, Alberta, Canada
May 28–31, 2007

This new conference on Discrete and Algorithmic Mathematics follows the format of the SIAM Conference on Discrete Mathematics and will be held every two years (in the odd years).

Aims and Scope

The conference focuses on research related to discrete and algorithmic mathematics. The scope includes the theory and application of discrete structures, and the conference aims to highlight the most salient trends in the field. Indeed, research in discrete mathematics can be viewed as a living, growing network involving links within discrete mathematics and to such diverse areas as cryptography, computer science, large-scale networks and biology. This conference brings together researchers from the various disciplines with which discrete and algorithmic mathematics interact. Particular areas of interest include: graphs and digraphs, hypergraphs, ordered sets, designs, coding theory, enumeration, discrete optimization, combinatorial algorithms and applications of discrete and algorithmic mathematics, including (but not limited to) web graphs, computational biology, telecommunication networks, and information processing.

Sponsors

The organizers are extremely grateful for the generous support of the following agencies. In addition to defraying the general conference costs, this support allowed many more graduate students and postdoctoral fellows to attend the conference than would have otherwise been possible. 80 of the 233 preregistrants are graduate students or postdoctoral fellows.

- Department of Computing Science, University of Alberta
- The Fields Institute for Research in Mathematical Sciences
- Centre de Recherches Mathématiques (CRM)
- Informatics Circle of Research Excellence of Alberta (iCORE)
- Pacific Institute for the Mathematical Sciences (PIMS)
- Mathematics of Information Technology and Complex Systems Canadian Research Network (MITACS)

Timetable CanaDAM'07

Monday, May 28				
9:00	Opening remarks			
9:15	Janos Pach			
10:05	Coffee break (shorter)			
10:25	MS I1	MS C1	MS C2	CT
10:50	MS I1	MS C1	MS C2	CT
11:15	MS I1	MS C1	MS C2	CT
11:40	MS I1	MS C1	MS C2	CT
12:05	MS I1	MS C1	MS C2	CT
12:30	Lunch			
14:00	CT	CT	CT	CT
14:25	CT	CT	CT	CT
14:50	Short break (5 min)			
14:55	Xuding Zhu			
15:45	Coffee break			
16:15	MS I2	MS C3	MS C4	CT
16:40	MS I2	MS C3	MS C4	CT
17:05	MS I2	MS C3	MS C4	CT
17:30	MS I2	MS C3	MS C4	CT
17:55	MS I2	MS C3	MS C4	CT
18:30	Reception			

Tuesday, May 29					
	P1	L1	L2	L3	L4
9:00	Bill Pulleyblank				
9:50	Coffee break				
10:20	MS I3	MS I1	MS C5	CT	CT
10:45	MS I3	MS I1	MS C5	CT	CT
11:10	MS I3	MS I1	MS C5	CT	CT
11:35	MS I3	MS I1	MS C5	CT	CT
12:00	MS I3	MS I1	MS C5	CT	CT
12:25	Lunch				
14:30	Peter Winkler				
15:20	Coffee break				
15:50	MS I4	MS I2	MS C7	MS C8	CT
16:15	MS I4	MS I2	MS C7	MS C8	CT
16:40	MS I4	MS I2	MS C7	MS C8	CT
17:05	MS I4	MS I2	MS C7	MS C8	CT
17:30	MS I4	MS I2	MS C7	MS C8	CT
17:55	CT	MS I2	MS C7	MS C8	CT
18:20					

Wednesday, May 30					
	P1	L1	L2	L3	L4
9:00	Vera Sos				
9:50	Coffee break				
10:20	MS I5	MS C6	MS C9	CT	CT
10:45	MS I5	MS C6	MS C9	CT	CT
11:10	MS I5	MS C6	MS C9	CT	CT
11:35	MS I5	MS C6	MS C9	CT	CT
12:00	MS I5	MS C6	MS C9	CT	CT
12:25	Lunch				
14:30	Valerie King				
15:20	Coffee break				
15:50	MS I6	MS C10	MS C11	CT	CT
16:15	MS I6	MS C10	MS C11	CT	CT
16:40	MS I6	MS C10	MS C11	CT	CT
17:05	MS I6	MS C10	MS C11	CT	CT
17:30	MS I6	MS C10	MS C11	CT	CT
17:55	Problem session (with emphasis for students)				
18:40	Student reception				

Thursday, May 31				
	P1	L1	L2	L3
9:00	Bruce Shepherd			
9:50	Coffee break			
10:20	MS I7	MS I8	MS C5	CT
10:45	MS I7	MS I8	MS C5	CT
11:10	MS I7	MS I8	MS C5	CT
11:35	MS I7	MS I8	MS C5	CT
12:00	MS I7	MS I8	MS C5	CT
12:25	Lunch			
14:00	David Sankoff			
14:50	Coffee break			
15:10	CT	CT	CT	CT
15:35	CT	CT	CT	CT
16:00	X	CT	CT	CT
16:25	Conference ends			

P1 Main lecture room (250)
L1 Lecture room DCH 300 (100)
L2 Lecture room DCH 305 (48+10)
L3 Lecture room DCH 307 (40+10)
L4 Lecture room DCH 303 (36)

Minisymposia information

No.	Organizer	Plenary	Title	No.talks
I1	Gabor Tardos	Janos Pach	Combinatorial geometry and graph drawing	10
I2	Doug West	Xuding Zhu	Graph colouring	11
I3	Tamas Terlaky	Bill Pulleyblank	Linear, polyhedral optimization and their relatives	5
I4	David Galvin	Peter Winkler	Problems at the interface of discrete math and statistical physics	6
I5	Penny Haxell	Vera Sos	Extremal combinatorics	5
I6	Petra Berenbrink	Valerie King	Randomized algorithms	5
I7	Bertrand Guenin	Bruce Shepherd	Cycles, flows, and colouring	5
I8	Anne Bergeron	David Sankoff	Combinatorial problems in genomics	5
C1	Richard Brewster		Graph Homomorphisms	5
C2	R. Laubenbacher and Henning Mortveit		Discrete Dynamical Systems over Graphs	5
C3	Gary MacGillivray		Discrete-time, deterministic graph processes and games	5
C4	Lucia Moura and Brett Stevens		Covering arrays: New generalizations for software testing applicat	5
C5	Conrado Martinez and Daniel Panario		Applications of Discrete Mathematics to the Analysis of Algorithms	10
C6	Mike Albertson and Bojan Mohar		Topological Graph Theory	5
C7	Stefan Pickl		Games on Graphs	6
C8	Karen Meagher		Applications of Association Schemes to Combinatorial Problems	6
C9	Sebastian Cioaba and Steve Kirkland		Spectral Graph Theory	5
C10	Ken-ichi Kawarabayashi		Graph Minors	5
C11	John Van Rees and Clement Lam		Combinatorial Designs	5

Invited Plenary Speakers

- János Pach
(City College New York and Rényi Institute):
State of the Intersection

- Xuding Zhu
(National Sun Yat-sen University):
Circular Choosability of Graphs

- William R. Pulleyblank
(IBM Global Business Services):
High Performance Computing, Business Analytics and Combinatorial Optimization

- Peter Winkler
(Dartmouth College):
You Can Do Physics

- Vera Sós
(Rényi Institute):
Graph Limits and the Similarity of Large Graphs

- Valerie King
(Microsoft Research SVC and University of Victoria)
Zombies, ETs and Other Encounters with Dynamic Graph Algorithms

- Bruce Shepherd
(McGill University)
Single-source Network Flows with Side Constraints

- David Sankoff
(University of Ottawa)
Polyploidy and Rearrangement Phylogeny

Invited Minisymposia

- Gábor Tardos (Simon Fraser):
  Combinatorial geometry and graph drawing
- Petra Berenbrink (Simon Fraser):
  Randomized algorithms
- Támas Terlaky (McMaster):
  Linear, polyhedral optimization and their relatives
- Anne Bergeron (U Québec à Montréal):
  Combinatorial problems in genomics
- Bertrand Guenin (U Waterloo):
  Cycles, flows, and colouring
- Penny Haxell (U Waterloo):
  Extremal combinatorics
- David Galvin (U Pennsylvania):
  Problems at the interface of discrete math and statistical physics
- Douglas B. West (U Illinois):
  Graph Colouring

Contributed Minisymposia

- Richard Brewster (Thompson Rivers):
  Graph Homomorphisms
- Sebastian Cioaba (UC San Diego) and
  Steve Kirkland (U Regina):
  Spectral Graph Theory
- Gary MacGillivray (U Victoria):
  Discrete-time, deterministic graph processes and games
- Karen Meagher (U Waterloo):
  Applications of Association Schemes to Combinatorial Problems
- Reinhard Laubenbacher (Virginia Bioinf Inst)
  and Henning Mortveit (Virginia Bioinf Inst):
  Discrete Dynamical Systems over Graphs
- Lucia Moura (U Ottawa) and
  Brett Stevens (Carleton):
  Covering arrays: New generalizations for software testing application
- Conrado Martinez (U Politecnica Catalunya)
  and Daniel Panario (Carleton):
  Applications of Discrete Mathematics to the Analysis of Algorithms
- Stefan Pickl (U Bundeswehr München):
  Games on Graphs
- John van Rees and Clement Lam (Concordia):
  Combinatorial Designs
- Ken-ichi Kawarabayashi (Tohoku U):
  Graph Minors
- Mike Albertson (Smith College) and
  Bojan Mohar (Simon Fraser):
  Topological Graph Theory

Invited Minisymposia

Combinatorial geometry and graph drawing

Organizer:
Gábor Tardos (Simon Fraser University)

Description:
This minisymposium consists of two parts of five talks each. The common theme is the interplay of discrete geometry, graph theory and combinatorics.

Titles and Speakers:

- *Almost Similar Configurations* Zoltán Füredi (Illinois Urbana-Champaign and Rényi Inst)
- *On Triangles of Distinct Areas and Tetrahedra of Distinct Volumes* Adrian Dumitrescu (Wisconsin-Milwaukee), Csaba D. Tóth (MIT)
- *Paths with No Small Angles*
  Imre Bárány (Rényi Inst and U College London), Pavel Valtr (Charles U), Attila Pór (Rényi Inst)
- *Geometry of Orthogonal Surfaces*
  Stefan Felsner (Technische U Berlin)
- *The Discharging Method and Its Applications for Graph Drawing* Radoš Radoičić (Baruch College CUNY), Géza Tóth (Rényi Inst)
- *Balanced Subdivision of Two Sets of Points in the Plane Lattice* Mikio Kano (Ibaraki U), Tomoharu Kawano (IU), Miyuki Uno (IU)
- *On the Integer Lattice in the Plane*
  Peter Hamburger (Western Kentucky), Robert Vandell (Indiana-Purdue), Matt Walsh (I-P)
- *Fixed Parameter Tractability in Geometry and Graph Drawing* Sue Whitesides (McGill)
- *Intersection Graphs of Convex Sets*
  Jan Kratochvil (Charles U), Martin Pergel (Charles U)
- *Pencils with Many Incidences* Mei-Chu Chang (UC Riverside), József Solymosi (UBC)

Graph Coloring

Organizer:
Douglas B. West (U Illinois)

Description:
Graph coloring is a fundamental model for problems of optimally partitioning a set into subsets that avoid conflicts. This minisymposium samples a wide variety of problems in this area. The first session studies optimal coloring of the vertices or edges of graphs in various families, using various labels and satisfying various constraints. The second session explores connections with other topics, including eigenvalues, topology, general graph properties, and induced forests.

Titles and Speakers:

- *Edge-colourings of multigraphs*
  Michael Stiebitz (Tech U Ilmenau), Diego Scheide (Tech U Ilmenau)
- *Circular edge-coloring of cartesian products*
  Douglas B. West (U Illinois), Xuding Zhu (National Sun Yat-Sen U)
- *Edge-coloring of cubic graphs with elements of Steiner triple systems*
  Daniel Král (Charles U), E. Máčajová (Comenius U), A. Pór (Charles U), J.-S. Sereni (Charles U)
- *Injective colouring of graphs*
  André Raspaud (LaBRI, U Bordeaux I)
- *Equitable coloring: New proofs, theorems, and conjectures* Hal Kierstead (Arizona State), Alexandr V. Kostochka (U Illinois)
- *Laplacian eigenvalues and chromatic number*
  Vladimir Nikiforov (Memphis)
  Cancelled due to bureaucratic error by US Government Replacement talk:
  Proper path-factors and interval edge-coloring of $(3,4)$*-biregular bigraphs*
  Douglas B. West (U Illinois)
- *Chromatic invariants and Borsuk-Ulam-type theorems* Gábor Simonyi (Rényi Inst), Gábor Tardos (SFU and Rényi Inst)
- *Local chromatic number of odd quadrangulations*
  Bojan Mohar (SFU), Gábor Simonyi (Rényi Inst), Gábor Tardos (SFU and Rényi Inst)
- *Generalized coloring and uniquely colorable graphs* Peter Mihók (Math Inst, Slovak Acad Sci)

- *On two conjectures about induced forests in planar graphs* Mohammad R. Salavatipour (U Alberta)
- *Bounding χ in terms of ω and Δ for quasi-line graphs* Andrew King (McGill), Bruce Reed (McGill)

Linear, polyhedral optimization and their relatives

Organizer:
Tamás Terlaky (McMaster)

Description:
The set of feasible solutions of a linear optimization (LO) problem is a convex polyhedron. Specially structured (integer) LO problems define polytopes with special structures, thus the theory and algorithms of LO inherently linked to polyhedral theory, properties of convex bodies and graphs theoretical problems. This mini-symposium covers recent fundamental results about geometrical properties of convex bodies; results on graph rigidity; an algorithm for network design problems; facet generation of polytopes by symmetric triangulation; finally results and conjectures about diameters and curvatures.

Titles and Speakers:

- *On the successive face indices of convex bodies* Károly Bezdek (Calgary), Alexander Litvak (Alberta)
- *On the Uniqueness, dimensional rigidity and global rigidity of bar-and-joint frameworks* Abdo Y. Alfakih (Windsor)
- *Minimizing the Number of Critical Vertices in Network Design* Hu Zhang and Tamás Terlaky (McMaster), Anthony Vannelli (Guelph)
- *Facet Generation and Symmetric Triangulation* David Bremner (New Brunswick)
- *Central Path & Edge Path: Curvature & Diameter* Antoine Deza (McMaster), Eissa Nematollahi (McMaster), Tamás Terlaky (McMaster), Yuriy Zinchenko (McMaster)

Problems at the interface of discrete mathematics and statistical physics

Organizer:
David Galvin (U Pennsylvania)

Description:
There has been great activity in recent years at the interface of discrete mathematics, theoretical computer science and statistical physics. Researchers in these disparate fields studying graph enumeration, percolation problems, efficiency of approximation and sampling algorithms, and phase transitions in spin-models, have been discovering connections that have enriched all three disciplines. This minisymposium gathers together workers whose recent activity has been inspired by this cross-fertilization, and hopes to demonstrate that each of these three disciplines can make meaningful contributions to the other two.

Titles and Speakers:

- *Counting matchings and independent sets of a fixed size* David Galvin (Pennsylvania)
- *Correlation decay in statistical physics and applications to counting problems* David Gamarnik (MIT)
- *A rigorous analysis of the Cavity Method for counting matchings* Mohsen Bayati (Stanford)
- *Spectral Radius, Dobrushin Uniqueness and Rapid Mixing* Tom Hayes (Toyota Tech Inst)
- *First-passage percolation on a width-2 strip and the path cost in a VCG auction* Abraham Flaxman (Microsoft Research)

Extremal Combinatorics

Organizer:
Penny Haxell (U Waterloo)

Description:
In extremal combinatorics, one seeks to find the extreme value of some combinatorial parameter, over all combinatorial objects in a certain class. Since its introduction by Turán in the 1940's, it has grown into an immensely broad field and has produced many fundamental results and conjectures. Several of the main topics of extremal combinatorics will be addressed in this minisymposium, including Ramsey

and anti-Ramsey problems, forbidden subgraph problems, and stability of extremal structures.

Titles and Speakers:

- *Regularity, stability, and Ramsey numbers* Jozef Skokan (LSE and Ill. Urbana-Champaign)
- *Quadruple systems with independent neighborhoods* Dhruv Mubayi (Illinois-Chicago)
- *Independent Dominating Sets and Hamiltonian Cycles* Jacques Verstraëte (McGill)
- *Extremal quadrilateral-free graphs* Zoltan Furedi (Ill. Urbana-Champaign and Rényi Inst)
- *On some Ramsey properties of the n-cube* Jozsef Solymosi (UBC)

Random Algorithms

Organizer:
Petra Berenbrink (Simon Fraser)

Description:
Randomness has been accepted in computer science as a useful resource for developing efficient protocols and algorithms. The study of randomized algorithms is firmly established within the community. This workshop will present a collection of techniques, ideas, and problem areas that demonstrate and motivate the usefulness of randomization in algorithms research.

Titles and Speakers:

- *The Price of Privacy and the Limits of LP Decoding* Kunal Talwar (Microsoft Res), Cynthia Dwork (MR), Frank McSherry (MR)
- *Balanced Allocations: The Weighted Case* Udi Wieder (Microsoft Res), Kunal Talwar (MR)
- *A Sublinear-Time Approximation Scheme for Bin Packing* Tugkan Batu (LSE), Petra Berenbrink (SFU), Christian Sohler (Paderborn).
- *Finding Frequent Patterns in a String in Sublinear Time* Petra Berenbrink (SFU), Funda Ergun (SFU), Tom Friedetzky (Durham)
- *Distributed Selfish Load Balancing* Russell Martin, Leslie A. Goldberg, Paul Goldberg (Liverpool), Tom Friedetzky (Durham), Petra Berenbrink (SFU), Zengjian Hu (SFU)

Cycles, flows, and colouring

Organizer:
Bertrand Guenin (U Waterloo)

Description:
The purpose of this section is to present some recent development pertaining to colouring in graphs (circular choosability), graph polynomials, circuits in matroids, and max-flow min-cut type relations in binary matroids.

Titles and Speakers:

- *Light Circuits in Heavy Graphs* Luis Goddyn (SFU), Matt DeVos (SFU), Bojan Mohar (SFU), Ken-ichi Kawarabayashi (NII)
- *Why is the chromatic polynomial a polynomial?* Janos Makowsky (Technion), B. Zilber (Oxford)
- *Nowhere-zero 3-flows in Cayley graphs and Sylow 2-subgroups* Martin Škoviera (Comenius U)
- *Circular Choosability* Serguei Norine (Georgia Tech), Tsai-Lien Wong (National Sun Yat-sen U), Xuding Zhu (National Sun Yat-sen U)
- 1-*flowing matroids* Bertrand Guenin (Waterloo), Paul Wollan, I. Pivotto

Combinatorial problems in genomics

Organizer:
Anne Bergeron (U Québec à Montréal)

Description:
The links between combinatorics and genomics are deeply rooted in thefact that the instructions for the construction of a living organismare coded sequentially in DNA molecules. Concepts such as permutations, words, patterns, or formal grammars, have been extensively used to model evolution and function of genomic sequences. On a higher level, the variousparts constructed from the elementary instructions, mainly proteins and RNAs,have complex interactions that are captured by networks and graphs. In this minisymposium, we will explore some of the challenging combinatorial problems that arise from genomics.

Titles and Speakers:

- *Genome rearrangements: the two parsimonies*
  Eric Tannier (U Claude Bernard, Lyon)
- *Towards more accurate RNA structure prediction* Anne Condon (U British Columbia)
- *Application of combinatorial optimization to prediction of domain-domain interactions*
  Teresa Przytycka (NCBI/NLM/NIH)
- *Handling duplications in genome rearrangements models* Cedric Chauve (Simon Fraser)
- *Counting the number of breakpoints between genomes containing duplicates*
  Guillaume Fertin (U Nantes)

Contributed Minisymposia

Graph Homomorphisms

Organizer:
Richard Brewster (Thompson Rivers U)

Description:
Homomorphisms are natural objects in many branches of mathematics and graph theory is no exception. However until recently, many graph theorists would not have considered homomorphisms a core topic within the discipline. This is changing with increased activity in the study of graph homomorphisms, together with increased applications to problems from computational complexity to theoretical physics. (See Hell and Nešetřil Graphs and Homomorphisms, Oxford Press 2004.)

The goal of the minisymposium is to present: an introduction to the discipline, for those less familiar with the topic; two deeper talks in the discipline; and two talks on applications of graph homomorphisms.

Titles and Speakers:

- *Graph Homomorphisms, an introduction*
  Richard Brewster (Thompson Rivers)
- *Homomorphisms and the web graph*
  Anthony Bonato (Wilfred Laurier)
- *Core-indicator graphs*
  Karen Collins (Welsleyan)
- *Covering arrays, graph products and homomorphisms* Brett Stevens (Carleton)
- *Right adjoints and Hedetniemi's conjecture*
  Claude Tardif (Royal Military College)

Discrete Dynamical Systems over Graphs

Organizers:
Reinhard Laubenbacher (Virginia Tech)
Henning S. Mortveit (Virginia Tech)

Description:
The study of dynamical systems over graphs is a growing area of mathematics and computer science with very interesting mathematical problems and many application areas. Examples include cellular automata and sequential dynamical systems. Their analysis combines techniques from discrete mathematics, combinatorics, algebra, and dynamical systems theory. This mini-symposium features talks on recent developments in this area, including both theoretical results and applications. Topics include persistent defects in cellular automata (Pivato), number-preserving cellular automata (Fukś), limit cycles of polynomial systems (Jarrah), schedule-instability of threshold systems over graphs (Mortveit), and applications to routing and network protocols (Hansson).

Titles and Speakers:

- *Scheduling Instability for Finite Dynamical Systems over Graphs*
  Henning S. Mortveit (Virginia Tech)
- *Enumeration of Number-Conserving Cellular Automata* Henryk Fukś (Brock)
- *Monomial Dynamical Systems over Finite Fields*
  Abdul S. Jarrah (Virginia Tech)
- *Emergent Defect Dynamics in Cellular Automata* Marcus Pivato (Trent)
- *A Sequential Dynamical Systems Framework for Congestion-Aware Routing*
  Anders Å. Hansson (Los Alamos National Lab)

Discrete-time, Deterministic Graph Processes and Games

Organizer:
Gary MacGillivray (U Victoria)

Description:
This minisymposium will consist of five talks on different, related, deterministic games that take place on graphs.

Titles and Speakers:

- *The Firefighter Problem*
  Gary MacGillivray (Victoria)
- *The Watchman's Watch Problem*
  Bert Hartnell (St. Mary's)
- *Eternal Dominating Sets in Graphs*
  Chip Klostermeyer (North Florida)
- *Cops and Robber*
  Nancy E. Clarke (Acadia)
- *Time Constrained Searching*
  Danny Dyer (Memorial U Newfoundland)

Covering arrays: New generalizations for software testing applications

Organizers:
Lucia Moura (U Ottawa)
Brett Stevens (Carleton)

Description:
Covering arrays are combinatorial designs that are used for testing systems such as software, circuits and networks, where failures can be caused by the interaction between their components or parameters. New generalizations of these objects employ techniques from design theory, graph homomorphisms, combinatorial group testing, among other fields. This minisymposium highlights current research that addresses some of the challenges that arise in real testing situations. Models under study incorporate graphs and hypergraphs to select relevant interactions to be tested, specification of forbidden interactions, and the ability to locate faulty interactions. This session will be closed by a talk discussing empirical data from applications and other challenges to be faced.

Titles and Speakers:

- *Adaptive algorithms for locating faulty interactions* Lucia Moura (Ottawa)
- *Covering arrays avoiding forbidden configurations* Peter Danziger (Ryerson)
- *Covering arrays on graphs*
  Karen Meagher (Waterloo)
- *Constructions for optimal mixed covering arrays on graphs and hypergraphs*
  Christine Cheng (Wisconsin-Milwaukee)
- *Empirical results and practical extensions: using covering arrays to test configurable software*
  Myra Cohen (Nebraska-Lincoln)

Applications of Discrete Mathematics to the Analysis of Algorithms

Organizers:
Conrado Martínez (U Politècnica Catalunya)
Daniel Panario (Carleton)

Description:
This minisymposium is centered around the mathematical analysis of algorithms, the area founded back in the sixties by Don Knuth's pioneering work on the analysis of linear probing hashing and quickselect. The goal of this area is to find precise estimations of the performance of important algorithms and data structures on average, variance and, whenever possible, its probability distribution. This kind of analysis is important if we need to know the "typical" behavior of an algorithm, and the most natural for randomized algorithms.

The area has witnessed many advances in recent years and this minisymposium aims to provide an overview of these, as well as the basic foundations of the field. The talks will also emphasize the fundamental role played by discrete mathematics (combinatorics, enumeration, discrete probability, and so on) as well as other areas of classical mathematics (most notably real and complex analysis) in the development and progress of this area.

Titles and Speakers:

- *Applications of Discrete Mathematics to the Analysis of Algorithms*
  Conrado Martínez (U Politècnica Catalunya)
- *On Selection, Partial Sorting and Quicksort*
  Markus Kuba (Technische U Wien)
- *Optimality of Video-on-Demand Broadcast Protocols* David Kirkpatrick (UBC)
- *Smallest Components in Decomposable Structures with a Restricted Pattern*
  Li Dong (Carleton)
- *Average-case analysis of perfect sorting by reversals* Cedric Chauve (SFU), Marni Mishna (SFU)
- *Interval Partitions and Polynomial Factorization over Finite Fields*
  Daniel Panario (Carleton)
- *Random Generation of Automata*
  Frédérique Bassino (U Marne-la-Vallée)
- *Heights on Trees*
  Bruce Reed (McGill)
- *Analyzing the Performance of Spatial Data Structures*
  Amalia Duch (U Politècnica Catalunya)
- *Some Applications of the Method of Moments in the Analysis of Algorithms*
  Alois Panholzer (Technische U Wien)

Games on Graphs

Organizer:
Stefan Pickl (U Bundeswehr München)

Description:
In this minisymposium the analysis and the examination of played games on graphs are in the main center of interest. Theoretical approaches are as well considered as practical applications. There are no restrictions to n-person games. Furthermore, infinite games, general constructive algorithms, discrete models and their complexity analysis should be discussed. Applications might be in the field of classical bargaining theory, modern experimental economics and auction theory as well as from biology (genetics) inspired examples.

Titles and Speakers:

- *Covering graphs with cliques and independent sets* Tinaz Ekim (Ecole Poly Lausanne), John Gimbel (Alasaka)
- *On two coloring problems in mixed graphs*
  Bernhard Ries (Ecole Poly Lausanne),
  Dominique de Werra (Ecole Poly Lausanne)
- *Knowledge states: A tool in randomized online algorithms* Wolfgang Bein (UNLV)
- *Fault-Tolerant Search Trees*
  Doina Bein (Texas-Dallas)
- *A constructive algorithm for max-min paths problems on networks*
  Stefan Pickl (U Bundeswehr München)
- *A new mathematical approach in environmental protection: gene-environment networks*
  Gerhard Wilhelm Weber (Middle East Tech),
  Marat U. Akhmet (Middle East Tech)

Applications of Association Schemes to Combinatorial Problems

Organizer:
Karen Meagher (University of Waterloo)

Description:
Algebraic combinatorics is a growing field of study that has proven to be a powerful method for solving combinatorial problems. A key structure in algebraic combinatorics is the association scheme; association schemes are general combinatorial objects with a strong algebraic nature.

The goal of this session is to present several problems that fit in the framework of an association scheme and to show how we can find results for these combinatorial problems using this structure.

Chris Godsil will give the first presentation which will provide an introduction to association schemes. The remaining presentations will focus on applications to combinatorial problems.

Titles and Speakers:

- *Association schemes and their applications*
  Chris Godsil (U Waterloo)
- *Association Schemes and Set-Partition Systems*
  Karen Meagher (U Waterloo)
- *Association schemes in complex systems of lines*
  Aidan Roy (U Calgary)
- *Inequalities for binary codes from the Terwilliger algebra* William J. Martin (Worcester Polytech, visiting MIT)
- *A strengthening of the Assmus-Mattson theorem based on the displacement and split decompositions* Hajime Tanaka (Worcester Polytech)
- *Distance-regular graphs and the quantum affine $\mathfrak{sl}_2$ algebra*
  Paul Terwilliger (U Wisconsin-Madison)

Topological Graph Theory

Organizers:
Michael O. Albertson (Smith College)
Bojan Mohar (Simon Fraser)

Description:
Graphs embedded on surfaces have been important mathematical objects for more than a century. The recent graph minors project has substantially increased this significance. This minisymposium will bring together five researchers to discuss some of their recent and ongoing contributions.

Titles and Speakers:

- *The orientable closed 2-cell embeddings of toroidal graphs* Xiaoya Zha (Mid Tenn State), Mark Ellingham (Vanderbilt)
- *Representativity of Cayley maps*
  Chris Stephens (Mid Tenn State)

- *Progress on the orientable genus of complete tripartite graphs (preliminary report)*
  Mark Ellingham (Vanderbilt), Chris Stephens (Mid Tenn State), Xiaoya Zha (Mid Tenn State)
- *Variants of nearly planar graphs (preliminary report* Michael O. Albertson (Smith College)
- *Trading Handles for Crossings*
  Matt DeVos (SFU), Bojan Mohar (SFU), Robert Šámal (SFU)

Spectral Graph Theory

Organizers:
Sebastian M. Cioabă (U California San Diego)
Steve Kirkland (U Regina)

Description:
Spectral Graph Theory is an important part of discrete mathematics with applications in many areas such as computer science, chemistry, network design and coding theory. One of the main goals of the theory is to deduce the principal properties of a graph from the spectral information furnished by one or more of the matrices associated with it (for instance the adjacency matrix, the Laplacian matrix or the normalized Laplacian matrix). In recent years, we have seen many new results connecting the eigenvalues of a graph with its independence number, the maximum number of independent edges, the chromatic number and the existence of certain subgraphs. This minisymposium will showcase some of these connections and their applications.

Titles and Speakers:

- *Eigenvalues of* $(3,6)$*-polyhedra*
  Matt DeVos (SFU), Luis Goddyn (SFU), Bojan Mohar (SFU), Robert Šámal (SFU)
- *Perfect matchings in regular graphs from eigenvalues* Sebastian M. Cioabă (UCSD), David Gregory (Queen's), Willem Haemers (Tilburg)
- *Limit points for normalized Laplacian eigenvalues* Steve Kirkland (Regina)
- *Constructing cospectral symmetric powers*
  Chris Godsil (Waterloo)
- *Spectra of non-regular graphs and non-backtracking* Joel Friedman (UBC)

Graph Minors and Structure Graph Theory

Organizer:
Ken-ichi Kawarabayashi (National Inst Informatics)

Description:
In this session, we shall discuss recent progress on Graph Minors and Structure Graph Theory. Topics include graph minors and matroid minors, graph width, the disjoint paths problem and algorithmic applications.

Titles and Speakers:

- *Structure theorem for the minimal counterexample to Hadwiger's Conjecture.*
  Ken-ichi Kawarabayashi (NII), Bruce Reed (McGill)
- *Circle graph obstructions under pivoting*
  Sang-il Oum (Waterloo), Jim Geelen (Waterloo)
- *Linear time algorithm for recognizing* K_5*-minors*
  Zhentao Li (Waterloo), Bruce Reed (McGill)
- *Graph minors in (nearly) linear time*
  Bruce Reed (McGill), Ken-ichi Kawarabayashi (NII), Zhentao Li (Waterloo)
- *Chromatic number and immersions of complete graphs* Matt DeVos (SFU), Ken-ichi Kawarabayashi (NII), Bojan Mohar (SFU), Haruko Okamura (Konan U)

Combinatorial Designs

Organizers:
Clement Lam (Concordia)
G. H. J. van Rees (U Manitoba)

Description:
This mini-symposium will present a mixture of new results, work-in-progress, and open problems in the area of combinatorial designs. It will demonstrate the practical aspects of algorithmic mathematics when applied to problems in designs.

Titles and Speakers:

- *Search Algorithm for partial geometries with non-trivial automorphism* C. Lam (Concordia)
- *Using Wilson's Theorem to Enumerate BIBDs*
  G. H. J. van Rees (U Manitoba)

- *Uniform group divisible Steiner quadruple systems* M. Keranen (Michigan Tech), D.L. Kreher (Michigan Tech), R. Rees (Memorial U Nfld)
- *On Generalized Separating Hash Families* D. R. Stinson (Waterloo), R. Wei (Lakehead), K. Chen (Yancheng Teachers U)
- *Constructions of Super-simple BIBDs* R. Wei (Lakehead), K. Chen (Yancheng Teachers U)

Abstracts

Monday May 28 at 9:00 in P1

Opening Remarks

Monday May 28 at 9:15 in P1

State of the Intersection

Speaker:
János Pach (City College NY and Rényi Inst)

Abstract:
Which graphs are *intersection* graphs of convex sets, continuous arcs, rectangles, segments or other geometric objects in the plane? Most of these questions are algorithmically hard. In many cases it is not even clear whether they are decidable. However, most classes of intersection graphs have very special extremal graph-theoretic properties. We concentrate on (1) Turán-type, (2) Ramsey-type results that can be obtained by various extensions of the Lipton-Tarjan separator theorem for planar graphs. Joint work with Jacob Fox.

Monday May 28 at 10:25 in P1/L1/L2/L3

Almost Similar Configurations

Speaker:
Zoltán Füredi (Illinois Urbana-Champaign and Rényi Inst)

Abstract:
Let A be a fixed k-set on the Euclidean plane. Two point sets $A = \{a_1, a_2, \dots, a_k\}$ and $B = \{b_1, b_2, \dots, b_k\}$ are ε-similar if $1-\varepsilon \le \frac{|a_i a_j|}{|b_i b_j|} \le 1+\varepsilon$ for all $i < j$. Let $S(A, n, \varepsilon)$ denote the maximum number of ε-similar images of A in an n-element planar set. In the case of true homothety ($\varepsilon = 0$) Elekes and Erdős (1991) showed that $S(A, n, 0) \ge cn^{2-o(1)}$ for all A, and Laczkovich and Ruzsa (1997) gave a necessary and sufficient condition for $S(A, n, 0) \ge cn^2$: namely, the cross ratio of any four elements of A must be algebraic.

The almost similar case is different, obviously $S(n, A, \varepsilon) \ge (n/k)^k$ for any $\varepsilon > 0$. Conway, Croft and Erdős (1979) studied the number of almost regular triangles (A is a regular triangle, $\varepsilon = 1^\circ$, say). Improving their results here we show, e.g., that for almost all triangles, (i.e., $|A| = 3$) there exists a $\delta = \delta(T) > 0$ such that

$$S(n, A, \varepsilon) = (1 + o(1))n^3/24$$

whenever $n \to \infty$ and $0 < \varepsilon < \delta$ is fixed. However, there are triangles with $S(n, A, \varepsilon) > n^3/15$.

Graph Homomorphisms, an introduction

Speaker:
Richard Brewster (Thompson Rivers)

Abstract:
The concept of a *homomorphism* appears in many branches of Mathematics and Computer Science (either explicitly or implicitly), and Graph Theory is no exception. Graph homomorphisms are natural objects with a rich literature devoted to their study, as well as an increasing number of applications.

In this talk we will give a brief introduction to graph homomorphisms and their basic properties. Key results in computational complexity will be presented. In addition we will discuss some applications.

Scheduling Instability for Finite Dynamical Systems over Graphs

Speaker:
Henning S. Mortveit (Virginia Tech)

Abstract:
For Sequential Dynamical Systems (SDS) the ω-limit set of a point x generally depends on the update order π. We show that generic classes of threshold SDS (for which $\omega_\pi(x)$ is always a single fixed point) exhibit update order instability in the sense that there are points x where the collection of limit sets $\cup_\pi \omega_\pi(x)$ has exponential size.

New upper bounds for p-center problems in a network

Speaker:
Binay Bhattacharya (SFU), Qiaosheng Shi (SFU), Arie Tamir (Tel Aviv)

Abstract:
The center problem has been well-studied on trees and general networks. Not much work is known on this problem when the underlying structure is a tree-like network (i.e., cactus, partial k-tree). We discuss some new results on the center problems in partial k-trees. We also showed that better upper bounds on

the p-center problems can be obtained by transforming it to a geometrical problem called Klee's measure problem.

Monday May 28 at 10:50 in P1/L1/L2/L3

On Triangles of Distinct Areas and Tetrahedra of Distinct Volumes

Speaker:
Adrian Dumitrescu (Wisconsin-Milwaukee), Csaba D. Tóth (MIT)

Abstract:
Erdős, Purdy, and Straus conjectured that the number of distinct areas of triangles determined by n noncollinear points in the plane is at least $\lfloor \frac{n-1}{2} \rfloor$, as given by distributing points evenly on two parallel lines. We show that this number is at least $\frac{17}{38}n - O(1) \approx 0.4473n$. The best previous bound, $(\sqrt{2}-1)n - O(1) \approx 0.4142n$, which dates back to 1982, follows from the combination of a result of Burton and Purdy and Ungar's theorem on the number of distinct directions determined by n noncollinear points in the plane.

For the same question on triangles in 3-space, we can show that every set of n points, not all on a line, determines at least $\Omega(n^{2/3}/\beta(n))$ triangles of distinct areas (which share a common side). Here $\beta(n)$ is an extremely slowly growing function related to the inverse Ackermann function.

For the analogous question on tetrahedra in 3-space, we show that n points in 3-space, not all on a plane, determine $\Omega(n)$ tetrahedra of distinct volumes (which share a common edge). This matches the $O(n)$ bound given by distributing points evenly on three equidistant parallel lines, modulo the constant factor. We thereby give a first partial answer in the three-dimensional case of an old question of Erdős, Purdy, and Straus.

Homomorphisms and the web graph

Speaker:
Anthony Bonato (Wilfred Laurier) Peter Cameron, Dejan Delić, Jeannette Janssen

Abstract:
The *web graph* W is a real-world, self-organizing network that has received much recent attention. The vertices of W represent web pages, and the edges represent links between pages. As models for the evolution of W introduce new vertices over time, it is natural to consider the limit graphs that result as time tends to infinity. We present some new results on the endomorphism monoids of these limit graphs.

Enumeration of Number-Conserving Cellular Automata

Speaker:
Henryk Fukś (Brock)

Abstract:
Although general conditions for existence of additive invariants in cellular automata (CA) are well known, not much is known about the distribution of CA rules possessing invariants in the space of all CA rules. We will show that for two-input rules with n states, number-conserving CA rules can be represented by balanced sequences, and, therefore, can be enumerated. We also demonstrate that number-conserving rules are becoming increasingly rare as the number of states increases.

An Improved Algorithm for Maximum Weighted Independent Set Problems

Speaker:
Vicky Choi (vchoi@dwavesys.com, work done at Virginia Tech)

Abstract:
We describe improvements on Ostergard's algorithm for maximum weighted independent set problems. We give a characteristic of a good ordering of vertices that partially answers the open problem posed by Ostergard. We also give better upper and lower bounds of independent set size for pruning the search tree. In particular, using 5-Sweep LBFS ordering, our algorithm runs in linear time for interval graphs, and is empirically efficient for non-interval graphs that are distorted locally, such as the graphs arising from genome rearrangement studies.

Monday May 28 at 11:15 in P1/L1/L2/L3

Paths with No Small Angles

Speaker:
Imre Bárány (Rényi Inst and U College London), Pavel Valtr (Charles U), Attila Pór (Rényi Inst)

Abstract:
We show that given a finite set of points in the plane, it is possible to connect them to a (possibly self-intersecting) polygonal path so that every angle on

the polygonal path is at least $\pi/9$.

We also show that there is a constant $\alpha > 0$ such that for any $d \geq 2$ and for any finite set of points in R^d, it is possible to connect the points to a polygonal path so that every angle on the polygonal path is at least α.

Core-indicator graphs

Speaker:
Karen Collins (Welsleyan University)

Abstract:
As part of their scheme to prove that the question of whether a graph H maps to a fixed, non-bipartite graph G is NP-complete, Hell and Nesetril used a duality lemma based on the idea of left and right adjoint functors. Define a triple (I, u, v) to be C-indicator if I is a finite graph, u, v are two distinct vertices in I, and there is an involution of I that takes u to v. Let G be any graph, and let $C_{I_{u,v}}(G)$ be the graph formed by replacing every edge of G by the graph I, where the vertices u, v in I replace the original vertices in the edge. Since I is symmetric with respect to u and v, it doesn't matter which of u, v replaces which of the two original vertices. Note that if $G \to H$, then $C_{I_{u,v}}(G) \to C_{I_{u,v}}(H)$. This talk will describe situations where G is a core if and only if $C_{I_{u,v}}(G)$ is a core.

Monomial Dynamical Systems over Finite Fields

Speaker:
Abdul S. Jarrah (Virginia Tech)

Abstract:
An important problem in the theory of finite dynamical systems is to draw conclusions about the dynamics of a system from its structure. In this talk, we present upper and lower bounds for the number of limit cycles in the dynamics of a given monomial system. These bounds are in terms of the antichains in the poset of the strongly connected components (and their dynamics) of the dependency graph of the system.

The Random Separation Method for Solving Fixed-Parameter Problems

Speaker:
Leizhen Cai (Chinese U Hong Kong), Siu Man Chan, Siu On Chan

Abstract:
We introduce a novel randomized method, random separation, for solving fixed-parameter graph problems. The key idea of the method is to partition the vertex set of a graph randomly into two disjoint sets to separate a solution from the rest of the graph into connected components, and then select appropriate components to form a solution. We can use universal sets to derandomize algorithms obtained from this method.

This new method is versatile and powerful as it can be used to solve a wide range of fixed-parameter problems for degree-bounded graphs, graphs of bounded degeneracy, and even general graphs.

Monday May 28 at 11:40 in P1/L1/L2/L3

Geometry of Orthogonal Surfaces

Speaker:
Stefan Felsner (Technische U Berlin)

Abstract:
Orthogonal surfaces allow a very natural approach to Schnyder woods on planar graphs which continue to find new applications in graph drawing, enumeration and in dimension theory of orders. These connections motivated the independent study of orthogonal surfaces. We give an overview of present knowledge about orthogonal surfaces. In particular we discuss connections with polytopes and their face lattices.

Covering arrays, graph products and homomorphisms

Speaker:
Brett Stevens (Carleton University)

Abstract:
Recently graph homomorphisms have been used in the study of optimal software testing protocols, called covering arrays. They optimize testing time when there are internal components known not to interact. Additionally they have prompted a powerful new way to study covering arrays in general, even outside this particular application instance. I will survey their application to this area and show that a previously known construction from design theory is most naturally viewed with graph products and homomorphisms.

Emergent Defect Dynamics in Cellular Automata

Speaker:
Marcus Pivato (Trent University)

Abstract:
Let $\Phi\colon A^Z \longrightarrow A^Z$ be a cellular automaton and let X be a Φ-invariant subshift of A^Z. Suppose x is a sequence in A^Z which is X-admissible everywhere except for a small region called a 'defect'. Empirically, such defects persist under iteration of Φ and propagate like 'particles'. We characterize the motion of these particles into several regimes, including simple deterministic motion, generalized random walks, and complex motion emulating Turing machines or pushdown automata.

A new algorithm to extract a hierarchy of web communities

Speaker:
Isheeta Nargis (Memorial U Newfoundland)

Abstract:
The web graph represents the structure of the world wide web by denoting each webpage as a vertex and each hyperlink as an arc. We propose a new algorithm based on iterative cycle contraction to extract a hierarchy of web communities. We also define a similarity measure between two vertices in the same community based on the iteration number when the vertices are first grouped into a shared community.

Monday May 28 at 12:05 in P1/L1/L2/L3

The Discharging Method and Its Applications for Graph Drawing

Speaker:
Radoš Radoičić (Baruch College CUNY), Géza Tóth (Rényi Inst)

Abstract:
We give a short introduction into the "discharging method", a general technique that has turned out to be useful in the proof of the four-color conjecture and many other important results on the colorings of graphs with low average degree. We describe some recent applications in discrete geometry, including Ackerman's theorem stating that the maximum number of edges that a graph with n vertices can have, if it can be drawn in the plane without four pairwise crossing edges, is $O(n)$. We also prove, for various instances of G, that if the intersection graph of n convex bodies in the plane contains no subgraph isomorphic to G, then its number of edges is $O(n)$, following up on the previous results of Pach and Sharir.

Right adjoints and Hedetniemi's conjecture

Speaker:
Claude Tardif (Royal Military College)

Abstract:
The *categorical product* $G \times H$ of two graphs G and H is the graph with vertex set $V(G) \times V(H)$, where two vertices (u, u') and (v, v') are adjacent if and only if u, v are adjacent in G and u', v' are adjacent in H. In 1966, Hedetniemi conjectured that the chromatic number of a categorical product of graphs can be expressed in terms of the chromatic numbers of the factors:
CONJECTURE: $\chi(G \times H) = \min\{\chi(G), \chi(H)\}$.

So far, the best result in this direction is the following result of El-Zahar and Sauer (1984):
THEOREM: $\chi(G \times H) = \min\{\chi(G), \chi(H)\}$ whenever $\min\{\chi(G), \chi(H)\} \leq 4$.

A *right adjoint* in the category of graphs is a construction Φ making a new graph $\Phi(G)$ out of a graph G, which commutes with the product: $\Phi(G \times H) = \Phi(G) \times \Phi(H)$. The best known example of a right adjoint is the "arc graph construction" δ in the category of digraphs: For a digraph $\vec{G}$, the vertices of $\delta(\vec{G})$ are the arcs (u, v) of $\vec{G}$, and the arcs of $\delta(\vec{G})$ are couples $((u, v), (v, w))$ of consecutive arcs of $\vec{G}$. Poljak and Rödl (1981) used the arc graph construction to expose our humbling state of knowledge about chromatic numbers of categorical products of graphs. Their result has been refined independently by Poljak, Schmerl and Zhu to the following:
THEOREM: If the function f defined by $f(n) = \min\{\chi(G \times H) : \chi(G) = \chi(H) = n\}$ is bounded, then its maximum is at most 9.

Of course, Hedetniemi's conjecture states that $f(n) = n$ for all n, so it is quite surprising that f is not known to be bounded on one hand, and yet precise upper bounds can be given in the case that f turns out to be bounded. Perhaps other right adjoint functors can help to refine the set of possible upper bounds for f, or to give positive results about Hedetniemi's conjecture. In this talk I will develop this topic further.

A Sequential Dynamical Systems Framework for Congestion-Aware Routing

Speaker:
Anders Å. Hansson (Los Alamos National Lab)

Abstract:
We study the flow dynamics of a class of computer network routing protocols over graphs through the

framework of sequential dynamical systems (SDS) with queue-sizes as states. The protocols, which are specified as local maps of an SDS, facilitate the transmission of unlabeled packets from a fixed source vertex to a fixed destination vertex D. The forwarding mechanism of vertex v takes the distance to D and the load of the v-neighbors as input parameters.

Cycles Embedding Problem in Hierarchical Hypercube Networks

Speaker:
Ruei-Yu Wu (National Taiwan University)

Abstract:
The hierarchical hypercube network is suitable for massively parallel systems. The number of links in the hierarchical hypercube network forms a compromise between those of the hypercube and the cube-connected cycles. Recently, some interesting properties of the hierarchical hypercube network were investigated. Since the hierarchical hypercube is bipartite. A bipartite graph is bipancyclic if it contains cycles of every even length from 4 to $|V(G)|$ inclusively. In this paper, we show that the hierarchical hypercube network is bipancyclic.

Monday May 28 at 14:00 in P1/L1/L2/L3

Graphs with Large Distinguishing Numbers

Speaker:
Michael O. Albertson (Smith College)

Abstract:
A labeling $c : V(G) \to \{1, 2, \ldots, r\}$ is said to be r-distinguishing if the only automorphism of G that preserves the labels is the identity. The distinguishing number, denoted by $D(G)$, is the minimum r for which G has an r-distinguishing labeling. Over the past few years there have been numerous distinguishing papers showing that for various families of graphs, almost all of the graphs have $D(G) = 2$. This talk will present a variety of graphs G with $D(G) > 2$ and offer open questions.

The fractional chromatic number of non-dominated coteries

Speaker:
Daya Gaur (Lethbridge), Kazuhisa Makino (Tokyo)

Abstract:
A coterie is an intersecting sperner family. Non-dominated coteries are of special interest in distributed systems. The complexity of determining whether a coterie is non-dominated is still open for more than 25 years now (a quasi-polynomial time algorithm is known).

We characterize exactly the fractional chromatic number of majority coteries, wheel coteries, crumbling wall coteries, and uniform Lovasz coteries. Our calculations establish that fractional chromatic number cannot be used to recognize non-dominated coteries.

We further strengthen the linear program for computing the fractional chromatic number, and show that determining whether a coterie is non-dominated is equivalent to determining feasibility of a given point in the new polytope.

On Minimum Path Cover in Interval Graphs

Speaker:
Barnaby Dalton (University of Toronto)

Abstract:
The minimum path-cover problem asks to find the minimum number of disjoint paths which cover a graph. The Hamiltonian path problem is the special case where the partition is a single path. The speaker presents an algorithm for finding the minimum path-cover for an interval graph and for finding a witness that no smaller path-cover exists. This certifying algorithm utilizes graph-search techniques: specifically two variants of depth-first search.

Edge intersection graphs of single bend paths on a grid

Speaker:
Michal Stern (U Haifa, Acad College Tel Aviv-Yaffo)

Abstract:
We define edge intersection graph EPG of paths on a grid to have vertices which correspond to the paths, such that two vertices are adjacent in EPG if the corresponding paths share an edge in the grid. We prove that any graph is EPG. For the case where each path has a single bend, denoted B_1-EPG, we prove that any tree is B_1-EPG, we give a structural property and characterize presentations of cliques and 4cycles.

Monday May 28 at 14:25 in P1/L1/L2/L3

Measuring Graph Symmetry using Determining Sets

Speaker:
Debra Boutin (Hamilton College)

Abstract:
It is well known that every isometry of $\mathbb{R}^2$ is uniquely determined by its action on a set of three non-collinear points. One can say such a set of points determines all the isometries of the plane. Similarly, a set of vertices of a graph is said to be *determining* if every graph automorphism is uniquely determined by its action on this set. The *determining number* of a graph is the minimum size of a determining set for the graph. This talk will discuss determining sets, some of their uses (*e.g.* finding distinguishing numbers), and give determining numbers for some graph families (*e.g.* Kneser graphs, hypercubes, Cartesian products).

Circular Colouring vs. Girth

Speaker:
Mohammad Ghebleh (Simon Fraser University)

Abstract:
The pentagon colouring problem of Nešetřil asks whether every cubic graph with arbitrary large girth maps to a 5-cycle. We present some alternate approaches to this problem as well as some partial results. In particular, we show that the pentagon colouring problem is false when girth is replaced by odd-girth.

The spectra of Manhattan Street Networks

Speaker:
F. Comellas, C. Dalfó, M.A. Fiol, Margarida Mitjana (U Politècnica de Catalunya)

Abstract:
Manhattan (Street) networks constitute a family of toroidal directed networks, which includes a class of Cayley digraphs with many interesting properties, such as easy routing, Hamiltonicity, and modular structure. In this work we completely determine the spectra of the 2-dimensional Manhattan networks. In addition some progress is made in the study of the spectra of the n-dimensional case. We prove that it contains the spectra of the n-cube and compute the corresponding eigenvectors.

Zero-Visibility Cops and Robber

Speaker:
Adrian Tang (University of Calgary)

Abstract:
This talk will present a version of the Cops and Robber pursuit game played on graphs. In this version, the cops are unable to see the location and movement of the robber. The goal is to find the minimum number of cops required to capture the robber on a given graph. I will present results of this problem on trees and present a relationship between this game and the path-width of a graph.

Monday May 14:55 in P1

Circular Choosability of Graphs

Speaker:
Xuding Zhu (National Sun Yat-sen University)

Abstract:
A (p,q)-*list assignment* L of a graph G assigns to each vertex v of G a set $L(v) \subseteq \{0,1,\ldots,p-1\}$ of permissible colours. A graph G is L-(p,q)-*colourable* if G has a (p,q)-colouring h such that $h(v) \in L(v)$ for each vertex v. This talk discusses for a given graph G, for which (p,q)-list assignments L, the graph G is L-(p,q)-colourable. In particular, circular t-choosability of graphs (in which case $|L(v)| = \lceil tq \rceil$ for each vertex v) and circular consecutive t-choosability of graphs (in which case $L(v)$ is a set of circular consecutive integers with $|L(v)| = \lceil tq \rceil$) will be discussed.

Monday May 28 at 16:15 in P1/L1/L2/L3

Edge-colourings of multigraphs

Speaker:
Michael Stiebitz, Diego Scheide (TU Ilmenau)

Abstract:
Let $f(D,m)$ denote the maximum of the edge-chromatic number $\chi'(G)$ over all graphs with maximum degree D and maximum multiplicity m. By Vizing's Theorem, $f(D,m) \leq D+m$. We ask when equality holds. We show that the gap between $f(D,m)$ and Vizing's bound $D+m$ can be arbitrarily large for $D \geq 2m$. That this is true for $D < 2m$ follows from Shannon's bound.

The Firefighter Problem

Speaker:
Gary MacGillivray (University of Victoria)

Abstract:
We discuss a problem that was introduced by Bert Hartnell in 1995. Imagine that, at time 0, a fire breaks out at a vertex of a graph G. At each subsequent time$t = 1, 2, \ldots$ the firefighter "defends" a vertex of G and then the fire spreads from each "burning" vertex to all of its undefended neighbours. Once a vertex is burning or defended, it remains so from then onwards. The process terminates when the fire can no longer spread. The main problem is to determine the maximum number of vertices that can be saved from burning, though a number of variations have received attention. We will survey questions, approaches and solutions that have arisen over the past 11.5 years.

Adaptive algorithms for locating faulty interactions

Speaker:
Lucia Moura (Ottawa), Conrado Martinez, Daniel Panario, Brett Stevens

Abstract:
Locating arrays are recent generalizations of covering arrays that can determine the exact locations of faulty interactions in a system. In this talk, we look at pairwise interactions and represent faulty interactions by edges of a graph. Under certain assumptions on the structure of this graph, we give an efficient adaptive algorithm that locates all errors. The algorithm is able to handle some cases in which locating arrays do not exist.

Unit Rectangle Visibility Graphs

Speaker:
Alice M. Dean (Skidmore College),
J. Ellis-Monaghan, S. Hamilton, G. Pangborn

Abstract:
A *unit rectangle visibility graph (URVG)* is a graph whose vertices can be represented by unit squares in the plane, with sides parallel to the axes, so that two vertices are adjacent if and only if there is a horizontal or vertical band of visibility between the corresponding squares. We characterize the complete graphs, complete bipartite graphs, and trees that are URVGs; give a tight edge bound; and show that any graph with linear arboricity ≤ 2 is a URVG.

Monday May 28 at 16:40 in P1/L1/L2/L3

Circular edge-coloring of cartesian products

Speaker:
Douglas B. West (University of Illinois), Xuding Zhu (National Sun Yat-Sen University)

Abstract:
The *circular chromatic index* $\chi'_c(G)$ is the least r such that some f mapping $E(G)$ to $[0, r)$ satisfies $1 \leq |f(e) - f(e')| \leq r - 1$ whenever e and e' are incident. Let $G = H \Box C_{2m+1}$, where $\Box$ denotes cartesian product and H is an $(s-2)$-regular graph of odd order, with $4 \mid s$. We prove a lower bound on $\chi'_c(G)$. When $H = C_{2k+1}$ and m is large, the lower bound is sharp. For example, if $m \geq 3k + 1$, then $\chi'_c(C_{2k+1} \Box C_{2m+1}) = 4 + 1/\lceil 3k/2 \rceil$.

The Watchman's Watch Problem

Speaker:
Bert Hartnell (St. Mary's University)

Abstract:
Consider the problem of a security firm that is asked to provide protection for a business by monitoring on a regular basis each node of a network. Each point of interest must either be visited or seen from a neighbouring point by a watchman but this need not be on a continuous basis. However, one wishes to either minimize the number of steps that the watchman takes or, the time between such monitorings. The limited progress made on this problem will be outlined.

Covering arrays avoiding forbidden configurations

Speaker:
Peter Danziger (Ryerson University), Eric Mendelsohn, Lucia Moura, Brett Stevens

Abstract:
In this talk we consider designing covering arrays when certain pairs of factors are prohibited from our test suites. Such situations arise naturally when certain configurations of the test parameters are to be avoided. For example, in drug testing certain pairs of drugs may have known interactions and produce unwanted side effects. We show that in the case where the alphabet size $g > 2$, the problem of designing a covering array avoiding a specified configuration is NP complete. We also consider possible solutions for $g = 2$.

On 3-Steiner Simplicial Elimination

Speaker:
Ortrud R. Oellermann (University of Winnipeg)

Abstract:
The Steiner interval of a set S of vertices of a connected graph G is the collection of all vertices in G that belong to some Steiner tree for S. A set X of vertices of G is k-Steiner convex ($k \geq 2$) if it contains the Steiner interval of every set of k vertices in X. A vertex $x \in X$ is a kSS vertex of X if $X \setminus \{x\}$ is also k-Steiner convex. Those classes of graphs for which every ordering produced by (i) LexBFS and (ii) MCS is a $3SS$ ordering are characterized.

Monday May 28 at 17:05 in P1/L1/L2/L3

Edge-coloring of cubic graphs with elements of Steiner triple systems

Speaker:
Daniel Král (Charles University), E. Máčajová (Comenius University), A. Pór (Charles University), J.-S. Sereni (Charles University)

Abstract:
A cubic graph G is S-edge-colorable for a Steiner triple system S if its edges can be colored with the points of S in such a way that the points assigned to three edges sharing a vertex form a triple in S. For every point-transitive Steiner triple system S, we characterize cubic graphs that are S-edge-colorable, verifying a conjecture of Holroyd and Škoviera [J. Combin. Theory Ser. B. 91 (2004), 57–66] for this case.

Eternal Dominating Sets in Graphs

Speaker:
Chip Klostermeyer (University of North Florida)

Abstract:
The eternal security number is the minimum number of guards needed to defend a graph from an arbitrary sequence of attacks, so each attack is defended by a guard at most distance one from the attack. We relate the independence number, eternal security number, and clique-covering number and show that any graph can be defended by $\binom{\alpha+1}{2}$ guards, where α is the independence number, and there exist graphs requiring this many guards.

Association Schemes and Set-Partition Systems

Speaker:
Karen Meagher (University of Waterloo)

Abstract:
In 1985 Mathon and Rosa described an association schemes on the 3×3 partitions based on how partitions intersect. This can be generalized to a coherent configuration on the $\ell \times k$ partitions. This raises two important questions. First, when does this define an association scheme? Second, how can we use the properties of the coherent configuration to determine the maximum set of partitions with a given pattern of intersection?

Gray codes for two-fold triple systems

Speaker:
Megan Dewar (Carleton University)

Abstract:
A κ-intersecting Gray code for a TS(v, λ) is a listing of the blocks of the design such that consecutive blocks intersect in exactly κ points. Every TS(v, λ) admits a 1-intersecting Gray cycle since a Hamilton cycle in the 1-block intersection graph (the existence of which was proved by Horák, Pike and Raines in 1999) is equivalent to such an ordering. When $\lambda = 1$, a 1-intersecting Gray code is the strongest possible minimal change ordering for the blocks of the design. A natural question to ask is: does a stronger minimal change ordering exist for higher λ? We show that for each admissible $v \equiv 1, 3, 4, 7 \pmod{12}$ there exists a TS$(v, 2)$ admitting a 2-intersecting Gray cycle for its blocks. When $v \equiv 1, 4, 7 \pmod{12}$ we show that these cycles are Universal cycles of rank three.

Monday May 28 at 17:30 in P1/L1/L2/L3

Injective colouring of graphs

Speaker:
André Raspaud (LaBRI, Université Bordeaux I)

Abstract:
A k-colouring of a graph G is a mapping from $V(G)$ to $\{0, 1, \ldots, k-1\}$. A colouring of a graph is *injective* if its restriction to any vertex neighbourhood is injective. The *injective chromatic number* $\chi_i(G)$ of a graph G is the least k such that there is an injective k-colouring. We will give a quick survey of old and new results about injective colouring and will focus on three results obtained recently.

Cops and Robber

Speaker:
Nancy E. Clarke (Acadia University)

Abstract:
In the Cops and Robber game, the opposing sides move alternately, where a move is to slide along an edge or pass. There is perfect information, and the cops win if at least one occupies the same vertex as the robber after a finite number of moves. In this talk, we survey the important results in the area. We then highlight results arising from games that are mixtures of Cops and Robber and Searching.

Constructions for optimal mixed covering arrays on graphs and hypergraphs

Speaker:
Christine Cheng (U Wisconsin-Milwaukee)

Abstract:
Let $\mathcal{I}$ be a set of n parameters and $\mathcal{O}$ be a collection of subsets of $\mathcal{I}$. Suppose each $I \in \mathcal{I}$ has $\kappa(I)$ data values. A test case is an n-tuple $(t_1, t_2, \ldots, t_n)$, where t_i is a data value of I_i, $i = 1, \ldots, n$. In this talk, we present families of $(\mathcal{I}, \mathcal{O}, \kappa)$ for which an optimal test suite that covers all combinations of each $O \in \mathcal{O}$ (i.e., an optimal mixed covering array on a hypergraph) can be constructed efficiently.

Rainbow Path-Free Complete Graphs

Speaker:
Peter Wagner (University of Rostock)

Abstract:
Motivated by questions in Ramsey theory, we consider colourings of the edges of the complete graph on n vertices that contain no rainbow path of size t. If fewer than t colours are used then certainly there is no such path. We show that, if at least t colours are used, then very few colourings are possible if $t \leq 5$, and these can be described precisely, whereas the situation for $t \geq 6$ is qualitatively different.

Monday May 28 at 17:55 in P1/L1/L2/L3

Equitable coloring: New proofs, theorems, and conjectures

Speaker:
Hal Kierstead (Arizona State University), Alexandr V. Kostochka (University of Illinois)

Abstract:
An equitable r-coloring of a graph is a proper coloring with r colors such that the sizes of any two of the r color classes differ by at most one. Hajnal and Semerédi answered a question of Erdős by proving that any graph with maximum degree r has an equitable $(r+1)$-coloring. We have found a simpler proof of this theorem that leads to further results and the formulation of new conjectures. I will discuss our progress.

Time Constrained Graph Searching

Speaker:
Danny Dyer (Memorial University of Newfoundland)

Abstract:
Using mobile agents (cops) to search a graph for a mobile intruder (a robber) is a well-studied graph theory problem. The most common question posed in these problems is: what is the least number of cops needed to catch the robber? We examine various search models instead trying to minimize the time needed to catch the robber, and also consider the trade-off between searchers and time using cost functions.

Empirical results and practical extensions: using covering arrays to test configurable software

Speaker:
Myra Cohen (University of Nebraska-Lincoln)

Abstract:
Covering arrays can be used for software interaction testing to detect faults caused by combinations of configuration options or features. In this talk we present empirical studies that examine the effectiveness of covering arrays for testing highly configurable software systems. We discuss common features of these systems that render covering array models infeasible and suggest extensions to the model of a covering array to make them more applicable to the software testing application domain.

On Arithmetic Progression With Odd Differences

Speaker:
J. Fox, Veselin Jungić (SFU), R. Radoičić.

Abstract:
We are interested in the following problem inspired by the Brown-Graham-Landman conjecture on large sets. For given $k, n \in \mathbb{N}$, how big can $A \subset \{1, 2, \ldots, n\}$ be so that A intersects each $i \pmod k$ class and is free of k-term odd difference arithmetic progressions?

Tuesday May 29 at 9:00 in P1

High Performance Computing, Business Analytics and Combinatorial Optimization

Speaker:
William R. Pulleyblank (IBM Global Business Services)

Abstract:
There have been two consistent drivers over the last sixty years of the evolution of computing: computer power and price/performance improve by a factor of two every eighteen months; the problems that we wish to solve require this growth in capability and more. This is particularly true in the area of business optimization, where global competitiveness requires speed and robustness of solution methods.

I will discuss this as it applies to combinatorial optimization, focusing on problems created by the most advanced parallel computing architectures. I will also describe some critical business problems: the need to handle massive data sets, to evolve from planning to operational systems, and to manage risk and uncertainty and corresponding opportunities for combinatorial optimization.

Tuesday May 29 at 10:20 in P1/L1–L4

On the successive face indices of convex bodies

Speaker:
Károly Bezdek (University of Calgary), Alexander Litvak (University of Alberta)

Abstract:
Let $\mathbf{K}$ be a convex body symmetric about the origin 0 in $\mathbf{R}^d, d \geq 2$. As usual, $\|x\|_{\mathbf{K}} = \inf\{\lambda > 0 \mid x \in \lambda \mathbf{K}\}$ denotes the norm of $x \in \mathbf{R}^d$ generated by $\mathbf{K}$. Now, we place $\mathbf{K}$ in a convex polytope, say $\mathbf{P}$. If F_m is an arbitrary m-dimensional face of $\mathbf{P}$ with $0 \leq m \leq d-1$, then let $\mathrm{dist}_{\mathbf{K}}(0, F_m) = \inf\{\|x\|_{\mathbf{K}} \mid x \in F_m\}$.

We introduce the *$m-$dimensional face index* $\mathrm{FI}_m(\mathbf{K})$ of the given 0-symmetric convex body $\mathbf{K}$ in the following way:

$$\mathrm{FI}_m(\mathbf{K}) = \inf_{\mathbf{P}} \left\{ \sum_{\mathbf{F_m} \in \mathcal{F}_\mathbf{m}(\mathbf{P})} \mathrm{dist}_{\mathbf{K}}(\mathbf{0}, \mathbf{F_m}) \mid \mathbf{K} \subset \mathbf{P} \right\},$$

where $\mathcal{F}_m(\mathbf{P})$ denotes the family of all m-dimensional faces of the convex polytope $\mathbf{P}$. We call the sequence $\mathrm{FI}_0(\mathbf{K}), \mathrm{FI}_1(\mathbf{K}), \ldots, \mathrm{FI}_{d-1}(\mathbf{K})$ the *successive face indices* of $\mathbf{K}$. In particular, we call $\mathrm{FI}_0(\mathbf{K})$ (resp., $\mathrm{FI}_1(\mathbf{K})$) the *vertex index* (resp., *edge index*) of $\mathbf{K}$. In the talk we give estimates on the successive face indices of 0-symmetric convex bodies.

Balanced Subdivision of Two Sets of Points in the Plane Lattice

Speaker:
Mikio Kano (Ibaraki U), Tomoharu Kawano (Ibaraki U) Miyuki Uno (Ibaraki U)

Abstract:
We consider a set R of red points and a set B of blue points lying on the plane lattice, where some points of $R \cup B$ may lie one the same line. A semi-vertical (semi-horizontal) line segment consists of two vertical (horizontal) line segments by connecting them by a line segment with length one. A semi-rectangular is defined to be a polygon consisting of one semi-vertical line segment and one semi-horizontal line segment emanating from the same point.

We first show that if $|R|$ and $|B|$ are even, there exists a semi-rectangular bisector of both R and B. We next consider general balanced subdivision problem in the case where $|R| = ag$, $|B| = bg$ and $g \geq 3$.

Applications of Discrete Mathematics to the Analysis of Algorithms

Speaker:
Conrado Martínez (U Politècnica Catalunya)

Abstract:
In this talk I will overview the field of Analysis of Algorithms, with a special emphasis in the mathematical areas which are at the heart of the field, and in particular, the fundamental role of discrete mathematics. During the talk I'll introduce some basic concepts and common techniques of the area. I'll be far from being exhaustive and cover the vast richness of field, but this talk should serve as an introduction for the rest of the talks of the minisymposium.

Generalized Cartesian Products and Vizing's Conjecture

Speaker:
Stephen Benecke (University of Victoria)

Abstract:
Confirming the truth of Vizing's well-known conjecture in domination theory, that $\gamma(G \Box H) \geq \gamma(G)\gamma(H)$, has enjoyed much attention in the literature. Given graphs G, H and a permutation

$\pi \in S_{|V(G)|}$, a generalized graph product $G *_\pi H$ is introduced, of which both the generalized prism graph πG and the Cartesian product $G \Box H$ are special cases. We conduct an investigation into the validity of a Vizing–like inequality $\gamma(G *_\pi H) \geq \gamma(G)\gamma(H)$ for this new graph product.

Approximation Algorithms for the k-path/tree/cycle Covering Problem

Speaker:
Binay Bhattacharya (SFU), Yuzhuang Hu (SFU)

Abstract:
Given an undirected complete graph G, the problem is to find a set of disjoint paths/trees/cycles with minimum cost to cover $V(G)$ where each path/tree/cycle contains at least k vertices. Imielinska, Kalantari and Khachiyan (1993) showed a 2-approximation algorithm for the k-tree covering problem. Goemans and Williamson(1995) also obtained the same bound using the primal dual approach. We give a different analysis from Goemans and Williamson and generalize their algorithm for a variation of this problem.

Tuesday May 29 at 10:45 in P1/L1–L4

On the Uniqueness, dimensional rigidity and global rigidity of bar-and-joint frameworks

Speaker:
Abdo Y. Alfakih (University of Windsor)

Abstract:
Let $V = \{1, \ldots, n\}$. A mapping $p : V \to R^r$ is called a configuration in R^r. Let $G = (V, E)$ be a graph. Then a configuration p together with graph G, where the points corresponding to adjacent vertices of G are constrained to stay the same distance apart, is called a framework, and it is denoted by $G(p)$. Two frameworks $G(p)$ in R^r and $G(q)$ in R^s are equivalent if $||q^i - q^j|| = ||p^i - p^j||$ for all $(i, j) \in E$, and $G(q)$ is not obtained from $G(p)$ via a rigid motion. In this talks we will discuss recent results concerning the problem of characterizing the uniqueness of $G(p)$ in R^r, and in all dimensions.

On the Integer Lattice in the Plane

Speaker:
Peter Hamburger (Western Kentucky), Robert Vandell (Indiana-Purdue), Matt Walsh (Indiana-Purdue)

Abstract:
In this talk we consider some known and new graphical parameters in subgraphs of the integer lattice in the plane, as well as (asymptotically) for the lattice itself. We determine some of the subsets that minimize these parameters, and we establish connections between them. If time allows we show how these results can be extended to subgraphs of the integer lattice, as well as (asymptotically) for the lattice itself in higher dimensional Euclidean spaces.

On Selection, Partial Sorting and Quicksort

Speaker:
Markus Kuba (Technische U Wien)

Abstract:
Quicksort is a well known sorting algorithm for sorting n given elements. It was voted one of top ten algorithms of the 20th century. It sorts by using a divide and conquer strategy: Pick one element as a "pivot", separate the remaining elements into piles of elements smaller or larger than the pivot. Apply this procedure recursively to the piles containing the smaller and larger elements, respectively. The related Quickselect algorithm (Hoare's FIND algorithm) solves the problem of finding the j-th smallest element in an array of n given elements by using a similar strategy as Quicksort.

Quicksort and Quickselect-type algorithms may be adapted for several problems as e.g. partial sorting, where one is interested in sorting the subarray of size m consisting of the first m elements, rather than sorting the whole array of size $n \geq m$. This variant is known as Partial Quicksort.

The analysis of these important algorithms requires the ability to solve certain recurrences. We present methods for obtaining solutions for the recurrences arising in the analysis of these algorithms. To be more specific, we present the solutions of the Quicksort recurrence and Quickselect recurrence with the simplest "splitting probability" $\pi_{n,k} = 1/n$. Here $\pi_{n,k}$ denotes the probability that element k is chosen as the pivot. Besides, results for more general splitting probability are also of interest. Furthermore, we present how one obtains limit laws for Quicksort, using the method of moments and solutions for Quicksort-type recurrences.

More Patterns in Trees: Up and Down, Young and Old, Odd and Even

Speaker:
Nachum Dershowitz (Tel Aviv and Microsoft Research), Shmuel Zaks (Technion)

Abstract:
Patterns are ordered trees with special leaves representing arbitrary or non-leaf subtrees and ellipses to span any number of subtrees. We extend our tree-pattern enumeration formula, developed previously, to include recent enumerations of distributions of leaves in ordered trees (by Chen, Deutsch, and Elizalde) and in bicolored ordered trees (Clark, McCanna, and Szeeeekely), and distributions of certain subpaths in Dyck lattice paths (by Y. Sun).

Finding independent sets of given weight: hard and easy cases

Speaker:
Martin Milanič (Rutgers University)

Abstract:
Motivated by the fact that the deterministic complexity of the exact perfect matching problem is still unsettled, we introduce and study the exact weighted independent set problem. We show that the problem is strongly NP-complete for cubic bipartite graphs, but solvable in pseudo-polynomial time for several other graph classes, including chordal graphs, circle graphs, AT-free graphs, distance-hereditary graphs, and graphs of bounded tree- or clique-width.
The talk is based on joint work with Jérôme Monnot (Université Paris-Dauphine).

Tuesday May 29 at 11:10 in P1/L1–L4

Minimizing the Number of Critical Vertices in Network Design

Speaker:
Hu Zhang, Tamás Terlaky (McMaster University), Anthony Vannelli (University of Guelph).

Abstract:
Given a weighted complete graph $G_K(V, E_K)$, we study a network design problem to find an edge set $E \subseteq E_K$ such that the graph $G(V, E)$ is connected. The power of a vertex u in G is the maximum weight of the edges in E incident with it. Minimizing the maximum vertex power is polynomial time solvable, while minimizing the number of critical vertices with this minimized maximum vertex power is NP-complete. For any fixed $\epsilon > 0$ we present a $(3/2 + \epsilon)$-approximation algorithm for the latter problem, and show that this ratio is tight.

Fixed Parameter Tractability in Geometry and Graph Drawing

Speaker:
Sue Whitesides (McGill University)

Abstract:
Fixed parameter tractability provides a systematic approach to dealing with seemingly intractable problems. While this approach has been explored extensively for combinatorial and graph theoretic problems, this is not yet the case for problems in geometry. Here we survey the area.

Optimality of Video-on-Demand Broadcast Protocols

Speaker:
David Kirkpatrick (University of British Columbia)

Abstract:
The design of efficient protocols for broadcast delivery of video content has been an area of active research for more than a decade. The goal typically is to minimize delay d, before playback can begin, as a function of the communication bandwidth (and video length). This talk addresses the intrinsic cost of such communication.

Our main focus is on recent results on the intrinsic average delay. While worst-case optimal protocols are not necessarily average-case optimal, we show that the optimal average delay is at most a (small) constant factor less than the optimal worst-case delay, when server and receiver bandwidths are the same.

Shortest cycle covers and Fano colourings

Speaker:
Edita Máčajová (Comenius University)

Abstract:
In this talk we establish - within the class of cubic graphs - connections of the conjecture of Alon and Tarsi claiming that every bridgeless graph has a cycle cover of total length at most $(7/5)|E|$ to other conjectures. Namely, we discuss a relationship to the conjecture saying that each bridgeless cubic graph admits a Fano colouring which uses at most five lines of the Fano plane, as well as a connection to the celebrated Fulkerson conjecture.

Packing Edge-Disjoint Cycles: Algorithms and Hardness

Speaker:
Zachary Friggstad (University of Alberta)

Abstract:
The *Edge-Disjoint Cycle Packing* problem is to find the largest collection of cycles in a graph which are pairwise edge-disjoint. Motivated by results for a related problem (Seymour, 1995), we study fractional and integral packings of cycles. A recent algorithm (Krivelevich *et al.*, 2005) produces an integral solution that is within $O(\sqrt{\log n})$ of the optimal fractional solution while improving this approximation guarantee was left as an open problem. We show that this guarantee is essentially the best possible and produce a hardness of approximation result.

Tuesday May 29 at 11:35 in P1/L1–L4

Facet Generation and Symmetric Triangulation

Speaker:
David Bremner (University of New Brunswick)

Abstract:
A crucial step in many linear optimization procedures is the generation of *cuts* or implicit constraints violated by a proposed solution. Several cut generation procedures rely on the generation of *facets* (which define a minimal description of a polyhedral set). In this talk I will discuss generating equivalence classes of facets up to some symmetry relation; I will concentrate on a method that amounts to computing a symmetric triangulation of the boundary of a polyhedron, i.e. a triangulation with a large symmetry group acting on its simplices.

Intersection Graphs of Convex Sets

Speaker:
Jan Kratochvil (Charles University), Martin Pergel (Charles University)

Abstract:
Intersection graphs of geometrical objects in the plane have attracted a lot of attention both for their practical motivation and for their interesting theoretical properties. We will discuss several recent results and long standing open problems on intersection graphs of convex sets (and their subclasses - intersection graphs of straight line segments and intersection graphs of convex polygons inscribed in a circle).

Smallest Components in Decomposable Structures with a Restricted Pattern

Speaker:
Li Dong (Carleton University)

Abstract:
We study combinatorial decomposable structures with restricted patterns. We focus on decomposable structures in the exp-log class. Examples of objects in this class are permutations, 2-regular graphs and polynomials over finite fields, among others.

We provide an estimate for the probability that a decomposable structure has a given restricted pattern. In addition to the restricted pattern, we further consider the probability that the size of the rth smallest component be bigger than a given integer k.

Homomorphism dualities and homomorphism order

Speaker:
Jan Foniok (Charles University)

Abstract:
We investigate situations where the existence of a homomorphism from a fixed digraph G to some digraph in a finite family is determined by forbidding homomorphisms to G from another finite family of digraphs („finite homomorphism dualities“). A connection to finite maximal antichains in the homomorphism order will be shown as well as generalisations for relational structures, or even more generally Cartesian closed categories and Heyting algebras. (Based on joint work with J. Nešetřil and C. Tardif.)

k-traceable oriented graphs

Speaker:
S. van Aardt, J. Dunbar, M. Frick, Morten H. Nielsen (Winnipeg), O. Oellermann

Abstract:
A digraph D of order n is *traceable* if it contains a spanning path and it is *k-traceable* (some $k \in \{1, 2, \ldots, n\}$) if every set of k vertices induces a traceable subdigraph of D. We consider the question, what is the largest integer $2 \leq p(n) \leq n$ such that every oriented graph, which is k-traceable for some $k \in \{2, 3, \ldots, p(n)\}$, is traceable? We conjecture $p(n) \geq \lceil \frac{n}{2} \rceil$ and present some partial results. This question is relevant in the context of the Path Partition Conjecture.

Tuesday May 29 at 12:00 in P1/L1–L4

Central Path & Edge Path: Curvature & Diameter

Speaker:
Antoine Deza, Eissa Nematollahi, Tamás Terlaky, Yuriy Zinchenko (McMaster University)

Abstract:
It was shown recently that the central path can be bent along the simplex path of Klee-Minty cubes. This lead to tightening the iteration complexity bound of central path following interior point methods. Further, intriguing analogs between edge-paths and central paths arise. We conjecture that the order of the largest total curvature of the central path is the number of inequalities, and that the average diameter of a bounded cell of an arrangement is less than the dimension. We substantiate these conjectures and prove a continuous analog of the d-step conjecture.

Pencils with Many Incidences

Speaker:
Mei-Chu Chang (University of California, Riverside), József Solymosi (University of British Columbia)

Abstract:
For $P \neq Q$, $L(P,Q)$ denotes the line through P, Q.

Our first result is the following; Given $c > 0$, there is $\delta > 0$ such that for any P_1, P_2, P_3 noncollinear, and $Q_1, \cdots, Q_n \in C^2$ if $|\{L(P_i, Q_j) : 1 \leq i \leq 3, 1 \leq j \leq n\}| \leq cn^{1/2}$, then for any $P \in C^2$, $P \neq P_i$, we have $|\{L(P, Q_j) : 1 \leq j \leq n\}| \geq \delta n$.

To prove the inequality, we invoke the subspace theorem, proved by W.M. Schmidt in 1972, which gives a bound on the number of 'nondegenerate' solutions of a linear equation in a multiplicative group.

We also show that there is $\delta > 0$ such that for any P_1, P_2, P_3, P_4 if for some pointset $Q_1, \cdots, Q_n \in C^2$ $|\{L(P_i, Q_j) : 1 \leq i \leq 4, 1 \leq j \leq n\}| \leq cn^{1/2+\delta}$, then the four points, P_1, P_2, P_3, P_4, are collinear.

Average-case analysis of perfect sorting by reversals

Speaker:
Cedric Chauve, Marni Mishna (SFU)

Abstract:
sorting by reversals is used to compute a genomic distance between genomes represented by signed permutations. This problem can be attacked with tools from the modular decomposition of permutation graphs. Here, we use this relationship, generating functions, and methods of analysis of algorithms to get several results on the average case analysis of perfect sorting by reversals. In particular we show evidence that this problem can be solved in polynomial average time.

Colourings of graphs with prescribed cycle lengths

Speaker:
Stephan Matos Camacho
(TU Bergakademie Freiberg)

Abstract:
Erdös and Bollobás conjectured that graphs with exactly k odd distinct cycle lengths are $2k + 1$-colourable, unless they are isomorphic to a K_{2k+2}. In 1992 Gyárfás confirmed this.

If we focus on graphs with exactly two distinct odd cycle lengths this estimation turns out to be not sharp if there is no triangle in the graph. We will show that graphs with two consecutive odd lengths are already 4-colourable.

Coflow and Covering Vertices by Directed Circuits

Speaker:
Cathie Cameron (Wilfred Laurier), Jack Edmonds

Abstract:
Let G be any digraph such that each edge and each vertex is in a dicircuit. Let $d(v)$ be non-negative integers for vertices v, and $d(e)$ be non-negative integers for edges e. The capacity $d(C)$ of a dicircuit C means the sum of the d's of the vertices and edges in C. A version of the Coflow Theorem (1982) says:

the max cardinality of a subset S of the vertices of G such that each dicircuit C of G contains at most $d(C)$ members of S equals the minimum of the sum of the capacities of any subset H of dicircuits of G plus the number of vertices of G which are not in a dicircuit of H.

A feedback set in G means a subset F of its edges (minimal by inclusion) such that $G - F$ is acyclic. It is interesting to apply the Coflow Theorem to G and a feedback set F by letting $d(e) = 1$ for each e in F and letting the other d's be 0.

A feedback set F is called coherent if every edge of G is in some dicircuit which contains at most one member of F. That any G has a coherent feedback set is equivalent to a theorem of Bessy and Thomassé. Applying the Coflow Theorem to G with a coherent F yields immediately the following recent theorem of Bessy and Thomassé, conjectured by Gallai in 1963:

For any digraph G such that each edge and each vertex is in a dicircuit, the maximum number of vertices in G such that no two of them are joined by an edge is at least as big as the minimum number of dicircuits which together cover all the vertices.

Tuesday May 29 at 14:30 in P1

You Can Do Physics

Speaker:
Peter Winkler (Dartmouth College)

Abstract:
What's up with combinatorics and statistical physics? One special year after another, at IAS/DIMACS, Newton Institute, MSRI, DIMACS again, Newton again, Schrodinger Institute... almost the whole fundamental research effort at Microsoft... articles in SIAM Discrete, STOC, FOCS, SODA...

Simply put, combinatorialists and statistical physicists have discovered that they are trying to understand similar phenomena, but with different methods (and vocabulary). In this talk I'll describe the most combinatorial of physical models, show you some cool stuff combinatorialists and physicists have already done with them, and explain why you may already have what it takes to do more.

Tuesday May 29 at 15:50 in P1/L1–L4

Counting matchings and independent sets of a fixed size

Speaker:
Teena Carroll (Georgia Tech), David Galvin (U Penn), Prasad Tetali (Georgia Tech)

Abstract:
A matching in a graph is a collection of edges no two of which share a vertex. An independent set is a collection of vertices no two of which are spanned by an edge. Both matchings and independent sets arise as configurations in well-studied studied statistical physics models, namely the dimer model and the hard-core model. A theorem of Bregman implies that among all d-regular, N-vertex bipartite graphs, the one with the most matchings of size $N/2$ (the maximum possible size) is the graph $K(N,d)$ composed of the disjoint union of $N/2d$ complete d-regular bipartite graphs. Recently Friedland et al. have conjectured that among d-regular, N-vertex bipartite graphs, $K(N,d)$ admits the most matchings of size k for any $0 \leq k \leq N/2$. In this talk we report on work in progress using methods from information theory to provide asymptotic evidence for Friedland's conjecture, and its natural analog for independent sets.

Proper path-factors and interval edge-coloring of $(3,4)$-biregular bigraphs

Speaker:
Armen S. Asratian (Linköping), Carl Johan Casselgren (Umeå), Jennifer Vandenbussche (Illinois), Douglas B. West (Illinois)

Abstract:
An *interval coloring* is a proper edge-coloring, using integers, such that the colors on the edges incident to any vertex are consecutive. A bipartite graph is $(3,4)$-*biregular* if vertices of one part have degree 3 and vertices of the other have degree 4; it is unknown whether these all have interval colorings. We prove that they do when there is a spanning subgraph whose components are paths with endpoints at 3-valent vertices and lengths in $\{2,4,6,8\}$, and we discuss when such a subgraph exists.

Covering graphs with cliques and independent sets

Speaker:
Tinaz Ekim (Ecole Polytechnique de Lausanne), John Gimbel (University of Alasaka)

Abstract:
A graph is called (j,k)-colorable if its vertex set can be partitioned into j independent sets and k cliques. We study the parameter c(j,k) which is the largest integer n with the property that every graph of order n has a (j,k)-coloring. Let z(G) = minj+k : G is (j,k)-colorable and s(G) = mink : G is (k,k)-colorable. We give results on graphs for which s(G) $\leq$ z(G) or z(G) $\leq$ 2s(G) holds with equality.

Association schemes and their applications

Speaker:
Chris Godsil (University of Waterloo)

Abstract:
I will present an introduction to association schemes and to some of the ways in which they can be applied to combinatorial problems.

Characterizing Euler Diagrams

Speaker:
Stirling Chow (University of Victoria)

Abstract:
The Olympic rings are an example of an Euler diagram; their interiors divide the plane into regions, each of which represents a certain single or pairwise subset of five elements. The Euler Diagram Generation Problem asks us to draw Jordan curves so that the overlap of their interiors represents a particular collection of subsets. In this work, we develop a dual graph representation for Euler diagrams and provide necessary-and-sufficient conditions for their existence.

Tuesday May 29 at 16:15 in P1/L1–L4

Correlation decay in statistical physics and applications to counting problems

Speaker:
David Gamarnik, Dmitriy Katz (MIT)

Abstract:
We propose new types of deterministic approximation algorithms for solving certain counting problems. Our technique builds on the notion of correlation decay, which originates in statistical physics in connection to the uniqueness property of Gibbs measures on infinite lattices. Using this technique we construct polynomial time approximation algorithms for some counting problems, including the problem of counting the number of matchings in a constant degree graph, the problem of counting proper colorings of a constant degree graph satisfying certain degree requirement, and the problem of computing a permanent of a graph satisfying some expansion property.

Chromatic invariants and Borsuk-Ulam-type theorems

Speaker:
Gábor Simonyi (Rényi Inst), Gábor Tardos (SFU and Rényi Inst)

Abstract:
If a certain topological invariant gives a sharp lower bound on $\chi(G)$, then the optimal colorings contain all completely multicolored complete bipartite graphs on $\chi(G)$ vertices. When allowing one more color, one can often avoid all but a few such subgraphs. The proofs use Tucker–Bacon and Ky Fan variants of the Borsuk–Ulam Theorem. We discuss consequences for local chromatic number and circular chromatic number of Kneser graphs, (generalized) Mycielski graphs, and their relatives.

Mixed Graph Coloring

Speaker:
Bernhard Ries (EPL), Dominique de Werra (EPL)

Abstract:
We consider a coloring problem in mixed graphs (i.e. graphs containing edges and arcs): we want to associate a color (integer) to each vertex such that any two vertices linked by an edge have different colors and the tail of an arc has a color strictly less than the head of this arc. We present bounds on the mixed chromatic number and we give some complexity results which strengthen former results.

Covering arrays on graphs

Speaker:
Karen Meagher (University of Waterloo)

Abstract:
In this talk I will describe a generalization of covering arrays, covering arrays on graphs. The original motivation for this generalization was for improving applications of covering arrays to testing systems and networks, but this extension also gives us new ways to study covering arrays. In particular, the addition of a graph structure to covering arrays makes it possible to use methods from graph theory to study these designs. In this talk, I will describe a family of graphs called the *qualitative independence graphs*. Understanding these graphs will help understand covering arrays on graphs and standard covering arrays.

The VC-Codimension

Speaker:
Dennis D.A. Epple (University of Victoria)

Abstract:
For a family $\mathcal{F} \subseteq 2^{[n]}$ define its *VC-Codimension* as the maximum cardinality k such that $\mathcal{F} \cap A = 2^A$ for all $A \in 2^{[n]}$ with $|A| = k$, where $\mathcal{F} \cap A := \{F \cap A | F \in \mathcal{F}\}$ is the trace of A in $\mathcal{F}$. The talk will explore the connections between the VC-Codimension and the well-known VC-Dimension and exhibit sharp upper bounds (and not quite as sharp lower bounds) on the cardinality of families with given VC-Codimension. A sharp lower bound is attained for VC-Codimension two using the Kruskal-Katona theorem.

Tuesday May 29 at 16:40 in P1/L1–L4

A rigorous analysis of the Cavity Method for counting matchings

Speaker:
Mohsen Bayati (Stanford University), Chandra Nair (Microsoft Research)

Abstract:
I will describe the use of the Cavity Method for counting the number of matchings in a graph. In particular, I will describe how Mézard and Zdeborová (2006) have applied this method to get an efficient method for counting matchings. The Cavity Method is a very successful heuristic from statistical physics and widely applicable to problems in combinatorial optimization and coding theory. Its validity is mostly supported by simulations and it is, therefore, important to rigorize its use. In this talk, I will rigorously prove the validity of the cavity equations in the context of counting the number of matchings in large girth graphs.

Local chromatic number of odd quadrangulations

Speaker:
Bojan Mohar (SFU), Gábor Simonyi (Rényi Inst), Gábor Tardos (SFU and Rényi Inst)

Abstract:
It is well known that an odd quadrangulation has no proper 3-coloring. A quadrangulation (of a non-orientable surface) is *odd* if orienting the faces yields an odd number of inconsistent edges. The *local chromatic number* is at least 4 when in any proper coloring some vertex has three neighbors with different colors. We sketch three proofs of the original theorem and then show that any odd quadrangulation of a surface of genus at most 4 has local chromatic number at least 4. The same is not true for larger genus.

Knowledge States: A Tool in Randomized Online Algorithms

Speaker:
Wolfgang Bein (University of Nevada, Las Vegas)

Abstract:
We introduce the novel concept of knowledge states; many well-known algorithms can be viewed as knowledge state algorithms. The knowledge state approach can be used to to construct competitive randomized online algorithms and study the tradeoff between competitiveness and memory.

Association schemes in complex systems of lines

Speaker:
Aidan Roy (University of Calgary)

Abstract:
In the 1970's, Delsarte, Goethals and Seidel used linear programming bounds to show that if a spherical code is also a spherical design of sufficient strength, then it has the structure of an association scheme. Recently, Bachoc and others have extended those bounds to the real Grassmannian spaces. In this talk, we review the LP method and use it to find association schemes in the complex Grassmannian spaces.

On persistent directed graphs

Speaker:
Jørgen Bang-Jensen (U Southern Denmark)

Abstract:
The concept of persistent directed graphs, closely related to rigidity of undirected graphs, was introduced by Hendrickx et al. to help analysing the stability in autonomous agent systems. They provided a combinatorial characterization for persistence but the complexity of testing persistence remained open. In this talk we point out that for directed graphs D with $\sum_{v\in V(D)} \min\{\delta_D(v), 2\} \leq 2|V| - 3$ persistence can be tested in polynomial time (here $\delta_D(v)$ denotes the out-degree of vertex v). This family of directed graphs includes acyclic digraphs (for which an efficient algorithm was known) as well as all digraphs with a leader-follower structure. We also discuss some related orientation problems. In particular we show that every rigid graph $G = (V, E)$ with $|E| = 2|V| - 2$ has a persistent orientation in which we can specify a vertex to have outdegree zero and another to have outdegree 1.

Tuesday May 29 at 17:05 in P1/L1–L4

Spectral Radius, Dobrushin Uniqueness and Rapid Mixing

Speaker:
Tom Hayes (Toyota Tech Inst)

Abstract:
Spin systems are a general model of local interactions between nodes in a graph. Well-known examples include the Ising model for magnetization and the hard-core (independent sets) model for gas dynamics. *Dobrushin uniqueness*, a notion dating back

to 1970, refers to the condition that the combined "influence" of other sites on any one site is not too large. This condition implies Gibbs uniqueness, which is an asymptotic decay of correlations between spins of sites at large distances. It also implies rapid convergence of the single-site heat-bath (or Glauber) dynamics for the spin system. Glauber dynamics are a class of Markov chains widely used in sampling and approximate counting.

I will discuss a natural spectral generalization of Dobrushin's condition, namely that the maximum eigenvalue, or spectral radius, of the influence matrix is not too large. This condition implies rapid mixing of the Glauber dynamics, but not always Gibbs uniqueness. I will try to demonstrate through examples that this is the "right" way to think about Dobrushin's condition in the context of rapid mixing.

Generalized coloring and uniquely colorable graphs

Speaker:
Peter Mihók (Math Inst Slovak Acad Sci)

Abstract:
In "generalized coloring", $\mathcal{P}_1, \ldots, \mathcal{P}_n$ are graph properties (families), and a $(\mathcal{P}_1, \ldots, \mathcal{P}_n)$-*partition* of G is a partition $(V_1, \ldots, V_n)$ of $V(G)$ such that each induced subgraph $G[V_i]$ satisfies $\mathcal{P}_i$. The property $\mathcal{P}_1 \circ \cdots \circ \mathcal{P}_n$ is the set of $(\mathcal{P}_1, \ldots, \mathcal{P}_n)$-partitionable graphs. If $\mathcal{R}$ is a product of other properties, then $\mathcal{R}$ is *reducible*. A graph G is *uniquely* $(\mathcal{P}_1, \ldots, \mathcal{P}_n)$*-colorable* if it has exactly one $(\mathcal{P}_1, \ldots, \mathcal{P}_n)$-partition. We survey unique colorability for additive hereditary properties. We show that a reducible property $\mathcal{P}_1 \circ \cdots \circ \mathcal{P}_n$ is generated by uniquely $(\mathcal{P}_1, \ldots, \mathcal{P}_n)$-colorable graphs. In particular, uniquely $(\mathcal{P}^n)$-partitionable graphs exist if and only if $\mathcal{P}$ is irreducible.

Fault-Tolerant Search Trees

Speaker:
Doina Bein (University of Texas at Dallas)

Abstract:
For any given tree, two new types of fault-tolerant search structure, called a min-max search tree, and a max-min search tree (both abbreviated M2ST) can be defined recursively and achieve better time complexities for the usual operations on search structures than the binary search tree. The predecessor and the successor of any node in the tree can be defined. Find, insert, and delete take time proportional to the height of the tree, that is $O(log(n))$ time on the average (where n is the total number of nodes in the tree), while retrieving the successor or predecessor of a value in the tree takes $O(1)$ time.

Inequalities for binary codes from the Terwilliger algebra

Speaker:
William J. Martin (Worcester Poly, visiting MIT), T. Visentin

Abstract:
In this talk, we derive new linear inequalities for the biweight enumerator of a binary code using the Terwilliger algebra. The minimal rank positive semidefinite matrices in the T-algebra are shown to be precisely the matrices representing orthogonal projection onto irreducible S_n-submodules and explicit forms for the corresponding inequalities are derived. A comparison to Schrijver's semidefinite programming approach and an initial application will be included.

New sufficient conditions for the existence of kernel in infinite digraphs

Speaker:
Mucuy-kak Guevara (U Nacional Aut México)

Abstract:
A kernel N of a digraph D is an independent and absorbent set of vertices of D. D is akernel perfect digraph, if every induced subdigraph of D has a kernel. We introduce theconcept of semikernel modulo a set of arcs to give sufficient conditions for an infinite-digraph to be a kernel perfect digraph. As consequence, we obtain sufficientconditions to assure when some kind of digraphs and all the possible union are kernelperfect.

Tuesday May 29 at 17:30 in P1/L1–L4

First-passage percolation on a width-2 strip and the path cost in a VCG auction

Speaker:
Abraham Flaxman (Microsoft Research)

Abstract:
We study the time constant for first-passage percolation, and the Vickery-Clarke-Groves (VCG) payment for the shortest path, on a width-2 strip with random edge costs. These statistics attempt to describe two seemingly unrelated phenomena, arising in physics and economics respectively: the first-passage perco-

lation time predicts how long it takes for a fluid to spread through a random medium, while the VCG payment for the shortest path is the cost maximizing social welfare among selfish agents. However, our analyses of the two are quite similar, and require solving (slightly different) recursive distributional equations. Using Harris chains, we can characterize distributions, not just expectations.

On two conjectures about induced forests in planar graphs

Speaker:
Mohammad R. Salavatipour (University of Alberta)

Abstract:
Albertson and Berman conjectured in 1979 that every planar graph on n vertices has an induced forest of size at least $n/2$. Akiyama and Wanatabe conjectured in 1987 that every bipartite planar graph on n vertices has an induced forest of size at least $5n/8$. The best known results regarding these two conjectures give bounds of $2n/5$ and $(17n+24)/32$, respectively. We improve on the second result by showing that every bipartite planar graph has an induced forest of size at least $(9n+12)/16$.

A Constructive Algorithm for Max-Min Paths Problems on Networks

Speaker:
Stefan Pickl (U Bundeswehr München)

Abstract:
Max-min paths problems on networks are in the main center of interest.They typically arose as an auxiliary problem within the study of a special class of discrete min-max control models and within so-called cyclic games. These problems generalizes the well-known combinatorial problem of the shortest and the longest paths in a weighted directed graph. A polynomial-time algorithm for determining the tree of max-min paths in networks is proposed. Furthermore we apply it for the solution of special zero value cyclic games.

A strengthening of the Assmus-Mattson theorem based on the displacement and split decompositions

Speaker:
Hajime Tanaka (Worcester Poly)

Abstract:
The Assmus-Mattson theorem states that the supports of the words of a fixed weight in a linear code form a combinatorial t-design under certain conditions. In this talk, we look at this theorem from the viewpoint of the Terwilliger algebra, exploiting Terwilliger's recent result on the displacement and split decompositions. In particular, this approach shows that the Assmus-Mattson theorem is valid for non-linear codes as well.

Large near optimal Golomb rulers

Speaker:
Apostolos Dimitromanolakis (Toronto), Apostolos Dollas (TU Crete)

Abstract:
A set of integers is a Golomb ruler if all pairwise differences of its elements are distinct. Golomb rulers have many applications and pose a simple, yet very difficult optimization problem. It is unknown if rulers of sub-quadratic size exist for any number of marks. We describe algorithms used for a search that yielded such near-optimal rulers with up to 65000 elements, whereas previous results for up to 150 elements were known.

Tuesday May 29 at 17:55 in P1/L1–L4

Integral point sets

Speaker:
Sascha Kurz (University of Bayreuth)

Abstract:
An integral point set $\mathcal{P}$ is a set of n points in the m-dimensional Euclidean space $\mathbb{E}^m$ with pairwise integral distances, where the largest occurring distance is called its diameter $\mathrm{diam}(\mathcal{P})$. For the minimum diameter $d(m,n)$ we give some exact numbers and bounds. We answer a famous question of P. Erdős on seven points in the plane, no three on a line, no four on a circle with pairwise integral distances.

Bounding χ in terms of ω and Δ for quasi-line graphs

Speaker:
Andrew King (McGill), Bruce Reed (McGill)

Abstract:
A *quasi-line* graph is a graph in which the neighbourhood of any vertex can be covered by two cliques. Reed conjectured that for any graph G, $\chi(G) \leq \lceil \frac{1}{2}(\Delta(G)+1+\omega(G)) \rceil$. We prove that the conjecture holds if G is a quasi-line graph, extending a result of King, Reed and Vetta and improving the bound of $\chi(G) \leq \frac{3}{2}\omega(G)$ given by Chudnovsky and Ovetsky.

Environment A New Mathematical Approach in Environmental Protection: Gene-Networks

Speaker:
Gerhard Wilhelm Weber (Middle East Tech), Marat U. Akhmet (Middle East Tech)

Abstract:
This paper surveys and improves recent advances in understanding the mathematical foundations and interdisciplinary implications of the newly introduced gene-environment networks. Given the data from DNA microarray experiments and environmental records, we analyze the topological landscape of gene-environment networks in its structural stability. With an example and some further perspectives we conclude.

Distance-regular graphs and the quantum affine $\mathfrak{sl}_2$ algebra

Speaker:
Paul Terwilliger (Wisconsin-Madison)

Abstract:
Let Γ denote a distance-regular graph with classical parameters (D, b, α, β) and $b \neq 1$, $\alpha = b-1$. The condition on α implies that Γ is formally self-dual. For $b = q^2$ we use the adjacency matrix and dual adjacency matrix to obtain an action of the q-tetrahedron algebra $\boxtimes_q$ on the standard module of Γ. We describe four algebra homomorphisms into $\boxtimes_q$ from the quantum affine algebra $U_q(\widehat{\mathfrak{sl}}_2)$; using these we pull back the above $\boxtimes_q$-action to obtain four actions of $U_q(\widehat{\mathfrak{sl}}_2)$ on the standard module of Γ.

Linear-time certifying algorithms for near-graphical sequences

Speaker:
David Kirkpatrick (U British Columbia)

Abstract:
Graphical degree sequences have been extensively studied and admit several elegant characterizations. We are interested in extending these characterizations to arbitrary degree sequences by introducing a natural measure of "near-graphical". We do this in the context of minimum deficiency (g, f)-factors of complete graphs. Our main result is a simple linear-time greedy algorithm for constructing minimum deficiency (g, f)-factors in complete graphs that generalizes the method of Hakimi and Havel (for constructing 0-deficiency (f, f)-factors in complete graphs, when possible). It has the added advantage of producing a certificate of minimum deficiency (through a generalization of the Erdös-Gallai characterization of 0-deficient (f, f)-factors in complete graphs) at no additional cost.
[Based on joint work with Pavol Hell.]

Wednesday May 30 at 9:00 in P1

Graph limits and the similarity of large graphs

Speaker:
Vera T. Sós (Rényi Institute)

Abstract:
In the lecture I give a survey on some joint work with Christian Borgs, Jennifer Chayes, Laszlo Lovász and Kati Vesztergombi. We define the distance of two graphs that reflects the similarity, the closeness of both local and global properties. We also define several natural notions of convergence of sequences of graphs. We show that these notions of convergence are equivalent and a sequence is convergent if and only if it is Cauchy in the given distance. Our results can also be viewed as a generalization of the theory of quasirandom graphs.

Wednesday May 30 at 10:20 in P1/L1–L4

Regularity, stability, and Ramsey numbers

Speaker:
Jozef Skokan (London School of Economics and University of Illinois, Urbana-Champaign)

Abstract:
For graphs $G_1, G_2, ..., G_r$, the Ramsey number $R(G_1, G_2, ..., G_r)$ is the smallest positive integer N such that if we colour the edges of the complete graph K_N with r colours, then at least one colour class contains a subgraph isomorphic to G_i. Very little is known about $R(G_1, G_2, ..., G_r)$ for $r \geq 3$ even for very special graphs $G_1, G_2, ..., G_r$.

We will survey the results and outline how the regularity lemma of Szemerédi and stability theorems help to find the exact values of three-colour Ramsey numbers for cycles.

Orientable Closed 2-cell Embeddings of Toroidal Graphs

Speaker:
Mark Ellingham (Vanderbilt University), Xiaoya Zha (Middle Tennessee State University)

Abstract:
The Orientable Strong Embedding Conjecture states that every 2-connected graph has a closed 2-cell embedding in some orientable surface, i.e., an embedding in an orientable surface such that the closure of each face is homeomorphic to a closed disk (equivalent to saying that each face is bounded by a cycle of the graph). This is probably the strongest conjecture along the lines of the Cycle Double Cover Conjecture. In this talk, we give a preliminary report on our research on torus embeddable graphs. We develop surface surgeries which convert toroidal 1-representative embeddings of cubic graphs directly to 2-representative embeddings in some orientable surface. By applying these surgeries we show that (1) all 2-connected cubic toroidal graphs have closed 2-cell embeddings in some orientable surfaces, and (2) all 2-connected toroidal graphs have orientable cycle double covers, i.e., the Orientable Strong Embedding Conjecture is true for cubic toroidal graphs and the Orientable Cycle Double Cover Conjecture is true for toroidal graphs.

Eigenvalues of $(3, 6)$-polyhedra

Speaker:
Matt DeVos, Luis Goddyn, Bojan Mohar, Robert Šámal (SFU)

Abstract:
A $(3, 6)$-polyhedron is a cubic planar graph in which all faces are of size 3 or 6. It was conjectured by Fowler et al. that the spectrum of any $(3, 6)$-polyhedron consists of pairs of opposite values λ, $-\lambda$, and four exceptional eigenvalues $\{3, -1, -1, -1\}$.

We prove this conjecture by expressing each $(3, 6)$-polyhedron as a Cayley sum graph.

Pivot and Gomory Cut

Speaker:
Shubhashis Ghosh (Alberta),
Ryan Hayward (Alberta)

Abstract:
We present Pivot and Gomory Cut, a mixed integer program feasibility heuristic that integrates Gomory cuts into the simplex-based pivoting framework of Balas and Martin's Pivot and Complement heuristic. On a standard test suite compiled from MIPLib and other sources, PGC performs comparably to the best known feasibility heuristics. On a new class of randomly generated feasibility-hard problem instances, PGC significantly outperforms all other known heuristics.

On Independent Neighborhood and Coloring Graphs

Speaker:
Sirous Ghobadi (Islamic Azad U Ghaemshahr)

Abstract:
Let G be a graph with chromatic number $\chi(G) = k$. The *nbd-color* number $n_{\chi(G)}$ is the maximum number of color classes which are neighborhood sets of G, where the maximum is taken over all k-colorings of G. The chromatic bondage number $\rho(G)$ of G is the minimum number of edges between two color classes in a k-coloring of G, where the minimum is taken over all k-colorings of G. In this presentation we introduce several interesting results on these parameters.

Wednesday May 30 at 10:45 in P1/L1–L4

Quadruple systems with independent neighborhoods

Speaker:
Dhruv Mubayi (Illinois-Chicago), Zoltan Furedi, Oleg Pikhurko

Abstract:
What is the maximum number of edges in a k-uniform hypergraph on n vertices, provided that the neighborhood of each of its $(k-1)$-sets of vertices is an independent set? When $k = 2$ we are just asking for the maximum number of edges in a triangle-free graph on n vertices. This was answered by Mantel in 1907 and is the first result of extremal graph theory. The case $k = 3$ was answered in 2005 by Furedi, Pikhurko and Simonovits. I will present a proof of the next case $k = 4$ and some related results.

Representativity of Cayley maps

Speaker:
D. Christopher Stephens (Mid Tenn State), Thomas W. Tucker (Colgate), Xiaoya Zha (Mid Tenn State)

Abstract:
A Cayley map is an embedded Cayley graph with the property that the clockwise rotation of generators is the same at each vertex. This project is driven by the following question: given a finite group and a generating set, what are the minimum and maximum representativities that can be achieved by a corresponding Cayley map? We are particularly interested in whether we can achieve representativity at least two. In this talk we will discuss the cases in which the generating set has size two or three; we will discuss prime-order cyclic groups and making use of primitive roots; and we will discuss a way to define representativity as a certain minimum over words in groups, and to thereby compute the representativity from the one-vertex rotation rather than by lifting to the actual embedding.

Perfect matchings in regular graphs from eigenvalues

Speaker:
Sebastian M. Cioabă (UCSD), David Gregory (Queen's), Willem Haemers (Tilburg)

Abstract:
Let G be a k-regular graph of even order. We find a best upper bound on the third largest eigenvalue $\lambda_3(G)$ that is sufficient to guarantee that G has a perfect matching.

Nested Traveling Salesperson Problems

Speaker:
Garth Isaak (Lehigh University)

Abstract:
Partition the edges of a complete graph into E_1, E_2, E_3 such that E_1 and $E_1 \cup E_2$ induce threshold graphs. Find a Hamiltonian path that maximizes E_1 edges and subject to that maximizes E_2 edges. In this case the problem is equivalent to finding a Hamiltonian path in a threshold graph containing a specified collection of disjoint paths. We give an efficient algorithm and characterization theorem for this problem.

Some new approaches towards determining the Chromatic Number of the Plane

Speaker:
Mohammed Ashraful Alam Tuhin (Memorial U Nfld)

Abstract:
Determining the chromatic number of the Euclidean plane E^2 is a problem, which has been unresolved for over fifty years. Some new class of infinite graphs and their chromatic number has been determined and in doing so the layering concept for graph coloring has been proposed. A novel approach for calculating the chromatic number of infinite graphs using the divide-and-conquer method has been proposed along with some illustrative examples.

Wednesday May 30 at 11:10 in P1/L1–L4

Independent Dominating Sets and Hamiltonian Cycles

Speaker:
Jacques Verstraëte (McGill University)

Abstract:
Using Thomason's parity argument, Thomassen showed that a hamiltonian graph has at least two hamiltonian cycles if it possesses a certain kind of independent dominating set. Using the Lovász Local Lemma, Thomassen then showed that every r-regular hamiltonian graph has such an independent dominating set for $r \geq 71$. In this talk, I will describe a simple modification of Thomassen's approach which shows that every r-regular hamiltonian graph has at least two hamiltonian cycles when $r > 20$, and when $r > 12$ if the girth is large enough. I shall conclude with a number of open problems on uniquely hamiltonian graphs and independent dominating sets, some of which have been open for many years.

Progress on the orientable genus of complete tripartite graphs (preliminary report)

Speaker:
Mark Ellingham (Vanderbilt), Chris Stephens (Mid Tenn State), Xiaoya Zha (Mid Tenn State)

Abstract:
In 1969 White conjectured that the genus of the complete tripartite graph $K_{l,m,n}$, with $l \geq m \geq n$, is $\lceil (l-2)(m+n-2)/4 \rceil$. The problem naturally breaks into sixteen cases according to the values of m and n modulo 4. Solutions for twelve of these cases are known. Here we discuss recent progress on the remaining four cases, which occur when m is odd and n is even.

Limit points for normalized Laplacian eigenvalues

Speaker:
Steve Kirkland (University of Regina)

Abstract:
We consider limit points for the positive eigenvalues of the normalized Laplacian matrix of a graph. Specifically, we show that the set of limit points for the j-th smallest such eigenvalues is equal to [0,1], while the set of limit points for the j-th largest such eigenvalues is equal to [1,2]. We also consider limit points for certain functions of the eigenvalues, motivated by considerations for random walks, distances between vertex sets, and isoperimetric numbers.

A Mixed Integer Programming Improvement Heuristic

Speaker:
Shubhashis Ghosh (University of Alberta)

Abstract:
Recently in Mixed Integer Programming (MIP), in the attempt of finding improved MIP solutions from a known MIP solution, neighbourhood search has been exploited with quite a bit of success.

In this talk, we will see a new neighbourhood search based MIP improvement heuristic that has been developed in the spirit of the Local Branching (LB) heuristic of Fischetti and Lodi and Relaxation Induced Neighbourhood Search (RINS) heuristic of Danna et al.

Computational experiments on a large class of very difficult MIP instances show that the introduced heuristic outperforms Cplex 9.13 (default setting) and existing neighbourhood search based heuristics LB and RINS with respect to the quality of solutions obtained within a reasonable time limit.

An optimal, edges-only fully dynamic algorithm for distance-hereditary graph recognition

Speaker:
Marc Tedder (University of Toronto)

Abstract:
The problem of dynamically recognizing a class of graphs has garnered interest of late. Given a graph and a sequence of vertex and edge additions and deletions, the algorithm determines if the graph resulting graph from each operation is a member of the class. This paper presents the first dynamic recognition algorithm for distance-hereditary graphs. The algorithm handles edge additions and deletions, and is optimal in that each operation can be performed in constant time.

Wednesday May 30 at 11:35 in P1/L1–L4

Extremal quadrilateral-free graphs

Speaker:
Zoltan Furedi (Illinois Urbana-Champaign and Rényi Inst)

Abstract:
Let $ex(n, C_4)$ denote the maximum number of edges in a graph on n vertices without a cycle of length 4. Its exact value, and all extremal graphs are known for $n \leq 31$ (McCuaig (1985), Clapham, Flockart and Sheehan (1989), Yuansheng and Rowlinson (1991)). Determining the exact value of $ex(n, C_4)$ for all n seems to be hopeless, except in the case $n = q^2+q+1$.

Asymptotically $ex(n, C_4) \sim n^{3/2}/2$ (Brown (1966), Erdős, Rényi, T. Sós (1966)). Their conjecture was proved in (1983, 1996) in the following form: Let G be a quadrilateral-free graph on q^2+q+1 vertices, where $q \neq 1, 7, 9, 11, 13$, then G has at most $q(q+1)^2/2$ edges. The aim of this talk is to describe some tools of the proof (we use linear algebra), that here equality holds only for polarity graphs ($q > 3$).

Variants of nearly planar graphs (preliminary report)

Speaker:
Michael O. Albertson (Smith College)

Abstract:
With purposeful imprecision a graph is said to be *nearly planar* if it resembles in some essential way a planar graph. Classic measures of near planarity include the genus, the thickness, and the crossing number. Modern versions of nearly planar graphs include the graphs embedded on surfaces with large width (shortest noncontractible cycle). This talk describes several more recent versions of near planarity and presents some results on nearly planar graphs.

Constructing cospectral symmetric powers

Speaker:
Chris Godsil (University of Waterloo)

Abstract:
The k-th symmetric power of a graph X has the k-subsets of X as its vertices, and two k-subsets are adjacent if their symmetric difference is an edge in X. One question that arises is whether there are two non-isomorphic graphs whose symmetric cubes are cospectral. Strongly regular graphs can be used to provide examples of non-isomorphic graphs whose symmetric squares are cospectral. I will discuss what is known about these questions, and describe the construction of some infinite families of non-isomorphic non-regular graphs with cospectral symmetric squares.

Optimal Dispersal of Certificate Chains

Speaker:
Ehab S. Elmallah (University of Alberta)

Abstract:
We consider a network where users can issue certificates that identify the public keys of other users in the network. The issued certificates in a network constitute a set of certificate chains between users. A user u can obtain the public key of another user v from a certificate chain from (the source) u to (the destination) v in the network.

Certificates in each chain are dispersed between the source and destination of the chain such that the following condition holds. If any user u needs to securely send messages to any other user v in the network, then u can use the certificates stored in u and v to obtain the public key of v (then u can use the public key of v to set up a shared key with v to securely send messages to v). The cost of dispersing certificates in a set of chains among the source and destination users in a network is measured by the total number of certificates that need to be stored in all users. A dispersal of a set of certificate chains in a network is optimal if no other dispersal of the same chain set has a strictly lower cost.

In this talk, we show that the problem of computing optimal dispersal of a given chain set is NP-complete, and identify a number of special classes of chain sets that are of practical interest, and admit polynomial-time algorithms for computing optimal dispersals.

Flow-free Selfish Routing

Speaker:
Neil Olver (McGill University)

Abstract:
In the standard model of selfish routing, all traffic on an arc experiences the same congestion delay. We propose a very general priority-based model motivated by the simple observation that, in communication (or traffic) networks, a packet can only delay packets arriving at a later time. We discuss some other applications, determine exactly the worst-case price of anarchy for linear and polynomial cost functions, and contrast our results with the standard model.

Wednesday May 30 at 12:00 in P1/L1–L4

On some Ramsey properties of the n-cube

Speaker:
Ron Graham, Jozsef Solymosi (UBC)

Abstract:
In this talk we show that in any r-coloring of the $\binom{2^n}{2}$ line segments spanned by the 2^n vertices of an n-cube, there are always monochromatic configurations of self-crossing connected triples of edges, provided $n > 2^{2^{cr}}$ for a suitable absolute constant c. The result has interesting applications to additive combinatorics.

Trading Handles for Crossings

Speaker:
Matt DeVos, Bojan Mohar, Robert Šámal (SFU)

Abstract:
Let $cr_n(G)$ be the minimum number of crossings when G is drawn on S_n (the orientable surface of genus n). Archdeacon, Bonnington, and Širáň conjecture that any strictly decreasing sequence (ending with zeros) is $(cr_n(G))_n$ for some graph G. We confirm this, in particular, for all sequences a, b, 0. That is, we show that for all integers $a > b$ there is a graph G with $cr_0(G) = a$, $cr_1(G) = b$ such that G embeds on the double torus.

Spectra of non-regular graphs and non-backtracking

Speaker:
Joel Friedman (University of British Columbia)

Abstract:
Alon's second eigenvalue conjecture and various other "expansion" problems have been studied by looking at the "non-backtracking spectrum" (as opposed to the adjacency matrix spectrum). For regular graphs it is easy to translate between the "non-backtracking" and adjacency spectrum. We take a first step to studying such issues in non-regular graphs: we show how to compute the non-backtracking spectrum of a tree covering a finite (not necessarily regular) graph. We prove an empirical observation of Stark and Terras that this non-backtracking spectrum has two dimensional measure in the complex plane for certain finite graphs.

On the feedback vertex set polytope of a series-parallel graph

Speaker:
Samuel Fiorini (U Libre Bruxelles), Odile Marcotte (CRM and UQAM)

Abstract:
The minimum weight feedback vertex set problem (FVS) on series-parallel graphs can be solved in $O(n)$ time by dynamic programming. This solution, however, does not provide a "nice" certificate of optimality. We prove a min-max relation for FVS on series-parallel graphs with no induced subdivision of $K_{2,3}$ (a class of graphs containing the outerplanar graphs), thereby establishing the existence of nice certificates for these graphs. Our proof relies on the description of a complete set of inequalities defining the feedback vertex set polytope of a series-parallel graph with no induced subdivision of $K_{2,3}$. We also prove that many of the inequalities described are facets of this polytope.

The Fractional Weak Discrepancy of an Ordered Set

Speaker:
Ann N. Trenk (Wellesley College)

Abstract:
The *fractional weak discrepancy* $wd_F(P)$ of a poset $P = (V, \prec)$ is the minimum nonnegative k for which there exists a function $f : V \to \mathbf{R}$ satisfying the following conditions for all $a, b, \in V$: (1) if $a \prec b$ then $f(a) + 1 \leq f(b)$ and (2) if $a \parallel b$ then $|f(a) - f(b)| \leq k$. In this talk we begin with some motivation for studying fractional weak discrepancy and (integral) weak discrepancy, and characterize the range of the fractional weak discrepancy function.

Wednesday May 30 at 14:30 in P1

Zombies, ETs and Other Encounters with Dynamic Graph Algorithms

Speaker:
Valerie King (Microsoft Research SVC and University of Victoria)

Abstract:
Given any graph problem, we may ask if it's possible to maintain a solution as an input graph changes incrementally, in time faster than recomputing from scratch for each update. The goal of a dynamic graph algorithm is to efficiently implement update

and query operations in reasonable space.

This talk will be a whirlwind tour of fundamental ideas in dynamic graph algorithms and lower bounds, focusing mainly on the problems of connectivity and minimum spanning tree, transitive closure and shortest paths.

Wednesday May 30 at 15:50 in P1/L1–L4

The Price of Privacy and the Limits of LP Decoding

Speaker:
Kunal Talwar, Cynthia Dwork, Frank McSherry (Microsoft Research)

Abstract:
Suppose one encodes an n-dimensional real vector x as $y = Ax$, for a suitably chosen A, and an adversary arbitrarily corrupts some of the entries of y to get y'. The surprising fact, proved by Donoho, is that by taking the entries of A as i.i.d. Gaussians, the vector x can be *exactly* recovered by minimizing the L_1 norm $|y' - Ax'|$ over all x', provided only a tiny constant fraction of the entries of y were corrupted. Our principal result is the discovery of a sharp threshold $\rho * \ 0.239$, such that (with overwhelming probability) this L_1 minimization succeeds up to any error rate less than rho*, but can be made to fail for rates $> \rho*$. This resolves an open question of Candes, Rudelson, Tao, and Vershynin. We show a similar result holds when each entry of A is chosen uniformly for $\{-1, +1\}$. Our interest in this problem arose while investigating the price, in accuracy, of protecting privacy in a statistical database. Our results say that any privacy mechanism, interactive or non-interactive, providing reasonably accurate answers to a 0.761 fraction of randomly generated weighted subset sum queries, and arbitrary answers on the remaining 0.239 fraction, is blatantly non-private.

On the structure of minimal counterexample of Hadwiger's conjecture

Speaker:
Ken-ichi Kawarabayashi (National Inst Inf), Bruce Reed (McGill)

Abstract:
We rediscover Robertson-Seymour's result, which says that minimal counterexample to Hadwiger's conjecture has bounded tree-width. Proof heavily depends on RS' structure theorem together with Thomassen's result on coloring graphs on a fixed surface. Proof gives rise to a polynomial time algorithm to decide Hadwiger's Conjecture (for fixed k).

Search Algorithm for partial geometries with non-trivial automorphism

Speaker:
Clement Lam (Concordia University)

Abstract:
A partial geometry $pg(s, t, \alpha)$ is a point-line structure such that

1. any line is incident with $s + 1$ points, and any point with $t + 1$ lines;

2. two lines are incdident with at most one point, and any two points is in at most one line; and

3. for every point P not on a line l, there exists exactly α lines that are incident on P and a point on l.

The CRC Handbook on Combinatorial Designs gives a table of known and unknown partial geometries with less than 100 points. The unknown cases seem too large to be solved by a brute-force approach. We will discuss the feasibility of searching for these partial geometries by assuming that they admit a non-trivial automorphism group.

Secure Domination Critical Graphs

Speaker:
Kieka Mynhardt (University of Victoria)

Abstract:
A secure dominating set X of a graph G is a dominating set with the property that each vertex $u \in V_G - X$ is adjacent to a vertex $v \in X$ such that $(X - \{v\}) \cup \{u\}$ is dominating. The minimum cardinality of such a set is called the secure domination number, denoted by $\gamma_s(G)$. We are interested in the effect of edge removal on $\gamma_s(G)$, and characterize γ_s-ER-critical graphs, i.e. graphs for which $\gamma_s(G - e) > \gamma_s(G)$ for any $e \in E_G$, bipartite γ_s-ER-critical graphs and γ_s-ER-critical trees.

Finding small transversals in some classes of graphs

Speaker:
M. Groshaus, P. Hell, S. Klein, L. Tito-Nogueira, Fábio Protti (U Federal Rio de Janeiro)

Abstract:
Let $\mathcal{H}$ be a finite family of graphs. An *$\mathcal{H}$-subgraph* of a graph G is an induced subgraph of G isomorphic to a member of $\mathcal{H}$. A graph is *$\mathcal{H}$-free* if it contains

no $\mathcal{H}$-subgraph. An $\mathcal{H}$-transversal of a graph G is a subset $T \subseteq V(G)$ such that T intersects all the $\mathcal{H}$-subgraphs of G. Clearly, if T is a small $\mathcal{H}$-transversal of G then $G-T$ is a large induced $\mathcal{H}$-free sugraph of G. In this work we study the problem of finding small $\mathcal{H}$-transversals in some classes of graphs, for specific families $\mathcal{H}$.

Wednesday May 30 at 16:15 in P1/L1–L4

Ballanced Allocations: The Weighted Case

Speaker:
Udi Wieder, Kunal Talwar (Microsoft Research)

Abstract:
We investigate balls-and-bins processes where m weighted balls are placed into n bins using the "power of two choices" paradigm, whereby a ball is inserted into the less loaded of two randomly chosen bins. The case where each of the m balls has unit weight had been studied extensively. In a seminal paper Azar et al. showed that when $m = n$ the most loaded bin has $\Theta(\log \log n)$ balls with high probability. Surprisingly, the gap in load between the heaviest bin and the average bin does not increase with m and was shown by Berenbrink et al to be $\Theta(\log \log n)$ with high probability for arbitrarily large m. We generalize this result to the weighted case where balls have weights drawn from an arbitrary weight distribution. We show that as long as the weight distribution has finite second moment and satisfies a mild technical condition, the gap between the weight of the heaviest bin and the weight of the average bin is independent of the number balls thrown. This is especially striking when considering heavy tailed distributions such as Power-Law and Log-Normal distributions. In these cases, as more balls are thrown, heavier and heavier weights are encountered. Nevertheless with high probability, the imbalance in the load distribution does not increase. Furthermore, if the fourth moment of the weight distribution is finite, the expected value of the gap is shown to be independent of the number of balls.

Circle graph obstructions under pivoting

Speaker:
Jim Geelen (Waterloo), Sang-il Oum (Waterloo)

Abstract:
Circle graphs are intersection graphs of chords of a circle; two vertices are adjacent if and only if the corresponding chords in a chord diagram cross. Bouchet [1994] characterized circle graphs by providing a list of 3 excluded vertex-minors (graphs obtainable by local complementation and vertex deletions). We showed that there is a list of 15 excluded pivot-minors (graphs obtainable by pivoting and vertex deletions) for circle graphs. This implies the Kuratowski-Wagner theorem on excluded minors for planar graphs.

Using Wilson's Theorem to Enumerate BIBDs

Speaker:
G. H. J. van Rees (University of Manitoba)

Abstract:
Here is an old construction for 2-designs. For q an odd prime and $k >= 3$, take any block B whose elements are in $GF(q)$. Let α be a primitive root of $GF(q)$. Construct the blocks $\mathcal{B} = aB + b$ for $a = 1, \alpha, (\alpha)^2, ..., (\alpha)^{(q-1)/2)}$ and $b = 0, 1, 2...q-1$. Wilson proved that this is a 2-design $(q, k, k(k-1)/2))$. There is no restriction on B. If we mentally try ever possible B in this construction, we get many non-isomorphic 2-design all with large automorphism groups. Under the right condition, if B' is not an element of $\mathcal{B}$ then $\mathcal{B}$ and $aB' + b$ will be non-isomorphic. We need group theory to sort out when this can happen. We use these theorems to prove that the lower bound on the number of non-isomorphic 2-designs with large automorphism groups is very large.

A transition from total domination in graphs to transversals in hypergraphs

Speaker:
Michael A. Henning (U KwaZulu-Natal)

Abstract:
In this talk we survey bounds on the total domination number of a graph in terms of the order of the graph, and provide a transition from total domination in graphs to transversals in hypergraphs.

Weakening Strongly Chordal Graphs

Speaker:
Terry McKee (Wright State University)

Abstract:
A line or triangle is *strength-k* in a graph if it is in k or more maxcliques. A graph is *strength-k*

chordal if every cycle of strength-k edges either has a strength-k chord or is a strength-k triangle. Being strength-1 chordal is equivalent to being chordal; being strength-k chordal $\forall k \geq 1$ is equivalent to being strongly chordal. Characterizations of being strength-k chordal $\forall k \geq 2$ include being hereditarily strength-2 chordal.

Wednesday May 30 at 16:40 in P1/L1–L4

A Sublinear-Time Approximation Scheme for Bin Packing

Speaker:
Tugkan Batu (LSE), Petra Berenbrink (SFU), Christian Sohler (Paderborn)

Abstract:
The bin-packing problem is defined as follows: given a set of n items with sizes $0 < w_1, w_2, \ldots, w_n \leq 1$, find a packing of these items into minimum number of unit-size bins possible. We present a sublinear-time asymptotic approximation scheme for the bin-packing problem; that is, for any $\epsilon > 0$, we present an algorithm A_ϵ that has sampling access to the input instance and outputs a value k such that $C_{opt} \leq k \leq (1+\epsilon) \cdot C_{opt} + 2$, where C_{opt} is the cost of an optimal solution. It is clear that uniform sampling by itself will not allow a sublinear-time algorithm in this setting; a small number of items might constitute most of the total weight and uniform samples will not hit them. In this work we use weighted samples, where item i is sampled with probability proportional to its weight: that is, with probability $w_i / \sum_i w_i$. In the presence of weighted samples, the approximation algorithm runs in $\tilde{O}(\sqrt{n} \cdot \text{poly}(1/\epsilon)) + g(1/\epsilon)$ time, where $g(x)$ is an exponential function of x. When both weighted and uniform sampling are allowed, $\tilde{O}(n^{1/3} \cdot \text{poly}(1/\epsilon)) + g(1/\epsilon)$ time suffices.

Linear time algorithm for recognizing K_5-minors

Speaker:
Zhentao Li (Waterloo), Bruce Reed (McGill)

Abstract:
We provide a linear time algorithm for recognizing a K_5-minor. The method gives rise to a decomposition of 3-connected graphs.

Uniform group divisible Steiner quadruple systems

Speaker:
M. Keranen (Michigan Tech) D.L. Kreher (Michigan Tech), R. Rees (Memorial U Nfld)

Abstract:
A uniform group divisible Steiner quadruple system of type g^u is a triple $(X, \mathcal{H}, \mathcal{B})$ where X is a ug-element set of *points*, $\mathcal{H} = \{H_1, H_2, \ldots, H_u\}$ is a partition of X into u *holes* of size g and $\mathcal{B}$ is a collection of 4-element subsets of X called *blocks* such that every 3-element subset is either in a block or a hole but not both. We give necessary and sufficient conditions for the existence of uniform group divisible Steiner quadruple systems of type g^u except possibly when $(g, u) = (10, 5)$.

Paired Domination Critical Graphs

Speaker:
Michelle Edwards (University of Victoria)

Abstract:
In comparison to classical domination variants, paired domination criticality has been an untouched area of research; here we present a preliminary investigation of the subject. For criticality, we study graphs where the addition of any edge or the deletion of any vertex decreases the paired domination number. Structural properties of critical graphs and a characterisation for a class of edge-critical graphs will be discussed. We also present bounds on the diameter of critical graphs.

Partial characterizations of circular-arc graphs

Speaker:
F. Bonomo, Guillermo Durán (U Chile), L. Grippo, M. Safe

Abstract:
A circular-arc graph is the intersection graph of a family of arcs on a circle. A characterization by forbidden subgraphs for this class of graphs is not known. In this work, we present a partial result in this direction, that is, we characterize circular-arc graphs by a list of minimal forbidden induced subgraphs when the graph belongs to the following classes: diamond-free, P_4-free, paw-free, and claw-free chordal graphs.

Wednesday May 30 at 17:05 in P1/L1–L4

Finding Frequent Patterns in a String in Sublinear Time

Speaker:
Petra Berenbrink, Funda Ergun (Simon Fraser University), Tom Friedetzky (University of Durham)

Abstract:
We consider the problem of testing whether a large part of a given string X of length n over some finite alphabet is covered by multiple occurrences of some (unspecified) pattern Y of arbitrary length in the combinatorial property testing model. That is, if a very large percentage (which can be user defined) of the string is covered by these occurrences, our algorithm returns a positive answer with an implicit pointer to the frequent substring. If less than a second (smaller) percentage is covered, the algorithm returns a negative answer.

Our algorithms randomly query a sublinear number of positions of X, and run in sublinear time in n. We first focus on finding patterns of a given length, and then discuss finding patterns of unspecified length.

Graph Minors in (Nearly) Linear Time

Speaker:
K. Kawarabayashi, Z. Li, Bruce Reed (McGill),

Abstract:
We discuss recent progress of algorithmic graph minor theory. Topics include minor testing, labeled minor testing, the disjoint paths problem, half disjoint paths problem, and a separator theorem.

On Generalized Separating Hash Families

Speaker:
K. Chen (Lakehead), D.R. Stinson (Waterloo), R. Wei (Lakehead)

Abstract:
Separating hash families are useful combinatorial structures which are discussed in a general form in this talk. Necessary and sufficient conditions for the existence of certain types of generalized hash functions are considered.

Counting Small Unlabelled Strongly Planar Two-pole Networks

Speaker:
Timothy Walsh (U Québec à Montréal)

Abstract:
A strongly planar two-pole network is obtained from a simple 2-connected planar graph by distinguishing, orienting and perhaps deleting an edge and distinguishing its incident vertices as distinct poles. Counting these networks up to graph isomorphism that preserves each pole is a step towards counting unlabeled planar graphs and $K(3,3)$-free toroidal graphs. Using the 3-connected planar graphs generated by Brendand McKay's program "plantri" I counted these networks with up to 14 vertices.

Coloring of graphs with restricted neighborhood

Speaker:
Martin Kochol (Math Inst Slovak Acad Sci)

Abstract:
The 3-colorability problem is known to be NP-complete in the class of graphs. We study this problem for classes of graphs where neighborhood of each vertex satisfies certain property. Primarily we present a linear time algorithm for 3-coloring of this graphs. We also study classes of graphs with degree at most four with restrictions on neighborhoods of vertices of degree exactly four. We show that the 3-coloring problem is either NP-complete or can be solved in linear time. In particular, we generalize classical Brooks' Theorem in case of 3-colorability to a larger class by showing that every connected graph in that class is 3-colorable, unless it is a complete graph on four vertices.

Wednesday May 30 at 17:30 in P1/L1–L4

Distributed Selfish Load Balancing

Speaker:
Russell Martin, Leslie Ann Goldberg, Paul Goldberg (Liverpool), Tom Friedetzky (Durham), Petra Berenbrink, Zengjian Hu (SFU)

Abstract:
Suppose that a set of m tasks are to be shared as equally as possible amongst a set of n resources. A game-theoretic mechanism to find a suitable allocation is to associate each task with a "selfish agent", and require each agent to select a resource, with the

cost of a resource being the number of agents to select it. Agents would then be expected to migrate from overloaded to underloaded resources, until the allocation becomes balanced.

Recent work has studied the question of how this can take place within a distributed setting in which agents migrate selfishly without any centralized control. In this paper we discuss a natural protocol for the agents which combines the following desirable features: It can be implemented in a strongly distributed setting, uses no central control, and has good convergence properties. For $m \gg n$, the system becomes approximately balanced (an ϵ-Nash equilibrium) in expected time $O(\log \log m)$. We show using a martingale technique that the process converges to a perfectly balanced allocation in expected time $O(\log \log m + n^4)$. We also give a lower bound of $\Omega(\max\{\log \log m, n\})$ for the convergence time.

Chromatic number and immersions of complete graphs

Speaker:
Matt DeVos (SFU), Ken-ichi Kawarabayashi (NII), Bojan Mohar (SFU), Haruko Okamura (Konan U)

Abstract:
It will be shown that for every positive integer $k \leq 7$, every $(k-1)$-edge-connected simple graph contains immersion of the complete graph K_k of order k. This implies a conjecture by Abu-Khzam and Langston (for $k \leq 7$) that every k-chromatic graph contains immersion of K_k.

Constructions of Super-simple BIBDs

Speaker: R. Wei (Lakehead University), K. Chen (Yancheng Teachers University)

Abstract:
Super-simple designs are useful in constructing codes and other designs such as superimposed codes and perfect hash families. In this talk, we give recent results about the constructions of super-simple BIBD with block size 5. Some computer algorithms used to find small size super-simple designs will also be discussed.

On 2-Subcolourings of Chordal Graphs

Speaker:
Juraj Stacho (SFU)

Abstract:
A 2-subcolouring of a graph is a partition of its vertices into two subsets, each inducing a P_3-free graph, i.e., a disjoint union of cliques. We give a polynomial time algorithm to test whether a chordal graph has a 2-subcolouring. This solves an open problem of Broersma, Fomin, Nesetril, and Woeginger (for two colours), who gave an $O(n^5)$ time algorithm for interval graphs. Our algorithm for the larger class of chordal graphs has time complexity only $O(n^3)$.

Symmetries of Chain Decompositions and Venn Diagrams on the Sphere

Speaker:
Mark Weston (Victoria), Brett Stevens (Carleton), Frank Ruskey (Victoria)

Abstract:
Chain decompositions provide ways of creating planar embeddings of the boolean hypercube. Using symmetric chain decompositions, it was shown recently that, in the plane, rotationally symmetric Venn diagrams exist if and only if the number of curves is prime. On the sphere, additional symmetries are possible. We present constructions for two chain decompositions that give Venn diagrams with interesting symmetries on the sphere. We also look at symmetries in which curves map onto themselves, curves map onto other curves, or curve colourings are ignored altogether. We present some diagrams with interesting symmetry

Thursday May 31 at 9:00 in P1

Single-source network flows with side constraints

Speaker:
Bruce Shepherd (McGill University)

Abstract:
We discuss several single-source network flow problems with additional restrictions on the structure of the flow. We examine in some detail the problem of finding network flows with out-degree constraints on the nodes. These models are inspired by traffic routing in data networks.

Thursday May 31 at 10:20 in P1/L1/L2/L3

Light Circuits in Heavy Graphs

Speaker:
Luis Goddyn (Simon Fraser University), Matt DeVos, Bojan Mohar, Ken-ichi Kawarabayashi

Abstract:
We show that if each element of a simple matroid M is assigned a non-zero integer weight, and the total weight of M is less than some integer $f(M)$, then M has a negative-weight cocircuit. The behavior of the bounding function f is strikingly different among various natural classes of matroids. Graphic matroids achieve f(M) = rank(M)/2, whereas f(M) = 0 for projective geometries M.

Genome rearrangements: the two parsimonies

Speaker:
Eric Tannier (U Claude Bernard Lyon)

Abstract:
The parsimony principle in evolutionary biology means that when several organisms present a common feature, their common ancestor is likely to present this feature. When transposing it to genome evolution, whereas the signification seems to be clear and consensual for small mutations at the nucleotide-level, it has several different translations for the evolution by genome rearrangements that invlove mutations of large parts of chromosomes. We investigate these different implicit definitions, their mathematical properties, their (in)compatibilities, with some examples of consequences on biological results.

Interval Partitions and Polynomial Factorization over Finite Fields

Speaker:
Daniel Panario (Carleton University)

Abstract:
We consider univariate polynomials over a finite field. Factoring such polynomials is a long standing problem first studied by Gauss and Galois. Up to 15 years ago, we could factor polynomials of degree only up to a few thousands. This has dramatically changed in recent years.

In this talk, we start explaining a basic factoring method. Then, we focus on recent variations that using interval partitions allow for much faster algorithms. We give some experimental results from a paper by von zur Gathen and Gerhard (2002) that show data of random polynomials over the binary field of degree quarter of a million factored in less than a day, half of a million in a couple of days, and if mild parallelism is allowed, over a million-degree polynomials factored in one day. We briefly comment on the analysis of these algorithms that involve generating functions and asymptotic analysis.

Skew Partition Recognition

Speaker:
Sean Kennedy (McGill University)

Abstract:
Chvátal defined a *skew partition* of a graph G to be a partition of its vertex set into two non-empty parts A and B such that A induces a disconnected subgraph of G and B induces a disconnected subgraph of $\overline{G}$. We present an $O(n^7)$ algorithm which either finds a skew partition or determines that no such partition exists. This improves both the De Figuereido et al. $O(n^{101})$ algorithm and our $O(n^8)$ algorithm for the same problem.

Thursday May 31 at 10:45 in P1/L1/L2/L3

Why is the chromatic polynomial a polynomial?

Speaker:
Janos Makowsky (Technion), B. Zilber (Oxford)

Abstract:
The number of k-vertex colorings of a graph is a polynomial in k, the chromatic polynomial. Many other graph invariants (Tutte polynomial, matching poly-

nomial, interlace polynomial, cover polynomial) are also polynomials (possibly in several variables). We show that this is no accident. The talk presents the results in an elementary way, although the underlying theory stems from deep results in model theory.

Towards more accurate RNA structure prediction

Speaker:
Anne Condon (University of British Columbia)

Abstract:
RNA play fascinating roles in our cells and hold significant promise in therapeutics. Function follows form in the molecular world, and so our ability to understand RNA function is enhanced by reliable means for predicting RNA structure. In this talk, we will describe new approaches to improving the accuracy and generality of RNA structure prediction, through improved energy parameter estimation and a hierarchical approach to folding.

Random Generation of Automata

Speaker:
Frédérique Bassino (U Marne-la-Vallée)

Abstract:
This talk deals with random generation of particular combinatorial structures: automata. Automata can be seen as oriented graphs whose edges are labeled on a finite alphabet and having two subsets of distinguished vertices (the set of resp. initial and terminal vertices). We explain how, making use of bijections, one can use Boltzmann samplers or the recursive method to generate uniformly at random different kinds of automata related with regular languages or free groups.

Dynamic Distance Hereditary Graphs Using Split Decomposition

Speaker:
Christophe Paul (CNRS, McGill, Montpellier)

Abstract:
We address the problem of maintaining a representation of a dynamic distance hereditary graph. To that aim, we revisit the split decomposition within the framework of graph-labeled trees. This allows us to unify the presentation of the split and modular decompositions. Well known can be easily restated and new results concerning distance hereditary graphs are obtained: vertex insertion and/or deletion can be handled in time $O(d)$. This yields an optimal fully dynamic recognition algorithm, which turns out to be simpler than the known linear time static algorithms.

Thursday May 31 at 11:10 in P1/L1/L2/L3

Nowhere-zero 3-flows in Cayley graphs and Sylow 2-subgroups

Speaker:
Martin Škoviera (Comenius University)

Abstract:
Tutte's 3-flow conjecture claims that every bridgeless graph without 3-edge-cuts has a nowhere-zero 3-flow. We show that this conjecture is true for Cayley graphs of groups whose Sylow 2-subgroup is a direct factor of the whole group; in particular, it is true for Cayley graphs of nilpotent groups. This improves a recent result of Potočnik et al. that every abelian Cayley graphs of valency at least 4 has a nowhere-zero 3-flow.

Application of combinatorial optimization to prediction of domain-domain interactions

Speaker:
Teresa Przytycka (NCBI/NLM/NIH)

Abstract:
Comprehending the cell functionality requires knowledge about the functionality of individual proteins as well as the interactions among them. Proteins typically contain two or more domains, and a protein interaction usually involves binding between specific pairs of domains. Identifying such interacting domain pairs is an important step towards determining the protein-protein interaction network. We demonstrate that evolutionary parsimony principle combined with combinatorial optimization techniques leads to a very successful approach to detecting domain-domain interactions from the topology of protein-protein interaction network.

Heights on Trees

Speaker:
Bruce Reeed (McGill University)

Abstract:
We discuss some results on the heights of Random Trees obtained using a combination of combinatorial arguments and concentration inequalities. Amongst

other things we tie down the height of a random binary search tree to within $O(1)$. Some of the work we discuss is joint with Louigi Addario-Berry.

A lexicographic BFS based algorithm for recognizing trivially perfect graphs and their complements

Speaker:
Frank Pok Man Chu (University of Toronto)

Abstract:
We will discuss a simple, linear time algorithm for recognizing trivially perfect (TP) graphs and their complements. Our algorithm improves upon previous algorithms in that it can recognize both TP and co-TP graphs in linear time, and that it is a linear time certifying algorithm. It is yet another algorithm to demonstrate the power of LBFS in graph family recognition.

Thursday May 31 at 11:35 in P1/L1/L2/L3

Circular Choosability

Speaker:
Serguei Norine (Georgia Tech), Tsai-Lien Wong, Xuding Zhu (National Sun Yat-sen U)

Abstract:
Circular choosability is a circular version of list-chromatic number, recently introduced by Mohar and Zhu. We will survey known results and open questions related to this notion. In particular, we will discuss bounds on circular choosability of bipartite graphs obtained via combinatorial Nullstellensatz.

Handling duplications in genome rearrangements models

Speaker:
Cedric Chauve (Simon Fraser University)

Abstract:
Genome rearrangements were initially studied, form an algorithmical point of view, with the assumption that the considered genomes do not contain duplicated markers, which implies that they can be represented by (signed) permutations. However, it is well known that the duplication of genomic segments is a fundamental evolution mechanism. Following the work of Sankoff on "exemplar distances" in 1999, several groups have proposed extensions of the classical genome rearrangements algorithms and models that allow to consider signed sequences instead of permutations. In this talk I will review these recent efforts.

Analyzing the Performance of Spatial Data Structures

Speaker:
Amalia Duch (U Politècnica Catalunya)

Abstract:
In this talk I will give an overview of relaxed K-d trees, as an example of a hierarchical multidimensional data structure that supports a large variety of spatial operations.

In particular, I will introduce the data structure as well as some of the associative queries that it supports (such as partial match, orthogonal range or nearest neighbor queries) and use them to give some examples of the classical ways to address their expected performance analysis.

Convex Partition of Graphs

Speaker:
Mitre C. Dourado (U Federal Rural Rio de Janeiro)

Abstract:
Let G be a graph. A set of vertices S of G is *convex* if all vertices of every geodesic between two of its vertices are in S. We say that G is k-*convex* if $V(G)$ can be partitioned into k convex sets. We show that deciding if a general graph is k-convex, for fixed $k \geq 2$, is NP-complete. Furthermore we present a polynomial time algorithm to check whether a cograph is k-convex, even for k variable.

Thursday May 31 at 12:00 in P1/L1/L2/L3

1-flowing matroids

Speaker:
Bertrand Guenin (Waterloo), P. Wollan, I. Pivotto

Abstract:
The max-flow min-cut theorem in graphs does not extend to binary matroids in general. However, Seymour conjectured that this minimax relation holds as long as the binary matroids do not contain any one of three special obstructions. We discuss progress on this conjecture.

Counting the number of breakpoints between genomes containing duplicates

Speaker:
Guillaume Fertin (Université de Nantes)

Abstract:
Let G_1 and G_2 be two genomes, each represented as an orderedsequence of signed genes. One way to compare these genomes is to count thenumber of breakpoints that occur between them. Roughly speaking, abreakpoint occurs between G_1 and G_2 if two consecutive genes of G_1 arenot consecutive in G_2. Counting the number of breakpoints between twogenomes is an easy task when none of them contain duplicates. However,when genomes do contain duplicates, the problem becomes computationally hard,even on very restricted instances.In this talk, I will go through the latest results concerning thisproblem, in terms of computational complexity, approximationalgorithms, heuristics, and even exact algorithms.

Some Applications of the Method of Moments in the Analysis of Algorithms

Speaker:
Alois Panholzer (Technische U Wien)

Abstract:
The "method of moments" uses the Theorem of Fréchet and Shohat to prove convergence in distribution of a sequence of random variables X_n to a limiting random variable X by showing convergence of all positive integer moments: $\mathbb{E}(X_n^r) \to \mathbb{E}(X^r)$, for $r \geq 1$.

This method is of particular interest if the distribution of the random variable can be described recursively as it is the case for many problems appearing in the analysis of random structures. Often one has then the situation that although a direct treatment of the distributional recurrence is too involved one is able to "pump out' all moments.

We illustrate the characterization of the limiting distribution via the method of moments for several examples stemming from the average-case analysis of algorithms including Quicksort, Linear Probing Hashing, Union-Find algorithms and pattern occurences in search trees.

On a new family of tractable decompositions for graphs

Speaker:
Michel Habib (U Paris Diderot), B.-M. Bui Xuan (Montpellier), V. Limouzy, F. de Montgolfier (UPD)

Abstract:
In the area of social networks, several vertex partitioning have been introduced in order to catch the idea of putting in the same part all vertices acknowledging similar behaviour, in other words finding regularities. Modular decomposition provides such a partitioning, yet seemingly too restrictive for real life applications. Modules of graphs can de defined as subsets of vertices having no splitters (i.e. there is no vertex outside of a module which can distinguish two vertices of the module). We propose here a related notion, "umodules", that can be defined as subsets of vertices which do not admit splitters inside that distinguish the outside. We study this generalisation of modular decomposition and propose several polynomial algorithms. The umodules family does not always admits a tree representation (as for modules) but some natural restriction yields crossing families. Furthermore when applied to undirected graphs it leads to a known decomposition called "bi-join". For tournaments it leads to a new interesting decomposition.

Thursday May 31 at 14:00 in P1

Polyploidy and Rearrangement Phylogeny

Speaker:
David Sankoff (University of Ottawa)

Abstract:
Rearrangement phylogenetics based on the genomes of N species usually requires a 1–1 correspondence between the set of markers in any one of the genomes being analyzed and the set of markers in any of the other $N-1$ genomes, where the markers may be genes, anchors, probe binding sites, chromosomal segments, synteny blocks, etc.

Genome doubling (called tetraploidization in some contexts) simultaneously introduces an second, exact copy of each of the chromosomes in a genome and hence results in two copies of each marker. This process is relatively common in the plant world, but also occurs in other evolutionary domains. Subsequent to doubling, over evolutionary time the chromosomes are scrambled and exchange chromosomal material

through various types of rearrangement event, so that the genomic neighbourhood of a marker need not resemble that of its copy.

Because of the requirement of 1–1 correspondences between genomes, it is not possible to include doubled and unduplicated genomes in the same phylogenetic analysis based on rearrangement. A framework for solving this difficulty requires separating out various possible local configurations of doubled and unduplicated genomes in a given phylogeny, each of which requires a different strategy for integrating genomic distance, halving and rearrangement median algorithms. In this talk, I focus on the a number of such configurations, including genome halving with one or two unduplicated outgroup genomes and the two cases where doubling precedes a speciation event and where it occurs independently in both lineages initiated by a speciation event. We apply our methods to a data set containing markers that are ancient duplicates in some yeast genomes.

Thursday May 31 at 15:10 in P1/L1/L2/L3

Adjacency preserving functions

Speaker:
Ming-Huat Lim (University of Malaya)

Abstract:
Let A be a non-empty set and m be an integer ≥ 2. Let $\equiv$ be the equivalence relation defined on A^m such that $(x_1, ..., x_m) \equiv (y_1, ..., y_m)$ if there exists a permutation σ on $\{1, ..., m\}$ such that $y_{\sigma(i)} = x_i$ for all i. Let $\overline{A^m}$ denote the set of all equivalence classes determined by $\equiv$. Two elements X and Y in $\overline{A^m}$ are said to be adjacent if $(x_1, ..., x_{m-1}, a) \in X$ and $(x_1, ..., x_{m-1}, b) \in Y$ for some $x_1, ..., x_{m-1} \in A$ and some distinct $a, b \in A$. We discuss the structure of functions from $\overline{A^m}$ to $\overline{B^m}$ that send adjacent elements to adjacent elements when A and B are infinite sets and its application to linear preservers of non-zero decomposable symmetric tensors.

Lower Bounds on Overlap Representations

Speaker:
Philip Henderson (University of Alberta)

Abstract:
Set representations are well studied, yet much remains unknown about overlap representations, including the NP-hardness of computing the overlap number and an algorithm to represent trees optimally. We present lower bounds on the overlap number relating to the size of independent sets. This yields constant-factor approximation algorithms for both trees and planar graphs. We also demonstrate that in the worst case an overlap representation requires a quadratic number of elements.

Hardness of the Power Dominating Set problem

Speaker:
Ashkan Aazami (Waterloo), Michael Stilp

Abstract:
The Power Dominating Set (PDS) problem is an extension of the well known Dominating Set problem. The best known hardness threshold for PDS is logarithmic which is proved by a reduction from Dominating Set. We show an improved hardness threshold for PDS. We also consider a variant of PDS, called ℓ-round PDS, and show a polynomial time approximating scheme (PTAS) for this problem on planar graphs.

On New Combinatorial Interpretations for Identities of the Rogers Ramanujan Type

Speaker:
José Plínio O. Santos (State U Campinas)

Abstract:
We present combinatorial interpretations for sums into two, three and four parameters form which we have, as special cases, combinatorial interpretations for many identities of Slater´s list including Rogers-Ramanujan identities, irrestricted partitions, overpartitions and Lebesgues´s partition identity. In this work we are representing a number as a *vector* and providing representation of this *vector* as a sum of *vectors*.

Thursday May 31 at 15:35 in P1/L1/L2/L3

Subgraph-avoiding colouring of graphs

Speaker:
Jia Shen (University of Calgary)

Abstract:
Given finite graphs F and G and an integer k, an F-avoiding k-colouring of G is a k-colouring of the vertices of G such that no maximal F-free subgraph

of G is monochromatic. The F-avoiding chromatic number $\mathrm{ac}_F(G)$ is the least integer k such that G is F-avoiding k-colourable. We will give a complete answer to the following problem: for which F is $\mathrm{ac}_F(G)$ bounded by a constant independent of G?

Subtree filament graphs are subtree overlap graphs

Speaker:
Jessica Enright (Alberta), Lorna Stewart (Alberta)

Abstract:
Subtree filament graphs are the intersection graphs of filaments in a tree, and subtree overlap graphs are the overlap graphs of subtrees in a tree. Since interval filament graphs contain interval overlap graphs and several other graph classes, it seems reasonable to expect that subtree overlap graphs would form a proper subset of subtree filament graphs. However, in this talk we show that the classes of subtree filament graphs and subtree overlap graphs are identical.

An upper bound for the satisfiability of a variation of the random k-SAT model

Speaker:
Calin Anton (Alberta), Joseph Culberson (Alberta)

Abstract:
We prove an upper bound for the satisfiability of lk-SAT, a random satisfiability model, which enables us to tune a uniform type of clustering on the selection of clauses. Using the second moment method we prove that with high probability there are two sets of clauses which force a Boolean variable to take contradictory values, therefore, asymptotically the instances are unsatisfiable. The proof implies that for fixed l, instances with clauses to variables ratio beyond the upper bound can be shown to be unsatisfiable in polynomial time.

On the broadcast function $B(n)$

Speaker:
Hovhannes Harutyunyan (Concordia University)

Abstract:
Broadcasting is the process of message dissemination from a vertex of graph G to all the vertices where, in each time unit, any informed vertex can pass the message to at most one of its neighbors. A minimum broadcast graph on n vertices is a graph with the minimum number of edges $B(n)$ that allows any vertex to broadcast in time $\lceil \log n \rceil$. We present an upper bound on $B(n)$, and discuss its monotonicity.

Thursday May 31 at 16:00 in L1/L2/L3

The solution space of sorting permutations by reversals

Speaker:
Celine Scornavacca (U Montpellier)

Abstract:
Algorithms that sort permutations by reversals are often used to proposeevolutionary scenarios of genomic mutations. The main problem of suchmethods is that they give one solution among a possibly huge set, whichis useless in practice. It was recently stated as an open problem todesign an algorithm that would construct a structure for the optimalsolutions without enumerating them. We propose such an algorithm, with atheoretical and practical complexity study.

The intersection Graph of the Bicliques of a Graph

Speaker:
Fabio Protti (U Federal Rio de Janeiro)
Authors:
Marina Groshaus (U Buenos Aires),
Jayme Szwarcfiter (U Federal Rio de Janeiro)

Abstract:
A *biclique* of a graph G is a maximal complete bipartite induced subgraph of G. We define the *biclique graph* of G, $KB(G)$, as the intersection graph of the family of all bicliques of G. A graph G is a biclique graph if there exists a graph H such that $KB(H) = G$. We formulate a general characterization for this class and additionally a characterization for the biclique graphs of bipartite graphs. We describe families of graphs which are not biclique graphs, for example, connected diamond-free graphs with more than 2 vertices. The proofs are based on new concepts such as bipartite-intersecting and bipartite-Helly families of sets.

Universal Cycles for Permutations with Suppressed Symbol

Speaker:
Aaron Williams (University of Victoria)

Abstract:
De Bruijn constructed circular strings of length 2^n where each substring of length n contains a unique binary string. Universal Cycles for permutations of $\{1, 2, \ldots, n\}$ do not directly exist when $n \geq 3$. However, we construct circular strings of length $n!$ where

each substring of length $n-1$ is unique. Jackson had proved that such strings exist, and Knuth noticed that every permutation can be inferred by appending the unique "missing" final symbol to each substring.

Index

Timetable CanaDAM'07

Monday 28				
9:00	Opening remarks			
9:15	Janos Pach			
10:05	Coffee break (shorter)			
10:25	Furedi	Brewster	Mortveit	Shi
10:50	Dumitrescu	Bonato	Fuks	Choi
11:15	Valtr	Collins	Jarrah	Cai
11:40	Felsner	Stevens	Pivato	Nargis
12:05	Radoicic	Tardif	Hansson	Wu
12:30	Lunch			
14:00	Albertson	Gaur	Dalton	Stern
14:25	Boutin	Ghebleh	Mitjana	Tang
14:50	Short break			
14:55	Xuding Zhu			
15:45	Coffee break			
16:15	Stiebitz	MacGillivray	Moura	Dean
16:40	West	Hartnell	Danziger	Oellerman
17:05	Kral	Klostermeyer	Meagher	Dewar
17:30	Raspaud	Clarke	Cheng	Wagner
17:55	Kierstead	Dyer	Cohen	Jungic
18:30	Reception			

Tuesday 29						
	P1	L1	L2	L3	L4	
9:00	Bill Pulleyblank					
9:50	Coffee break					
10:20	Bezdek	Kano	Martinez	Benecke	Hu	
10:45	Alfakih	Hamburger	Kuba	Dershowitz	Milanic	
11:10	Zhang	Whitesides	Kirkpatrick	Macajova	Friggstad	
11:35	Bremner	Kratochvil	Dong	Foniok	Nielsen	
12:00	Terlaky	Solymosi	Mishna	Matos Camach	Cameron	
12:25	Lunch					
14:30	Peter Winkler					
15:20	Coffee break					
15:50	Galvin	West	Ekim	Godsil	Chow	
16:15	Gamarnik	Simonyi	Ries	Meagher	Epple	
16:40	Bayati	Tardos	W. Bein	Roy	Bang-Jensen	
17:05	Hayes	Mihok	D. Bein	Martin	Guevara	
17:30	Flaxman	Salavatipour	Pickl	Tanaka	Dimitromanolak	
17:55	Kurz	King	Weber	Terwilliger	Kirkpatrick	
18:20						

Wednesday 30						
	P1	L1	L2	L3	L4	
9:00	Vera Sos					
9:50	Coffee break					
10:20	Skokan	Zha	Samal	Hayward	Ghobadi	
10:45	Mubayi	Stephens	Cioaba	Isaak	Tuhin	
11:10	Verstraete	Ellingham	Kirkland	Ghosh	Tedder	
11:35	Furedi	Albertson	Godsil	Elmallah	Olver	
12:00	Solymosi	Samal	Friedman	Marcotte	Trenk	
12:25	Lunch					
14:30	Valerie King					
15:20	Coffee break					
15:50	Talwar	Kawarabayashi	Lam	Mynhardt	Protti	
16:15	Wieder	Oum	van Rees	Henning	McKee	
16:40	Batu	Li	Keranen	Edwards	Duran	
17:05	Ergun	Reed	Stinson	Walsh	Kochol	
17:30	Martin	Mohar	Wei	Weston	Stacho	
17:55	Problem session					
18:40	Student reception					

Thursday 31				
	P1	L1	L2	L3
9:00	Bruce Shepherd			
9:50	Coffee break			
10:20	Goddyn	Tannier	Panario	Kennedy
10:45	Makowsky	Condon	Bassino	Paul
11:10	Škoviera	Przytycka	Reed	Chu
11:35	Norine	Chauve	Duch	Dourado
12:00	Guenin	Fertin	Panholzer	Habib
12:25	Lunch			
14:00	David Sankoff			
14:50	Coffee break			
15:10	Lim	Henderson	Aazami	Santos
15:35	Shen	Enright	Anton	Harutyunyan
16:00	X	Scornavacca	Groshaus	Williams
16:25	Conference ends			