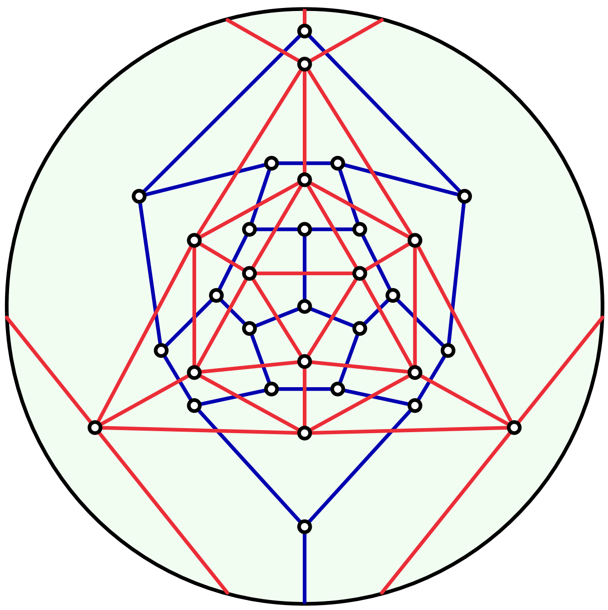
Program and Abstracts

CanaDAM 2021

The Canadian Discrete and Algorithmic Mathematics Conference

2021.canadam.math.ca



May 25 – May 28, 2021

This program was generated on: May 19, 2021

Table of Contents

List of Abbreviations

CM = Contributed Minisymposium CT = Contributed Talk IM = Invited Minisymposium SM = Special Minisymposium

PIL	Public Interest Lecture
Plenary	Plenary Speakers
CM1	Algebraic and Combinatorial Approaches to Designs and Codes - Part I
CM2	Arithmetic Combinatorics - Part I
CM3	Chemical Graph Theory - Part I
CM4	Computational proof techniques for combinatorics on words
CM5	Extremal problems for hypergraphs
CM6	Graph Searching
CM7	Algebraic and Combinatorial Approaches to Designs and Codes - Part II
CM8	Chemical Graph Theory - Part II
CM9	Cycles in Planar Graphs
CM10	Graph Product Structure Theory
CM11	Movement and symmetry in graphs - Part I
CM12	Algebraic and Combinatorial Approaches to Designs and Codes - Part III
CM13	Arithmetic Combinatorics - Part II
CM14	Chemical Graph Theory - Part III
CM15	The Metric Dimension of a Graph and its Variants - Part I
CM16	Average Graph Parameters - Part I
CM17	Graph Polynomials - Part I
CM18	Recent aspects of sphere packings - Part I
CM19	Coherent configurations with few fibers - Part I
CM20	Spectral Graph Theory - Part I
CM21	The Metric Dimension of a Graph and its Variants - Part II
CM22	Coherent configurations with few fibers - Part II
CM23	Graph Polynomials - Part II
CM24	New Trends in Analytic Combinatorics
CM25	Recent aspects of sphere packings - Part II
CM26	Algorithms for interval graphs and related families - Part I
CM27	Flow polytopes of graphs
CM28	Graph Colouring – surfaces, homomorphisms, and distinguishing
CM29	Movement and symmetry in graphs - Part II
CM30	Practical Applications of Design Theory - Part I
CM31	Spectral Graph Theory - Part II
CM32	Algorithms for interval graphs and related families - Part II
CM33	Average Graph Parameters - Part II
CM34	Enumerative and Extremal Graph Theory
CM35	Practical Applications of Design Theory - Part II
CT1	Random graphs
CT2	Broadcasting and Domination
CT3	Spectral graph theory and distance-regular graphs
CT4	Hamiltonicity
CT5	Scheduling and Algorithms
CT6	Game Theory
CT7	Graph Colouring I
CT8	Patterns and Compositions
CT9	Polynomials and groups
CT10	Arithmetic Combinatorics
CT11	Hypergraphs

Back to Table of Contents

Plenary Talks

Schedule

Tuesday May 25

10:00 - 11:00 László Végh (London School of Economics), *The circuit imbalance measure and its role in linear programming* (p. 40)

14:10 - 15:10 Natasha Morrison (University of Victoria), *Uncommon systems of equations* (p. 40)

Wednesday May 26

10:00 - 11:00 Yufei Zhao (Massachusetts Institute of Technology), *Extremal problems in discrete geometry* (p. 40)

14:10 - 15:10 Caroline Colijn (Simon Fraser University), *Mathematics and policy in the COVID-19 pandemic* (p. 41)

Thursday May 27

10:00 - 11:00 Mireille Bousquet-Mélou (CNRS, Université de Bordeaux), *Counting lattice walks confined to cones* (p. 41)

14:10 - 15:10 William T. Trotter (Georgia Tech University), *Posets with Planar Cover Graphs* (p. 41)

Friday May 28

14:10 - 15:10 Sergey Norin (McGill University), *Recent progress towards Hadwiger's conjecture* (p. 42)

Invited Minisymposia

	Topic	Date	Time
IM1	Combinatorial Optimization - Part I	Tuesday May 25	11:20 - 13:45
IM2	Invitation to distributed graph algorithms	Tuesday May 25	11:20 - 13:45
IM3	Approximation Algorithms	Tuesday May 25	15:30 - 17:55
IM4	Discrete Geometry	Wednesday May 26	11:20 - 13:45
IM5	Extremal Combinatorics	Wednesday May 26	11:20 - 13:45
IM6	In honour of Pavol Hell - Part I	Wednesday May 26	11:20 - 13:45
IM7	Invitation to Sparsity	Wednesday May 26	11:20 - 13:45
IM8	Combinatorial Optimization - Part II	Wednesday May 26	15:30 - 17:55
IM9	Discrete and algorithmic mathematics in biology and epidemiology - Part I	Wednesday May 26	15:30 - 17:25
IM10	In honour of Pavol Hell - Part II	Wednesday May 26	15:30 - 17:55
IM11	Discrete and algorithmic mathematics in biology and epidemiology - Part II	Thursday May 27	11:20 - 13:15
IM12	Generating series and confined lattice walks - Part I	Thursday May 27	11:20 - 13:15
IM13	Combinatorics on Posets - Part I	Thursday May 27	15:30 - 17:55
IM14	Invitation to Reconfiguration - Part I	Thursday May 27	15:30 - 17:55
IM15	Probabilistic Approaches	Thursday May 27	15:30 - 17:55
IM16	Combinatorics on Posets - Part II	Friday May 28	11:20 - 13:15
IM17	Generating series and confined lattice walks - Part II	Friday May 28	11:20 - 13:15
IM18	Invitation to Reconfiguration - Part II	Friday May 28	15:30 - 17:55
IM19	Structural Graph Theory	Friday May 28	15:30 - 17:55

Contributed Minisymposia

	Topic	Date	Time
CM1	Algebraic and Combinatorial Approaches to Designs and Codes - Part I	Tuesday May 25	11:20 - 13:45
CM2	Arithmetic Combinatorics - Part I	Tuesday May 25	11:20 - 13:45
CM3	Chemical Graph Theory - Part I	Tuesday May 25	11:20 - 13:45
CM4	Computational proof techniques for combinatorics on words	Tuesday May 25	11:20 - 13:45
CM5	Extremal problems for hypergraphs	Tuesday May 25	11:20 - 13:45
CM6	Graph Searching	Tuesday May 25	11:20 - 13:45
CM7	Algebraic and Combinatorial Approaches to Designs and Codes - Part II	Tuesday May 25	15:30 - 17:55
CM8	Chemical Graph Theory - Part II	Tuesday May 25	15:30 - 17:55
CM9	Cycles in Planar Graphs	Tuesday May 25	15:30 - 17:55
CM10	Graph Product Structure Theory	Tuesday May 25	15:30 - 17:55
CM11	Movement and symmetry in graphs - Part I	Tuesday May 25	15:30 - 17:25
CM12	Algebraic and Combinatorial Approaches to Designs and Codes - Part III	Wednesday May 26	11:20 - 13:45
CM13	Arithmetic Combinatorics - Part II	Wednesday May 26	11:20 - 13:45
CM14	Chemical Graph Theory - Part III	Wednesday May 26	11:20 - 13:45
CM15	The Metric Dimension of a Graph and its Variants - Part I	Wednesday May 26	11:20 - 13:45
CM16	Average Graph Parameters - Part I	Wednesday May 26	15:30 - 17:55
CM17	Graph Polynomials - Part I	Wednesday May 26	15:30 - 17:55
CM18	Recent aspects of sphere packings - Part I	Wednesday May 26	15:30 - 17:55
CM19	Coherent configurations with few fibers - Part I	Thursday May 27	11:20 - 13:15
CM20	Spectral Graph Theory - Part I	Thursday May 27	11:20 - 13:15
CM21	The Metric Dimension of a Graph and its Variants - Part II	Thursday May 27	11:20 - 13:15
CM22	Coherent configurations with few fibers - Part II	Thursday May 27	15:30 - 17:25
CM23	Graph Polynomials - Part II	Thursday May 27	15:30 - 17:55
CM24	New Trends in Analytic Combinatorics	Thursday May 27	15:30 - 17:55
CM25	Recent aspects of sphere packings - Part II	Thursday May 27	15:30 - 17:55
CM26	Algorithms for interval graphs and related families - Part I	Friday May 28	11:20 - 13:45
CM27	Flow polytopes of graphs	Friday May 28	11:20 - 13:45
CM28	Graph Colouring – surfaces, homomorphisms, and distinguishing	Friday May 28	11:20 - 13:45
CM29	Movement and symmetry in graphs - Part II	Friday May 28	11:20 - 13:45
CM30	Practical Applications of Design Theory - Part I	Friday May 28	11:20 - 13:45
CM31	Spectral Graph Theory - Part II	Friday May 28	11:20 - 13:15
CM32	Algorithms for interval graphs and related families - Part II	Friday May 28	15:30 - 17:55
CM33	Average Graph Parameters - Part II	Friday May 28	15:30 - 17:55
CM34	Enumerative and Extremal Graph Theory	Friday May 28	15:30 - 17:55
CM35	Practical Applications of Design Theory - Part II	Friday May 28	15:30 - 17:55

Back to Table of Contents

Contributed Talks

	Topic	Date	Time
CT1	Random graphs	Tuesday May 25	11:20 - 13:45
CT2	Broadcasting and Domination	Tuesday May 25	15:30 - 17:55
CT3	Spectral graph theory and distance-regular graphs	Tuesday May 25	15:30 - 17:55
CT4	Hamiltonicity	Wednesday May 26	11:20 - 13:45
CT5	Scheduling and Algorithms	Wednesday May 26	11:20 - 13:15
CT6	Game Theory	Wednesday May 26	15:30 - 17:55
CT7	Graph Colouring I	Wednesday May 26	15:30 - 17:25
CT8	Patterns and Compositions	Wednesday May 26	15:30 - 17:55
CT9	Polynomials and groups	Wednesday May 26	15:30 - 17:55
CT10	Arithmetic Combinatorics	Thursday May 27	11:20 - 13:15
CT11	Hypergraphs	Thursday May 27	11:20 - 13:15
CT12	Orientations	Thursday May 27	11:20 - 13:15
CT13	Potage of algorithmic designs	Thursday May 27	11:20 - 13:15
CT14	Structures in Graphs	Thursday May 27	11:20 - 13:15
CT15	Graph Colouring II	Thursday May 27	15:30 - 17:55
CT16	Structural Graph Theory	Thursday May 27	15:30 - 17:55
CT17	Contributed Talks II	Friday May 28	11:20 - 13:45
CT18	Contributed Talks I	Friday May 28	15:30 - 17:55
CT19	Contributed Talks III	Friday May 28	15:30 - 17:55
CT20	Flows and signed graphs	Friday May 28	15:30 - 17:55
CT21	Posets and lattices	Friday May 28	15:30 - 17:55

Schedule Overview

<table>
<tr><th colspan="5">CanaDAM 2021</th></tr>
<tr><th></th><th>Tuesday</th><th>Wednesday</th><th>Thursday</th><th>Friday</th></tr>
<tr><td>Plenaries
10:00-10:00</td><td>László Végh</td><td>Yufei Zhao</td><td>Mireille Bousquet-Mélou</td><td></td></tr>
<tr><td>10:00-11:00</td><td></td><td></td><td></td><td>Gil Kalai</td></tr>
<tr><td>Sessions
11:20-13:15</td><td></td><td></td><td>CM19 Coherent configurations with few fibers - Part I</td><td></td></tr>
<tr><td rowspan="2">Sessions
11:20-13:45</td><td></td><td>CT5 Scheduling and Algorithms</td><td></td><td>CM31 Spectral Graph Theory - Part II</td></tr>
<tr><td>CM1 Algebraic and Combinatorial Approaches to Designs and Codes - Part I</td><td>CM12 Algebraic and Combinatorial Approaches to Designs and Codes - Part III</td><td></td><td>CM26 Algorithms for interval graphs and related families - Part I</td></tr>
<tr><td>13:20-14:10</td><td></td><td></td><td>Women in Math Networking Event</td><td></td></tr>
<tr><td>Plenaries
14:10-14:10</td><td>Natasha Morrison</td><td>Caroline Colijn</td><td>William T. Trotter</td><td>Sergey Norin</td></tr>
<tr><td rowspan="2">Sessions
15:30-17:55</td><td>CM11 Movement and symmetry in graphs - Part I</td><td>CT7 Graph Colouring I</td><td>CM22 Coherent configurations with few fibers - Part II</td><td></td></tr>
<tr><td>CM7 Algebraic and Combinatorial Approaches to Designs and Codes - Part II</td><td>CM16 Average Graph Parameters - Part I</td><td>CM23 Graph Polynomials - Part II</td><td>CM32 Algorithms for interval graphs and related families - Part II</td></tr>
</table>

Back to Table of Contents

Detailed Daily Schedule

Tuesday May 25

10:00 - 11:00	László Végh (London School of Economics), *The circuit imbalance measure and its role in linear programming*, Plenary (p. 40)
11:20 - 11:45	Christoph Hunkenschröder (TU Berlin), *Block-Structured Integer and Linear Programming in Near Linear Time*, IM1 (p. 43)
11:20 - 11:45	Yannic Maus (Technion, Israel Institute of Technology), *Distributed Graph Coloring Made Easy*, IM2 (p. 45)
11:20 - 11:45	Curtis Bright (University of Windsor), *SAT solvers and combinatorics problems*, CM4 (p. 53)
11:20 - 11:45	Stefan Glock (ETH Zürich), *The intersection spectrum of 3-chromatic intersecting hypergraphs*, CM5 (p. 55)
11:20 - 11:45	Elizabeth Hartung (Massachusetts College of Liberal Arts, USA), *Resonance Structures and Aromaticity in Capped Carbon Nanotubes*, CM3 (p. 51)
11:20 - 11:45	Fionn Mc Inerney (CISPA Helmholtz Center for Information Security), *Eternal Domination in D-Dimensional Grids*, CM6 (p. 57)
11:20 - 11:45	Jingzhou Na (Simon Fraser University), *Perfect Sequence Covering Arrays*, CM1 (p. 47)
11:20 - 11:45	Sarah Peluse (Institute for Advanced Study), *An asymptotic version of the prime power conjecture for perfect difference sets*, CM2 (p. 49)
11:20 - 11:45	David de Boer (Korteweg-de Vries Institute, UvA), *Uniqueness of the Gibbs measure for the 4-state anti-ferromagnetic Potts model on the regular tree*, CT1 (p. 59)
11:50 - 12:15	Sebastian Brandt (ETH Zurich), *Round Elimination: A Technique for Proving Distributed Lower Bounds*, IM2 (p. 45)
11:50 - 12:15	Edin Husić (London School of Economics), *Approximating Nash Social Welfare under Rado Valuations*, IM1 (p. 43)
11:50 - 12:15	Joel D. Day (Loughborough University), *Computational methods for solving word equations*, CM4 (p. 53)
11:50 - 12:15	Jack Graver (Syracuse University, USA), *The Clar - Fries Mystery*, CM3 (p. 51)
11:50 - 12:15	Tom Kelly (University of Birmingham), *A proof of the Erdős–Faber–Lovász conjecture*, CM5 (p. 55)
11:50 - 12:15	Karen Meagher (University of Regina), *Erdős-Ko-Rado theorems for 2-transitive groups*, CM1 (p. 47)
11:50 - 12:15	Bojan Mohar (Simon Fraser University), *Cops and robbers on surfaces*, CM6 (p. 57)
11:50 - 12:15	George Shakan (University of Oxford), *Effective Khovanskii Theorems*, CM2 (p. 49)
11:50 - 12:15	Jeroen Huijben (University of Amsterdam), *Sampling from the low temperature Potts model through a Markov chain on flows*, CT1 (p. 59)
12:20 - 12:45	Seri Khoury (Simons Institute, UC Berkeley), *The congest model: a glimpse into the challenges that arise due to bandwidth limitations.*, IM2 (p. 45)
12:20 - 12:45	Jason Li (Carnegie Mellon University), *Deterministic Mincut in Almost-Linear Time*, IM1 (p. 43)
12:20 - 12:45	Nancy Clarke (Acadia University), *A variation of the Cops and Robber game with a new capture condition*, CM6 (p. 57)
12:20 - 12:45	Stepan Holub (Charles University, Prague), *Proof assistants in combinatorics on words*, CM4 (p. 53)
12:20 - 12:45	Ander Lamaison (Masaryk University), *Hypergraphs with minimum uniform Turán density*, CM5 (p. 55)
12:20 - 12:45	Petra Žigert Pleteršek (University of Maribor, Slovenia), *Topological indices of unsaturated hydrocarbons*, CM3 (p. 52)
12:20 - 12:45	Andriaherimanana Razafimahatratra (University of Regina), *On transitive groups that do not have the Erdős-Ko-Rado property*, CM1 (p. 47)
12:20 - 12:45	Max Wenqiang Xu (Stanford University), *Discrepancy in Modular Arithmetic Progressions*, CM2 (p. 49)
12:20 - 12:45	Amedeo Sgueglia (London School of Economics), *Clique factors in randomly perturbed graphs*, CT1 (p. 59)
12:50 - 13:15	Soheil Behnezhad (University of Maryland), *Locality and the Stochastic Matching Problem*, IM2 (p. 46)
12:50 - 13:15	Kent Quanrud (Purdue University), *Faster Algorithms for Rooted Connectivity in Directed Graphs*, IM1 (p. 44)
12:50 - 13:15	William Kinnersley (University of Rhode Island), *Infinitely fast robbers on grids*, CM6 (p. 58)
12:50 - 13:15	Richard Lang (Heidelberg University), *Minimum degree conditions for tight Hamilton cycles*, CM5 (p. 55)
12:50 - 13:15	Aidan W. Murphy (Virginia Tech, VA), *Codes from curves and repair*, CM1 (p. 48)

12:50 - 13:15	Cosmin Pohoata (Yale University), *Zero-sum subsets in vector spaces over finite fields*, CM2 (p. 50)
12:50 - 13:15	Jeffrey Shallit (University of Waterloo), *Proving theorems in combinatorics on words with Walnut*, CM4 (p. 54)
12:50 - 13:15	Dong Ye (Middle Tennessee State University, USA), *Resonance graphs on perfect matchings*, CM3 (p. 52)
12:50 - 13:15	Maksim Zhukovskii (MIPT), *Cycle saturation in random graphs*, CT1 (p. 60)
13:20 - 13:45	Huang Lingxiao (Institute for Interdisciplinary Information Sciences), *Coreset construction for clustering: offline and distributed settings*, IM2 (p. 46)
13:20 - 13:45	Sahil Singla (Princeton University and Institute for Advanced Study), *Improved Truthful Mechanisms for Combinatorial Auctions*, IM1 (p. 44)
13:20 - 13:45	Vesna Andova (Ss. Cyril and Methodius University, Northern Macedonia), *On Three Constructions of Nanotori*, CM3 (p. 52)
13:20 - 13:45	Melissa Huggan (Ryerson University), *Locating an invisible adversary*, CM6 (p. 58)
13:20 - 13:45	Yifan Jing (University of Illinois at Urbana-Champaign), *Minimal and nearly minimal measure expansions in connected unimodular groups*, CM2 (p. 50)
13:20 - 13:45	Bill Martin (Worcester Polytechnic Institute, MA), *Selecting resilient functions for fault-tolerant random bit generation*, CM1 (p. 48)
13:20 - 13:45	Reed Oei (University of Illinois), *Design and use of the Pecan system*, CM4 (p. 54)
13:20 - 13:45	Nicolás Sanhueza-Matamala (Czech Academy of Sciences), *Spanning bounded-degree tight k-trees*, CM5 (p. 56)
13:20 - 13:45	R W R Darling (U.S. Department of Defense), *Efficient comparison-based learning via partitioned local depth for near neighbors*, CT1 (p. 60)
14:10 - 15:10	Natasha Morrison (University of Victoria), *Uncommon systems of equations*, Plenary (p. 40)
15:30 - 15:55	Deeparnab Chakrabarty (Dartmouth College), *Algorithms for minimum norm combinatorial optimization*, IM3 (p. 61)
15:30 - 15:55	Vida Dujmovic (University of Ottawa), *Product structure Theorem(s)*, CM10 (p. 69)
15:30 - 15:55	Patrick W. Fowler (University of Sheffield, UK), *The Chemical Significance of Graph Energy*, CM8 (p. 65)
15:30 - 15:55	Karen Gunderson (University of Manitoba), *Bootstrap percolation on infinite graphs*, CM11 (p. 71)
15:30 - 15:55	Hadi Kharaghani (University of Lethbridge), *A class of balanced weighing matrices and the corresponding association scheme*, CM7 (p. 63)
15:30 - 15:55	Xiaonan Liu (Georgia Institute of Technology), *Number of Hamiltonian cycles in planar triangulations*, CM9 (p. 67)
15:30 - 15:55	Aysel Erey (Gebze Technical University), *Chromatic number and distance spectral radius*, CT3 (p. 75)
15:30 - 15:55	Kieka Mynhardt (University of Victoria), *Boundary independent broadcasts in graphs*, CT2 (p. 73)
16:00 - 16:25	Chandra Chekuri (University of Illinois, Urbana-Champaign), *Covering Multiple Submodular Constraints and Applications*, IM3 (p. 61)
16:00 - 16:25	Jim Davis (University of Richmond, VA), *Designs with the Symmetric Difference Property*, CM7 (p. 63)
16:00 - 16:25	Jeannette Janssen (Dalhousie University), *An approximation algorithm for finding the zero-forcing number of a graph*, CM11 (p. 71)
16:00 - 16:25	On-Hei Solomon Lo (University of Science and Technology of China), *Gaps in the cycle spectrum of polyhedral graphs*, CM9 (p. 67)
16:00 - 16:25	Dragan Stevanović (Mathematical Institute of the Serbian Academy of Sciences and Arts, Serbia), *On Hosoya's dormants and sprouts*, CM8 (p. 65)
16:00 - 16:25	David Wood (Monash University), *Planar graphs have bounded queue-number*, CM10 (p. 69)
16:00 - 16:25	Ahmad Mojallal (University of Regina), *The minimum number of distinct eigenvalues of threshold graphs*, CT3 (p. 75)
16:00 - 16:25	Aaron Slobodin (University of Victoria), *2-Limited Broadcast Domination in Grids*, CT2 (p. 73)
16:30 - 16:55	Anupam Gupta (Carnegie Mellon University), *Matroid-Based TSP Rounding for Half-Integral Solutions*, IM3 (p. 61)
16:30 - 16:55	Louis Esperet (Laboratoire G-SCOP (CNRS, Univ. Grenoble Alpes)), *Planar graphs have bounded nonrepetitive chromatic number*, CM10 (p. 69)

Back to Table of Contents

16:30 - 16:55	Emily A. Marshall (Arcadia University), *Hamiltonicity of planar graphs with a forbidden minor*, CM9 (p. 67)
16:30 - 16:55	Karen Meagher (University of Regina), *Open problems related to Erdős-Ko-Rado type results*, CM11 (p. 71)
16:30 - 16:55	Irene Sciriha (University of Malta, Malta), *The conductivity of the connected sum of root graphs with a common nullspace*, CM8 (p. 66)
16:30 - 16:55	Zeying Wang (Michigan Technological University, MI), *New necessary conditions on (negative) Latin square type partial difference sets in abelian groups*, CM7 (p. 63)
16:30 - 16:55	Jesmina Pervin (Indian Institute of Technology(Banaras Hindu University), Varanasi), *Q-integral connected graphs with maximum edge-degrees less than or equal to 8*, CT3 (p. 75)
16:30 - 16:55	Virgélot Virgile (University of Victoria), *Eternal domination and clique covering*, CT2 (p. 73)
17:00 - 17:25	Aleksandar Nikolov (University of Toronto), *Maximizing Determinants under Combinatorial Constraints*, IM3 (p. 62)
17:00 - 17:25	Piotr Micek (Jagiellonian University), *Centered colorings and vertex rankings*, CM10 (p. 70)
17:00 - 17:25	Joy Morris (University of Lethbridge), *Regular Representations*, CM11 (p. 72)
17:00 - 17:25	Jens M. Schmidt (Hamburg University of Technology), *The Isolation Lemma*, CM9 (p. 68)
17:00 - 17:25	Riste Škrekovski (University of Ljubljana, Slovenia), *On 12-regular nut graphs*, CM8 (p. 66)
17:00 - 17:25	Ian Wanless (Monash University, Australia), *Omniversal Latin squares*, CM7 (p. 64)
17:00 - 17:25	Brendan Rooney (Rochester Institute of Technology), *Efficient k-Domination in Hamming Graphs*, CT2 (p. 74)
17:00 - 17:25	Sanja Rukavina (Department of Mathematics, University of Rijeka, Croatia), *Self-orthogonal codes from equitable partitions of distance-regular graphs*, CT3 (p. 76)
17:30 - 17:55	Ola Svensson (Ecole Polytechnique Fédérale de Lausanne), *The Primal-Dual method for Learning Augmented Algorithms*, IM3 (p. 62)
17:30 - 17:55	Gwenaël Joret (Université Libre de Bruxelles), *Sparse universal graphs for planarity*, CM10 (p. 70)
17:30 - 17:55	Jelena Sedlar (University of Split, Croatia), *Two types of indices and their extremal trees*, CM8 (p. 66)
17:30 - 17:55	Abhinav Shantanam (Simon Fraser University), *Pancyclicity in 4-connected planar graphs*, CM9 (p. 68)
17:30 - 17:55	Xiande Zhang (University of Science and Technology of China), *Optimal ternary constant weight codes in l_1-metric*, CM7 (p. 64)
17:30 - 17:55	Anna Bachstein (Clemson University), *Compelling Colorings: A generalization of the dominator chromatic number*, CT2 (p. 74)
17:30 - 17:55	Ludmila Tsiovkina (IMM UB RAS), *On some classes of vertex-transitive distance-regular antipodal covers of complete graphs*, CT3 (p. 76)

Wednesday May 26

10:00 - 11:00	Yufei Zhao (Massachusetts Institute of Technology), *Extremal problems in discrete geometry*, Plenary (p. 40)
11:20 - 11:45	Zdeněk Dvořák (Charles University), *Sparsity: Concepts and applications*, IM7 (p. 83)
11:20 - 11:45	Dor Minzer (Massachusetts Institute of Technology), *Optimal tiling of the Euclidean space using permutation-symmetric bodies*, IM4 (p. 77)
11:20 - 11:45	Wojciech Samotij (Tel Aviv University), *Sharp thresholds for Ramsey properties*, IM5 (p. 79)
11:20 - 11:45	Xuding Zhu (Zhejiang Normal University), *On Hedetniemi's Conjecture*, IM6 (p. 81)
11:20 - 11:45	Marco Buratti (University of Perugia, Italy), *Old and new results on elementary abelian 2-designs*, CM12 (p. 85)
11:20 - 11:45	Florent Foucaud (University Clermont Auvergne, France), *Bounds on the order of a graph of given metric dimension and diameter: studies for standard graph classes*, CM15 (p. 91)
11:20 - 11:45	Weikun He (Korea Institute for Advanced Study), *Sum-product estimates in semisimple algebras and random walks on the torus*, CM13 (p. 87)
11:20 - 11:45	Tomaž Pisanski (University of Ljubljana, Slovenia), *Flat benzenoid complexes*, CM14 (p. 89)
11:20 - 11:45	Alane de Lima (Federal University of Paraná (UFPR)), *Sample Complexity in Graph Problems*, CT5 (p. 95)
11:20 - 11:45	Carol T. Zamfirescu (Ghent University, Belgium), *K_2-hamiltonian graphs*, CT4 (p. 93)
11:50 - 12:15	Shenwei Huang (Nankai University), *k-critical graphs in P5-free graphs*, IM6 (p. 81)
11:50 - 12:15	Shoham Letzter (University College London), *Chi-boundedness of graphs with no cycle with exactly k chords*, IM5 (p. 79)
11:50 - 12:15	Alexandr Polyanskii (Moscow Institute of Physics and Technology), *A cap covering theorem*, IM4 (p. 77)
11:50 - 12:15	Felix Reidl (Birkbeck University of London), *Algorithmic aspects I*, IM7 (p. 83)
11:50 - 12:15	Tomislav Došlić (University of Zagreb, Croatia), *Nice subgraphs of fullerene graphs with prescribed components*, CM14 (p. 89)
11:50 - 12:15	Nikolay Kaleyski (University of Bergen, Norway), *Bounding the Hamming distance between APN functions*, CM12 (p. 85)
11:50 - 12:15	Simon Machado (University of Cambridge), *Approximate Subgroups, Meyer Sets and Arithmeticity*, CM13 (p. 87)
11:50 - 12:15	Ismael Gonzalez Yero (Universidad de Cadiz, Spain), *Comparing the metric and edge metric dimensions of graphs*, CM15 (p. 91)
11:50 - 12:15	Jan Goedgebeur (Ghent University), *Graphs with few hamiltonian cycles*, CT4 (p. 93)
11:50 - 12:15	Sarah NOURI (RECITS laboratory, Faculty of Mathematics, USTHB University), *Scheduling on identical machines with conflict graphs*, CT5 (p. 95)
12:20 - 12:45	Jaroslav Nešetřil (Charles University), *In praise of homomorphisms*, IM6 (p. 81)
12:20 - 12:45	Michał Pilipczuk (University of Warsaw), *Algorithmic aspects II*, IM7 (p. 83)
12:20 - 12:45	Yair Shenfeld (Massachusetts Institute of Technology), *Extremal structures of log-concave sequences via convex geometry*, IM4 (p. 77)
12:20 - 12:45	Katherine Staden (University of Oxford), *Ringel's tree packing conjecture*, IM5 (p. 79)
12:20 - 12:45	Eimear Byrne (University College Dublin, Ireland), *New subspace designs from q-matroids*, CM12 (p. 85)
12:20 - 12:45	Arturo Rodriguez Fanlo (University of Oxford), *On metric approximate subgroups*, CM13 (p. 87)
12:20 - 12:45	Tero Laihonen (Turku University, Finland), *On Vertices Belonging to Every Metric Basis*, CM15 (p. 91)
12:20 - 12:45	Damir Vukičević (University of Split, Croatia), *Vukicevic, Boskovic: Adriatic graphs - mathematical properties and applications to correct NIST database*, CM14 (p. 89)
12:20 - 12:45	Abdennour AZERINE (Université des Sciences et de la Technologie Houari Boumedienne, Alger, Algérie), *Two-machine no-wait flow shop with two agents and makespan criteria*, CT5 (p. 95)
12:20 - 12:45	Alberto Espuny Díaz (Technische Universität Ilmenau), *Hamiltonicity of randomly perturbed graphs*, CT4 (p. 93)
12:50 - 13:15	Kathie Cameron (Wilfred Laurier University), *A Parity Theorem About Trees with Specified Degrees*, IM6 (p. 81)

12:50 - 13:15	Patrice Ossona de Mendez (CNRS, École des Hautes Études en Sciences Sociales), *A model theoretical approach to sparsity*, IM7 (p. 83)
12:50 - 13:15	Rob Morris (Instituto de Matemática Pura e Aplicada), *Flat Littlewood Polynomials Exist*, IM5 (p. 80)
12:50 - 13:15	Cosmin Pohoata (Yale University), *On the Zarankiewicz problem for graphs with bounded VC-dimension*, IM4 (p. 78)
12:50 - 13:15	Gabriel Conant (University of Cambridge), *Quantitative stable arithmetic regularity in arbitrary finite groups*, CM13 (p. 88)
12:50 - 13:15	Gohar Kyureghyan (University of Rostock, Germany), *Image sets of APN maps*, CM12 (p. 86)
12:50 - 13:15	Elizabeth Maritz (University of the Free State, South Africa), *On the partition dimension of circulant graphs*, CM15 (p. 92)
12:50 - 13:15	Lavanya Selvaganesh (Indian Institute of Technology (BHU), India), *Bounds Of The Symmetric Division Deg Index For Graphs With Cyclomatic Number At Most 2 And With A Perfect Matching*, CM14 (p. 90)
12:50 - 13:15	Radek Hušek (Charles University, Czech Republic), *Counting Circuit Double Covers*, CT4 (p. 94)
12:50 - 13:15	Nazim Sami (RECITS laboratory, faculty of Mathematics, Ushtb University), *New algorithms for the two-machine chain-reentrant shop problem with the no-wait constraint*, CT5 (p. 96)
13:20 - 13:45	Marcelo Campos (Instituto de Matemática Pura e Aplicada), *Singularity of random symmetric matrices revisited*, IM5 (p. 80)
13:20 - 13:45	Arash Rafiey (Indiana State University), *2-SAT and Transitivity Clauses*, IM6 (p. 82)
13:20 - 13:45	Sebastian Siebertz (University of Bremen), *Characterizing sparsity by games.*, IM7 (p. 84)
13:20 - 13:45	Josh Zahl (University of British Columbia), *Sphere tangencies, line incidences, and Lie's line-sphere correspondence*, IM4 (p. 78)
13:20 - 13:45	Nino Bašić (University of Primorska, Slovenia), *Pentagonal Clusters in Fullerenes*, CM14 (p. 90)
13:20 - 13:45	Dorota Kuziak (Universidad de Cadiz, Spain), *The strong metric dimension of a graph*, CM15 (p. 92)
13:20 - 13:45	Alex Pott (Otto-von-Guericke University, Germany), *Designs and bent functions*, CM12 (p. 86)
13:20 - 13:45	Chieu-Minh Tran (University of Notre Dame), *A nonabelian Brunn-Minkowski inequality*, CM13 (p. 88)
13:20 - 13:45	Craig Larson (Virginia Commonwealth University), *Deming Decompositions and Egervary Graphs*, CT4 (p. 94)
14:10 - 15:10	Caroline Colijn (Simon Fraser University), *Mathematics and policy in the COVID-19 pandemic*, Plenary (p. 41)
15:30 - 15:55	Richard Brewster (Thompson Rivers University), *Characterizing Circular Colouring Mixing for $p/q < 4$*, IM10 (p. 101)
15:30 - 15:55	Baptiste Elie (MIVGEC, Université Montpellier), *The source of individual heterogeneity shapes infectious disease outbreaks*, IM9 (p. 99)
15:30 - 15:55	Vera Traub (ETH Zurich), *Improving the Approximation Ratio for Capacitated Vehicle Routing*, IM8 (p. 97)
15:30 - 15:55	Iain Beaton (Dalhousie University), *On the Unimodality of Domination Polynomials*, CM17 (p. 105)
15:30 - 15:55	Peter Dankelmann (University of Johannesburg), *On the Wiener Index of Graphs with Large Maximum Degree*, CM16 (p. 103)
15:30 - 15:55	Serge Vladut (Aix-Marseille University, France), *Lattices with exponentially large kissing numbers*, CM18 (p. 107)
15:30 - 15:55	Alexander Clow (St. Francis Xavier University), *From Poset Games to Partially Ordered Games*, CT6 (p. 109)
15:30 - 15:55	Logan Crew (University of Waterloo), *Identities of the Chromatic and Tutte Symmetric Functions*, CT9 (p. 115)
15:30 - 15:55	Rachel Domagalski (Michigan State University), *Pattern Avoidance in Circular Permutations*, CT8 (p. 113)
15:30 - 15:55	Mária Šurimová (Pavol Jozef Šafárik University), *Adynamic coloring of graphs*, CT7 (p. 111)
16:00 - 16:25	Xingru Chen (Dartmouth College), *Effectiveness of Massive Travel Restrictions on Mitigating Outbreaks of COVID-19 in China*, IM9 (p. 99)
16:00 - 16:25	David Kirkpatrick (UBC), *Forbidden Induced Subgraphs for k-Nested Interval Graphs*, IM10 (p. 101)
16:00 - 16:25	Zhuan Khye Koh (London School of Economics), *An Accelerated Newton-Dinkelbach Method and its Application to Two Variables Per Inequality Systems*, IM8 (p. 97)

16:00 - 16:25	Danielle Cox (Mount Saint Vincent University), *Chromatic Polynomials of 2-Edge-Coloured Graphs*, CM17 (p. 105)
16:00 - 16:25	Alexander Kolpakov (University of Neuchatel, Neuchatel, Switzerland), *Kissing number in non-Euclidean spaces of constant sectional curvature*, CM18 (p. 107)
16:00 - 16:25	Riste Skrekovski (University of Ljubljana), *Some problems and results on some graph parameters*, CM16 (p. 103)
16:00 - 16:25	Hossein Teimoori Faal (Allameh Tabataba'i University, Tehran, Iran), *The Generalized Face Handshaking Lemma and Higher Derivatives of Face Polynomials*, CT9 (p. 115)
16:00 - 16:25	Mozhgan Farahani (Memorial University of Newfoundland), *The deduction game to capture robbers*, CT6 (p. 109)
16:00 - 16:25	John Gimbel (University of Alaska Fairbanks), *On Graphs with Proper Connection Number Two*, CT7 (p. 111)
16:00 - 16:25	Jinting Liang (Michigan State University), *Generating functions over avoidance sets of circular permutations*, CT8 (p. 113)
16:30 - 16:55	Jing Huang (University of Victoria), *Obstructions for local tournament orientation completions*, IM10 (p. 101)
16:30 - 16:55	Sharat Ibrahimpur (University of Waterloo), *Approximation Algorithms for Stochastic Minimum Norm Combinatorial Optimization*, IM8 (p. 97)
16:30 - 16:55	Wasiur KhudaBukhsh (Ohio State University), *Chemical reaction networks with covariates*, IM9 (p. 99)
16:30 - 16:55	Eva Czabarka (University of South Carolina), *Minimum Wiener index of planar triangulations and quadrangulations*, CM16 (p. 103)
16:30 - 16:55	Samantha Dahlberg (Arizona State University), *Chromatic symmetric functions and e-positivity*, CM17 (p. 105)
16:30 - 16:55	Maria Dostert (Royal Institute of Technology (KTH), Stockholm, Sweden), *Kissing number of the hemisphere in dimension 8*, CM18 (p. 107)
16:30 - 16:55	Ryan Hayward (University of Alberta), *Let's Play Hex: Some Open Problems*, CT6 (p. 109)
16:30 - 16:55	Gabriel Loos (Georgia Southern University), *Combinatorics of Cyclic Compositions*, CT8 (p. 113)
16:30 - 16:55	Zuzana Šárošiová (Pavol Jozef Šafárik University in Košice, Slovakia), *Algorithms for finding the interval chromatic number of trees*, CT7 (p. 111)
16:30 - 16:55	Foster Tom (UC Berkeley), *A combinatorial Schur expansion of triangle-free horizontal-strip LLT polynomials*, CT9 (p. 115)
17:00 - 17:25	Cesar Hernandez-Cruz (Universidad Nacional Autónoma de México), *Strongly Chordal Digraphs*, IM10 (p. 102)
17:00 - 17:25	Nathan Klein (University of Washington), *Approximating the minimum k-edge connected multi-subgraph problem*, IM8 (p. 98)
17:00 - 17:25	Joel Miller (La Trobe University), *Simulating epidemic spread on contact networks*, IM9 (p. 100)
17:00 - 17:25	David Galvin (University of Notre Dame), *The independence polynomial of the random tree*, CM17 (p. 106)
17:00 - 17:25	Alexey Glazyrin (The University of Texas Rio Grande Valley, USA), *Linear programming bounds revisited*, CM18 (p. 108)
17:00 - 17:25	Fadekemi Janet Osaye (Auburn University), *The average eccentricity of a graph with prescribed girth*, CM16 (p. 104)
17:00 - 17:25	Kyle MacKeigan (Dalhousie University), *Orthogonal Colourings of Random Geometric Graphs*, CT7 (p. 112)
17:00 - 17:25	Masood Masjoody (Simon Fraser University), *Confining the Robber on Cographs*, CT6 (p. 110)
17:00 - 17:25	Bruce Sagan (Michigan State University), *On a rank-unimodality conjecture of Morier-Genoud and Ovsienko*, CT8 (p. 113)
17:00 - 17:25	Laurence Wijaya (Institut Teknologi Bandung), *A Relationship Between Cayley-Dickson Process and The Generalized Study Determinant*, CT9 (p. 116)
17:30 - 17:55	Sami Davies (University of Washington), *Scheduling with Communication Delays via LP Hierarchies and Clustering*, IM8 (p. 98)
17:30 - 17:55	Gary MacGillivray (University of Victoria), *Frugal homomorphisms*, IM10 (p. 102)

Back to Table of Contents

17:30 - 17:55	János Makowsky (Technion - Israel Institute of Technology), *Graph polynomials unimodular for almost all graphs.*, CM17 (p. 106)
17:30 - 17:55	Lucas Mol (The University of Winnipeg), *The mean subtree order of graphs under edge addition*, CM16 (p. 104)
17:30 - 17:55	Oleg Musin (The University of Texas Rio Grande Valley, USA), *The SDP bound for spherical codes using their distance distribution*, CM18 (p. 108)
17:30 - 17:55	Ajay Kumar (Indian Institute of Technology (BHU), Varanasi, India), *Vertex connectivity of superpower graphs of dicyclic groups* T_{4n}, CT9 (p. 116)
17:30 - 17:55	Jérémie Turcotte (McGill University), *Finding the smallest 4-cop-win graph(s)*, CT6 (p. 110)
17:30 - 17:55	Hua Wang (Georgia Southern University), *Counting colored compositions and tilings*, CT8 (p. 114)

Thursday May 27

10:00 - 11:00	Mireille Bousquet-Mélou (CNRS, Université de Bordeaux), *Counting lattice walks confined to cones*, Plenary (p. 41)
11:20 - 11:45	Lucia Di Vizio (CNRS, Université de Versailles-St Quentin), *Differential transcendence for the Bell numbers and their relatives*, IM12 (p. 119)
11:20 - 11:45	Jianrong Yang (Sun Yat-sen University), *Developmental cell lineage trees, and the quantitative comparisons between them*, IM11 (p. 117)
11:20 - 11:45	Shonda Dueck (University of Winnipeg, Canada), *Logarithmic bounds on the threshold strong dimension of a graph*, CM21 (p. 125)
11:20 - 11:45	Stefan Gyurki (Slovak University of Technology), *The Paulus-Rozenfeld-Thompson graph on 26 vertices*, CM19 (p. 121)
11:20 - 11:45	Ferdinand Ihringer (Ghent University), *Strongly regular graphs satisfying the 4-vertex condition*, CM20 (p. 123)
11:20 - 11:45	Natalie Behague (Ryerson University), *The Cerny Conjecture and Synchronizing Times for k-sets in Automata*, CT12 (p. 131)
11:20 - 11:45	Alexander Clifton (Emory University), *An exponential bound for exponential diffsequences*, CT10 (p. 127)
11:20 - 11:45	Mehrdad Ghadiri (Georgia Institute of Technology), *Socially Fair k-Means Clustering*, CT13 (p. 133)
11:20 - 11:45	Robert Hickingbotham (Monash University), *Stack-number is not bounded by queue-number*, CT14 (p. 135)
11:20 - 11:45	Michal Stern (Academic College of Tel-Aviv Yaffo), *Minimum removal or insertion list for Clustered Spanning Tree by Paths*, CT11 (p. 129)
11:50 - 12:15	Helen Jenne (Université de Tours and Université d'Orléans), *Three-dimensional lattice walks confined to an octant: non-rationality of the second critical exponent*, IM12 (p. 119)
11:50 - 12:15	Christoph Weitkamp (Universität Göttingen), *GROMOV-WASSERSTEIN BASED PHYLOGENETIC TREE SHAPE COMPARISON*, IM11 (p. 117)
11:50 - 12:15	Bohdan Kivva (University of Chicago), *Robustness of the Johnson scheme under fusion and extension*, CM19 (p. 121)
11:50 - 12:15	Jephian Lin (National Sun Yat-sen University), *The strong spectral property for graphs*, CM20 (p. 123)
11:50 - 12:15	Beth Novick (Clemson University, USA), *A geometric characterization of the threshold strong dimension of a graph*, CM21 (p. 125)
11:50 - 12:15	Carl Feghali (Charles University), *Decomposing a triangle-free planar graph into a forest and a subcubic forest*, CT14 (p. 135)
11:50 - 12:15	Torin Greenwood (North Dakota State University), *Bounding monochromatic arithmetic progressions*, CT10 (p. 127)
11:50 - 12:15	Nick Harvey (Univeristy of British Columbia), *How to make predictions using two experts, forever*, CT13 (p. 133)
11:50 - 12:15	James Ross (University of New South Wales), *Sampling hypergraphs with given degrees*, CT11 (p. 129)
11:50 - 12:15	Ying Ying (Fay) Ye (University of Victoria), *Chordality of locally semicomplete and weakly quasi-transitive digraphs*, CT12 (p. 131)
12:20 - 12:45	Michael Singer (North Carolina State University), *Differentially Algebraic Generating Series for Walks in the Quarter Plane*, IM12 (p. 119)
12:20 - 12:45	Louxin Zhang (National University of Singapore), *The Bourque Distances for Mutation Trees of Cancers*, IM11 (p. 117)
12:20 - 12:45	Aida Abiad (Eindhoven University of Technology), *Neumaier graphs with few eigenvalues*, CM20 (p. 123)
12:20 - 12:45	Linda Eroh (University of Wisconsin, Oshkosh Campus, USA), *The threshold strong dimension of trees*, CM21 (p. 125)
12:20 - 12:45	Mikhail Muzychuk (Ben-Gurion University of the Negev), *On Jordan schemes*, CM19 (p. 122)
12:20 - 12:45	Glenn Hurlbert (Virginia Commonwealth University), *On intersecting families of independent sets in trees*, CT10 (p. 127)
12:20 - 12:45	Tomáš Kaiser (University of West Bohemia), *Edge-critical subgraphs of Schrijver graphs*, CT14 (p. 135)

12:20 - 12:45	Santiago Guzmán Pro (Facultad de Ciencias, UNAM), *Hereditary properties and forbidden orientations*, CT12 (p. 131)
12:20 - 12:45	Richard Santiago (ETH Zürich), *Non-monotone weakly submodular function maximization subject to a cardinality constraint*, CT13 (p. 133)
12:20 - 12:45	Sam Spiro (UC San Diego), *Cycle-free Subgraphs of Random Hypergraphs*, CT11 (p. 129)
12:50 - 13:15	Julia Palacios (Stanford University), *Distance-based summaries and modeling of evolutionary trees*, IM11 (p. 118)
12:50 - 13:15	Michael Wallner (TU Wien), *More Models of Walks Avoiding a Quadrant*, IM12 (p. 120)
12:50 - 13:15	Krystal Guo (University of Amsterdam), *Entanglement of free Fermions on distance-regular graphs*, CM20 (p. 124)
12:50 - 13:15	Grigory Ryabov (Novosibirsk State University), *Infinite family of nonschurian separable association schemes*, CM19 (p. 122)
12:50 - 13:15	Richard Tillquist (University of Colorado, USA), *A Bound on the Metric Dimension of Hamming Graphs and Applications in Machine Learning*, CM21 (p. 126)
12:50 - 13:15	Alexandre Blanché (LaBRI, Université de Bordeaux), *Gallai's path decomposition conjecture for planar graphs*, CT14 (p. 136)
12:50 - 13:15	Katarína Čekanová (Pavol Jozef Šafárik University, Košice, Slovakia), *Types of edges in embedded graphs with minimum degree 2*, CT12 (p. 132)
12:50 - 13:15	Stanisław Radziszowski (Rochester Institute of Technology), *On Some Generalized Vertex Folkman Numbers*, CT10 (p. 128)
12:50 - 13:15	Bruce Shepherd (UBC), *Single Tree Cut Approximators and Disjoint Paths in Outerplanar Graphs*, CT13 (p. 134)
12:50 - 13:15	Christian Winter (Karlsruhe Institute of Technology, Karlsruhe, Germany), *Size-Ramsey Number of Tight Paths*, CT11 (p. 130)
13:20 - 14:10	Women in Math Networking Event
14:10 - 15:10	William T. Trotter (Georgia Tech University), *Posets with Planar Cover Graphs*, Plenary (p. 41)
15:30 - 15:55	Patrice Ossona de Mendez (CNRS, École des Hautes Études en Sciences Sociales), *Small, sparse and ordered*, IM13 (p. 137)
15:30 - 15:55	Erik Demaine & Nicole Wein (MIT & University of Waterloo), *Hardness of Token Swapping on Trees*, IM14 (p. 139)
15:30 - 15:55	Annika Heckel (Ludwig-Maximilians-Universität München), *How does the chromatic number of a random graph vary?*, IM15 (p. 141)
15:30 - 15:55	Ferenc Bencs (Alfréd Rényi Institute of Mathematics), *Zero-free regions for some graph polynomials.*, CM23 (p. 145)
15:30 - 15:55	Robert Connelly (Cornell University, Ithaca, NY, USA), *Flipping and flowing*, CM25 (p. 149)
15:30 - 15:55	Dennis Epple (University of Toronto), *The Shrikhande Graph on the Crossroads of Algebraic and Topological Graph Theory*, CM22 (p. 143)
15:30 - 15:55	Michael Wallner (TU Wein), *Compacted binary trees and minimal automata admit stretched exponentials*, CM24 (p. 147)
15:30 - 15:55	Michael Barrus (University of Rhode Island), *Unigraphs and hereditary graph classes*, CT16 (p. 153)
15:30 - 15:55	Tomáš Madaras (Pavol Jozef Šafárik University in Košice, Slovakia), *Facial homogeneous colourings of graphs*, CT15 (p. 151)
16:00 - 16:25	Colin R Defant & Noah Kravitz (Princeton University), *Random Friends and Strangers Walking on Random Graphs*, IM14 (p. 139)
16:00 - 16:25	Matthew Jenssen (University of Birmingham), *Singularity of random symmetric matrices revisited*, IM15 (p. 141)
16:00 - 16:25	Gwenaël Joret (Université Libre de Bruxelles), *The extension dimension and the linear extension polytope of a poset*, IM13 (p. 137)
16:00 - 16:25	Jason Brown (Dalhousie University), *Recent Results in Network Reliability*, CM23 (p. 145)
16:00 - 16:25	Thomas Fernique (University of Paris 13, Paris, France), *Maximally dense sphere packings*, CM25 (p. 149)

16:00 - 16:25	Veronika Pillwein (RISC - Johannes Kepler University), *Algorithms beyond the holonomic universe*, CM24 (p. 147)
16:00 - 16:25	Sven Reichard (Dresden International University), *On Jordan Schemes II*, CM22 (p. 143)
16:00 - 16:25	Fernando Esteban Contreras-Mendoza (Universidad Nacional Autónoma de México), *Forbidden subgraph characterization for* (∞, k)*-polar cographs*, CT16 (p. 153)
16:00 - 16:25	Simona Rindošová (Pavol Jozef Šafárik University in Košice), *Unique maximum and minimum (double maximum) coloring of plane graphs*, CT15 (p. 151)
16:30 - 16:55	Bartłomiej Bosek (Jagellonian University), *Dilworth's Theorem for Borel Posets*, IM13 (p. 137)
16:30 - 16:55	Jinyoung Park (Institute for Advanced Study), *On a problem of M. Talagrand*, IM15 (p. 141)
16:30 - 16:55	Emo Welzl (ETH Zurich), *Vertex-Connectivity of Triangulation Flip Graphs of Planar Point Sets*, IM14 (p. 139)
16:30 - 16:55	Ben Cameron (University of Guelph), *The largest real root of the independence polynomial of a unicyclic graph*, CM23 (p. 145)
16:30 - 16:55	Stephen Gillen (University of Pennsylvania), *Gillis-Reznick-Zeilberger's power series and the mysterious factor of 3*, CM24 (p. 148)
16:30 - 16:55	Philippe Moustrou (UiT – The Arctic University of Norway, Norway), *Coloring the Voronoi cell of a lattice*, CM25 (p. 149)
16:30 - 16:55	Alyssa Sankey (University of New Brunswick), *Strongly regular designs admitting fusion to strongly regular decomposition*, CM22 (p. 143)
16:30 - 16:55	Terry McKee (Wright State University, Dayton Ohio), *Graphs in which every cycle has a 'major chord'*, CT16 (p. 153)
16:30 - 16:55	Alfréd Onderko (Pavol Jozef Šafárik University in Košice, Slovakia), *On* M_f*-edge colorings of cacti*, CT15 (p. 151)
17:00 - 17:25	Jean Cardinal (Université Libre de Bruxelles), *Flip Distances between Graph Orientations*, IM14 (p. 140)
17:00 - 17:25	Jarosław Grytczuk (Technical University of Warsaw), *Variations on twins in permutations*, IM13 (p. 138)
17:00 - 17:25	Will Perkins (University of Illinois at Chicago), *Correlation decay, phase transitions, and enumeration*, IM15 (p. 142)
17:00 - 17:25	Péter Csikvári (Eötvös Loránd University), *Evaluations of Tutte polynomials of large girth regular graphs*, CM23 (p. 146)
17:00 - 17:25	Dustin G. Mixon (The Ohio State University, Columbus, USA), *Uniquely optimal codes of low complexity are symmetric*, CM25 (p. 150)
17:00 - 17:25	Greta Panova (University of Southern California), *Unimodality and Kronecker asymptotics via random variables*, CM24 (p. 148)
17:00 - 17:25	Jason Williford (University of Wyoming), *Coherent Configurations and Extremal Graph Theory*, CM22 (p. 144)
17:00 - 17:25	Elham Roshanbin (Alzahra University), *Burning number of some families of graphs*, CT16 (p. 154)
17:00 - 17:25	Jialu Zhu (Zhejiang Normal University), *Ohba type result on lambda choosability*, CT15 (p. 152)
17:30 - 17:55	Linda Kleist (Technische Universität Braunschweig), *Flip graphs and Rainbow cycles*, IM14 (p. 140)
17:30 - 17:55	Piotr Micek (Jagellonian University), *Excluding a ladder*, IM13 (p. 138)
17:30 - 17:55	Mehtaab Sawhney (Massachusetts Institute of Technology), *Friendly bisections of random graphs*, IM15 (p. 142)
17:30 - 17:55	Karoly Bezdek (University of Calgary, Canada), *Bounds for contact numbers of locally separable unit sphere packings*, CM25 (p. 150)
17:30 - 17:55	Marcus Michelen (University of Illinois at Chicago), *Maximum entropy and integer partitions*, CM24 (p. 148)
17:30 - 17:55	Stephan Wagner (Uppsala University), *Distribution of the coefficients of the subtree polynomial*, CM23 (p. 146)
17:30 - 17:55	Miloš Stojaković (University of Novi Sad), *Structural properties of bichromatic non-crossing matchings*, CT16 (p. 154)
17:30 - 17:55	Rongxing Xu (Zhejiang Normal University), *The strong fractional choice number of graphs*, CT15 (p. 152)

Friday May 28

10:00 - 11:00	Gil Kalai (Einstein Institute of Mathematics, Hebrew University), *The beautiful combinatorics of convex polytopes*, PIL (p. 155)
11:20 - 11:45	Irène Markovici (Université de Lorraine), *Bijections between walks inside a triangular domain and Motzkin paths of bounded amplitude*, IM17 (p. 158)
11:20 - 11:45	Torsten Ueckerdt (Karlsruhe Institute of Technology), *The queue number of posets*, IM16 (p. 156)
11:20 - 11:45	Yasmeen Akhtar (IISER Pune, India), *Level-wise Screening via Locating Arrays*, CM30 (p. 168)
11:20 - 11:45	Debra Boutin (Hamilton College), *Distinguishing Cube Families*, CM28 (p. 164)
11:20 - 11:45	Derek G. Corneil (University of Toronto), *Early days of interval graph algorithms*, CM26 (p. 160)
11:20 - 11:45	Edward Dobson (University of Primorska), *Recognizing vertex-transitive digraphs which are wreath products and double coset digraphs*, CM29 (p. 166)
11:20 - 11:45	Jihyeug Jang (Sungkyunkwan University), *Volumes of flow polytopes related to the caracol graphs*, CM27 (p. 162)
11:20 - 11:45	Sjanne Zeijlemaker (Eindhoven University of Technology), *Optimization of eigenvalue bounds for the independence and chromatic number of graph powers*, CM31 (p. 170)
11:20 - 11:45	Andriy Prymak (University of Manitoba), *Spherical coverings and X-raying convex bodies of constant width*, CT17 (p. 172)
11:50 - 12:15	Alin Bostan (INRIA Saclay Île-de-France), *On the D-transcendence of generating functions for singular walks in the quarter plane*, IM17 (p. 158)
11:50 - 12:15	Łukasz Bożyk (University of Warsaw), *Vertex deletion into bipartite permutation graphs*, IM16 (p. 156)
11:50 - 12:15	Akanksha Agrawal (Indian Institute of Technology Madras), *Polynomial Kernel for Interval Vertex Deletion*, CM26 (p. 160)
11:50 - 12:15	Nathan Lindzey (University of Colorado, Boulder), *Some Recent Applications of Association Schemes*, CM31 (p. 170)
11:50 - 12:15	Karola Mészáros (Cornell University), *Flow polytopes in combinatorics and algebra*, CM27 (p. 162)
11:50 - 12:15	Lucia Moura (University of Ottawa), *Variable-strength arrays and applications*, CM30 (p. 168)
11:50 - 12:15	Venkata Raghu Tej Pantangi (Southern University of Science and Technology), *Intersecting sets in Permutation groups.*, CM29 (p. 166)
11:50 - 12:15	Zhouningxin Wang (IRIF, Universite de Paris), *Circular chromatic number of signed graphs*, CM28 (p. 164)
11:50 - 12:15	Mária Maceková (P.J. Šafárik University in Košice, Slovakia), *Scarce and frequent cycles in polyhedral graphs*, CT17 (p. 172)
12:20 - 12:45	Manuel Kauers (Johannes Kepler Universität), *Quadrant Walks Starting Outside the Quadrant*, IM17 (p. 158)
12:20 - 12:45	Michał Seweryn (Jagellonian University), *Dimension of posets with k-outerplanar cover graphs.*, IM16 (p. 156)
12:20 - 12:45	Avery St. Dizier (University of Illinois, Urbana-Champaign), *Flow Polytopes and Grothendieck polynomials*, CM27 (p. 162)
12:20 - 12:45	Guillaume Ducoffe (University of Bucharest, Romania), *Faster computation of graph diameter by using one (or two) properties of the interval graphs*, CM26 (p. 160)
12:20 - 12:45	Arnott Kidner (University of Victoria), *Switchable 2-Colouring is Polynomial*, CM28 (p. 164)
12:20 - 12:45	Sidhanth Mohanty (University of California, Berkeley), *On the relationship between spectra, girth and vertex expansion in regular graphs*, CM31 (p. 170)
12:20 - 12:45	Maura Paterson (Birkbeck, University of London), *Authentication codes with perfect secrecy and algebraic manipulation detection codes*, CM30 (p. 168)
12:20 - 12:45	Jason Semeraro (University of Leicester), *Higher tournaments, hypergraphs, automorphisms and extremal results*, CM29 (p. 166)
12:20 - 12:45	Venkitesh S. (Indian Institute of Technology Bombay), *Covering Symmetric Subsets of the Cube by Affine Hyperplanes*, CT17 (p. 172)
12:50 - 13:15	Marni Mishna (Simon Fraser University), *Lattice Walk Classification: algebraic, analytic, and geometric perspectives*, IM17 (p. 159)

12:50 - 13:15	Marcin Witkowski (Adam Mickiewicz University), *Adjacency posets of outerplanar graphs*, IM16 (p. 157)
12:50 - 13:15	Emily Barnard (DePaul University), *Pairwise Completability for 2-Simple Minded Collections*, CM27 (p. 163)
12:50 - 13:15	Theo McKenzie (University of California, Berkeley), *Support of Closed Walks and Second Eigenvalue Multiplicity of Graphs*, CM31 (p. 171)
12:50 - 13:15	Mahsa Nasrollahi (University of Regina), *On a generalization of the Erdos-Ko-Rado theorem to intersecting and set-wise intersecting perfect matchings*, CM29 (p. 167)
12:50 - 13:15	Evelyne Smith-Roberge (University of Waterloo), *Local choosability of planar graphs*, CM28 (p. 165)
12:50 - 13:15	Francisco Soulignac (University of Buenos Aires), *Representation problems for unit interval and unit circular-arc graphs*, CM26 (p. 161)
12:50 - 13:15	Brett Stevens (Carleton University), *Single change covering designs*, CM30 (p. 169)
12:50 - 13:15	Zach Walsh (Louisiana State University), *Totally D-Modular Matroids*, CT17 (p. 173)
13:20 - 13:45	Flavia Bonomo (University of Buenos Aires), *Algorithms for k-thin and proper k-thin graphs*, CM26 (p. 161)
13:20 - 13:45	Benjamin Moore (University of Waterloo), *A density bound for triangle free 4-critical graphs*, CM28 (p. 165)
13:20 - 13:45	Doug Stinson (University of Waterloo), *On equitably ordered splitting BIBDs*, CM30 (p. 169)
13:20 - 13:45	Gabriel Verret (University of Auckland), *Regular Cayley maps and skew morphisms of monolithic groups*, CM29 (p. 167)
13:20 - 13:45	Martha Yip (University of Kentucky), *A unifying framework for the ν-Tamari lattice and principal order ideals in Young's lattice*, CM27 (p. 163)
13:20 - 13:45	Sean McGuinness (Thompson Rivers University), *Rota's Basis Conjecture for Binary Matroids: the case for constructing bases one-at-a-time.*, CT17 (p. 173)
14:10 - 15:10	Sergey Norin (McGill University), *Recent progress towards Hadwiger's conjecture*, Plenary (p. 42)
15:30 - 15:55	Satyan Devadoss (University of San Diego), *Associativity reconfigurations: Colors, Graphs, Polytopes*, IM18 (p. 174)
15:30 - 15:55	Rose McCarty (University of Waterloo), *Connectivity for adjacency matrices and vertex-minors*, IM19 (p. 176)
15:30 - 15:55	Gabriela Araujo-Pardo (Universidad Nacional Autónoma de México), *The Moore and Cage Problems on Mixed Graphs*, CM34 (p. 182)
15:30 - 15:55	Iain Beaton (Dalhousie University), *The Average Order of Dominating Sets of a Graph*, CM33 (p. 180)
15:30 - 15:55	Yixin Cao (Hong Kong Polytechnic University), *Recognizing (unit) interval graphs by zigzag graph searches*, CM32 (p. 178)
15:30 - 15:55	Charlie Colbourn (Arizona State University), *Popularity Block Ordering for Steiner Systems*, CM35 (p. 184)
15:30 - 15:55	Rafael González D'León (Universidad Sergio Arboleda, Colombia), *Column-convex 0,1-matrices, consecutive coordinate polytopes and flow polytopes*, CT20 (p. 190)
15:30 - 15:55	John Machacek (Hampden-Sydney College), *Lattice walks ending on a coordinate hyperplane using ± 1 steps*, CT21 (p. 192)
15:30 - 15:55	Rinovia Simanjuntak (Institut Teknologi Bandung), *Multiset Dimension of Cartesian Product Graphs*, CT19 (p. 188)
15:30 - 15:55	MATTHEW SULLIVAN (University of Waterloo), *Simple Drawings of K_n from Rotation Systems*, CT18 (p. 186)
16:00 - 16:25	Édouard Bonnet (CNRS, ÉNS Lyon), *Twin-width*, IM19 (p. 176)
16:00 - 16:25	Jonathan Narboni (Université de Bordeaux), *On Vizing's edge colouring question*, IM18 (p. 174)
16:00 - 16:25	Zhanar Berikkyzy (Fairfield University), *Rainbow solutions to the Sidon equation in cyclic groups and in the interval*, CM34 (p. 182)
16:00 - 16:25	Celina de Figueiredo (Universidade Federal do Rio de Janeiro), *Maximum cut and Steiner tree restricted to interval graphs and related families*, CM32 (p. 178)
16:00 - 16:25	Peter Dukes (University of Victoria), *The use of graph decompositions for variance-balanced designs in the presence of correlated errors*, CM35 (p. 184)
16:00 - 16:25	Valisoa Misanantenaina (Stellenbosch University), *The average size of independent vertex/edge sets of a graph*, CM33 (p. 180)

16:00 - 16:25	MacKenzie Carr (Simon Fraser University), *Digital Convexity in Cycles and Cartesian Products*, CT18 (p. 186)
16:00 - 16:25	Andrew Goodall (Charles University Prague), *Tutte's dichromate for signed graphs*, CT20 (p. 190)
16:00 - 16:25	Lluís Vena (Universitat Politècnica de Catalunya), *Characterization of extremal families for the shadow minimization problem in the Boolean lattice*, CT21 (p. 192)
16:00 - 16:25	Michael Yatauro (Penn State - Brandywine), *A Parameterized Extension of the Binding Number*, CT19 (p. 188)
16:30 - 16:55	Daniel Cranston (Virginia Commonwealth University), *In Most 6-regular Toroidal Graphs All 5-colorings are Kempe Equivalent*, IM18 (p. 174)
16:30 - 16:55	Richard Montgomery (University of Birmingham), *A solution to Erdős and Hajnal's odd cycle problem*, IM19 (p. 176)
16:30 - 16:55	Jessica De Silva (California State University Stanislaus), *Image Segmentation via Hypergraph-based MRF Models*, CM34 (p. 182)
16:30 - 16:55	Guang Gong (University of Waterloo), *Polynomials, Sequences and Complementary Codes*, CM35 (p. 184)
16:30 - 16:55	Pavol Hell (Simon Fraser University), *Variants of interval graphs and related families*, CM32 (p. 178)
16:30 - 16:55	Andrew Vince (University of Florida), *The Average Size of a Connected Vertex Set of a Graph*, CM33 (p. 180)
16:30 - 16:55	Andrew Beveridge (Macalester College), *de Finetti Lattices and Magog Triangles*, CT21 (p. 192)
16:30 - 16:55	Alexander Kolpakov (Université de Neuchâtel), *Space vectors forming rational angles*, CT18 (p. 186)
16:30 - 16:55	Katherine Moore (Wake Forest University), *Communities in Data via Partitioned Local Depths*, CT19 (p. 188)
16:30 - 16:55	Robert Šámal (Charles University), *Many flows in the group connectivity setting*, CT20 (p. 190)
17:00 - 17:25	Marc Heinrich (University of Leeds), *Glauber dynamics for colourings of chordal graphs and graphs of bounded treewidth*, IM18 (p. 175)
17:00 - 17:25	Sophie Spirkl (University of Waterloo), *Excluding a tree and a biclique*, IM19 (p. 176)
17:00 - 17:25	Michael Guyer (Auburn University), *On clique immersions in line graphs*, CM34 (p. 183)
17:00 - 17:25	Michel Habib (Paris University), *Grounded intersection graphs and forbidden patterns on 4 vertices*, CM32 (p. 179)
17:00 - 17:25	John Haslegrave (University of Warwick), *The average size of a connected set in a connected graph with degree constraints*, CM33 (p. 181)
17:00 - 17:25	Kirsten Nelson (Carleton University), *Construction of Covering Arrays from Interleaved Sequences*, CM35 (p. 185)
17:00 - 17:25	Farzane Amirzade (Carleton University), *Quasi-Cyclic Protograph-Based Raptor-Like LDPC Codes With Girth 6 and Shortest Length*, CT19 (p. 189)
17:00 - 17:25	Yiting Jiang (Université de Paris (IRIF), France and Zhejiang Normal University, China), *Colouring of generalized signed planar graphs*, CT20 (p. 191)
17:00 - 17:25	GaYee Park (University of Massachusettes Amherst), *Naruse hook formula for linear extensions of mobile posets*, CT21 (p. 193)
17:00 - 17:25	James Tuite (Open University, UK), *The degree/geodecity problem for mixed graphs*, CT18 (p. 187)
17:30 - 17:55	Chun-Hung Liu (Texas A&M University), *Asymptotic dimension of minor-closed families and beyond*, IM19 (p. 177)
17:30 - 17:55	Kuikui Liu (University of Washington), *Markov Chain Analysis Through the Lens of High-Dimensional Expanders*, IM18 (p. 175)
17:30 - 17:55	Linda Lesniak (Western Michigan University), *On the necessity of Chvátal's hamiltonian degree condition*, CM34 (p. 183)
17:30 - 17:55	Lalla Mouatadid (University of Toronto and Google), *(α, β)-Modules in Graphs*, CM32 (p. 179)
17:30 - 17:55	Suil O (The State University of New York, Korea), *The average connectivity matrix of a graph*, CM33 (p. 181)
17:30 - 17:55	Daniel Panario (Carleton University), *LDPC codes based on trade designs*, CM35 (p. 185)
17:30 - 17:55	Hiranya Kishore Dey (IIT Bombay, India), *Signed Alternating-runs Enumeration in Classical Weyl Groups*, CT20 (p. 191)
17:30 - 17:55	Christopher Mary, *Geometric datatypes for geometric parsing algorithms*, CT19 (p. 189)

17:30 - 17:55	Gara Pruesse (Vancouver Island University), *Plain Greed suffices to 2-approximate Jump Number for Interval Posets*, CT21 (p. 193)
17:30 - 17:55	Aaron Williams (Williams College), *Constructing Universal Cycles for Fixed-Content Strings*, CT18 (p. 187)

Detailed Daily Schedule – by Session

Tuesday May 25

Plenary Talk (Abstract p. 40)

10:00 - 11:00 László Végh (London School of Economics), *The circuit imbalance measure and its role in linear programming*, Plenary(p. 40)

IM1: Combinatorial Optimization - Part I (Abstracts p. 43)

Organized by: László Végh

11:20 - 11:45 Christoph Hunkenschröder (TU Berlin), *Block-Structured Integer and Linear Programming in Near Linear Time*

11:50 - 12:15 Edin Husić (London School of Economics), *Approximating Nash Social Welfare under Rado Valuations*

12:20 - 12:45 Jason Li (Carnegie Mellon University), *Deterministic Mincut in Almost-Linear Time*

12:50 - 13:15 Kent Quanrud (Purdue University), *Faster Algorithms for Rooted Connectivity in Directed Graphs*

13:20 - 13:45 Sahil Singla (Princeton University and Institute for Advanced Study), *Improved Truthful Mechanisms for Combinatorial Auctions*

IM2: Invitation to distributed graph algorithms (Abstracts p. 45)

Organized by: Jara Uitto

11:20 - 11:45 Yannic Maus (Technion, Israel Institute of Technology), *Distributed Graph Coloring Made Easy*

11:50 - 12:15 Sebastian Brandt (ETH Zurich), *Round Elimination: A Technique for Proving Distributed Lower Bounds*

12:20 - 12:45 Seri Khoury (Simons Institute, UC Berkeley), *The congest model: a glimpse into the challenges that arise due to bandwidth limitations.*

12:50 - 13:15 Soheil Behnezhad (University of Maryland), *Locality and the Stochastic Matching Problem*

13:20 - 13:45 Huang Lingxiao (Institute for Interdisciplinary Information Sciences), *Coreset construction for clustering: offline and distributed settings*

CM1: Algebraic and Combinatorial Approaches to Designs and Codes - Part I (Abstracts p. 47)

Organized by: Thaís Bardini Idalino , Jonathan Jedwab and Shuxing Li

11:20 - 11:45 Jingzhou Na (Simon Fraser University), *Perfect Sequence Covering Arrays*

11:50 - 12:15 Karen Meagher (University of Regina), *Erdős-Ko-Rado theorems for 2-transitive groups*

12:20 - 12:45 Andriaherimanana Razafimahatratra (University of Regina), *On transitive groups that do not have the Erdős-Ko-Rado property*

12:50 - 13:15 Aidan W. Murphy (Virginia Tech, VA), *Codes from curves and repair*

13:20 - 13:45 Bill Martin (Worcester Polytechnic Institute, MA), *Selecting resilient functions for fault-tolerant random bit generation*

CM2: Arithmetic Combinatorics - Part I (Abstracts p. 49)

Organized by: Yifan Jing and Chieu-Minh Tran

11:20 - 11:45 Sarah Peluse (Institute for Advanced Study), *An asymptotic version of the prime power conjecture for perfect difference sets*

11:50 - 12:15 George Shakan (University of Oxford), *Effective Khovanskii Theorems*

12:20 - 12:45 Max Wenqiang Xu (Stanford University), *Discrepancy in Modular Arithmetic Progressions*

12:50 - 13:15 Cosmin Pohoata (Yale University), *Zero-sum subsets in vector spaces over finite fields*

13:20 - 13:45 Yifan Jing (University of Illinois at Urbana-Champaign), *Minimal and nearly minimal measure expansions in connected unimodular groups*

CM3: Chemical Graph Theory - Part I (Abstracts p. 51)

Organized by: Nino Bašić and Elizabeth Hartung

11:20 - 11:45 Elizabeth Hartung (Massachusetts College of Liberal Arts, USA), *Resonance Structures and Aromaticity in Capped Carbon Nanotubes*

11:50 - 12:15 Jack Graver (Syracuse University, USA), *The Clar - Fries Mystery*

12:20 - 12:45 Petra Žigert Pleteršek (University of Maribor, Slovenia), *Topological indices of unsaturated hydrocarbons*

12:50 - 13:15 Dong Ye (Middle Tennessee State University, USA), *Resonance graphs on perfect matchings*

13:20 - 13:45 Vesna Andova (Ss. Cyril and Methodius University, Northern Macedonia), *On Three Constructions of Nanotori*

CM4: Computational proof techniques for combinatorics on words (Abstracts p. 53)

Organized by: James Currie , Narad Rampersad and Jeffrey Shallit

11:20 - 11:45 Curtis Bright (University of Windsor), *SAT solvers and combinatorics problems*

11:50 - 12:15 Joel D. Day (Loughborough University), *Computational methods for solving word equations*

12:20 - 12:45 Stepan Holub (Charles University, Prague), *Proof assistants in combinatorics on words*

12:50 - 13:15 Jeffrey Shallit (University of Waterloo), *Proving theorems in combinatorics on words with Walnut*

13:20 - 13:45 Reed Oei (University of Illinois), *Design and use of the Pecan system*

CM5: Extremal problems for hypergraphs (Abstracts p. 55)

Organized by: Frederik Garbe

11:20 - 11:45 Stefan Glock (ETH Zürich), *The intersection spectrum of 3-chromatic intersecting hypergraphs*

11:50 - 12:15 Tom Kelly (University of Birmingham), *A proof of the Erdős–Faber–Lovász conjecture*

12:20 - 12:45 Ander Lamaison (Masaryk University), *Hypergraphs with minimum uniform Turán density*

12:50 - 13:15 Richard Lang (Heidelberg University), *Minimum degree conditions for tight Hamilton cycles*

13:20 - 13:45 Nicolás Sanhueza-Matamala (Czech Academy of Sciences), *Spanning bounded-degree tight k-trees*

CM6: Graph Searching (Abstracts p. 57)

Organized by: Anthony Bonato and Nancy Clarke

11:20 - 11:45 Fionn Mc Inerney (CISPA Helmholtz Center for Information Security), *Eternal Domination in D-Dimensional Grids*

11:50 - 12:15 Bojan Mohar (Simon Fraser University), *Cops and robbers on surfaces*

12:20 - 12:45 Nancy Clarke (Acadia University), *A variation of the Cops and Robber game with a new capture condition*

12:50 - 13:15 William Kinnersley (University of Rhode Island), *Infinitely fast robbers on grids*

13:20 - 13:45 Melissa Huggan (Ryerson University), *Locating an invisible adversary*

CT1: Random graphs (Abstracts p. 59)

11:20 - 11:45 David de Boer (Korteweg-de Vries Institute, UvA), *Uniqueness of the Gibbs measure for the 4-state anti-ferromagnetic Potts model on the regular tree*

11:50 - 12:15 Jeroen Huijben (University of Amsterdam), *Sampling from the low temperature Potts model through a Markov chain on flows*

12:20 - 12:45 Amedeo Sgueglia (London School of Economics), *Clique factors in randomly perturbed graphs*

12:50 - 13:15 Maksim Zhukovskii (MIPT), *Cycle saturation in random graphs*

Back to Table of Contents

13:20 - 13:45 R W R Darling (U.S. Department of Defense), *Efficient comparison-based learning via partitioned local depth for near neighbors*

Plenary Talk (Abstract p. 40)

14:10 - 15:10 Natasha Morrison (University of Victoria), *Uncommon systems of equations*, Plenary(p. 40)

IM3: Approximation Algorithms (Abstracts p. 61)

Organized by: Chaitanya Swamy

15:30 - 15:55 Deeparnab Chakrabarty (Dartmouth College), *Algorithms for minimum norm combinatorial optimization*

16:00 - 16:25 Chandra Chekuri (University of Illinois, Urbana-Champaign), *Covering Multiple Submodular Constraints and Applications*

16:30 - 16:55 Anupam Gupta (Carnegie Mellon University), *Matroid-Based TSP Rounding for Half-Integral Solutions*

17:00 - 17:25 Aleksandar Nikolov (University of Toronto), *Maximizing Determinants under Combinatorial Constraints*

17:30 - 17:55 Ola Svensson (Ecole Polytechnique Fédérale de Lausanne), *The Primal-Dual method for Learning Augmented Algorithms*

CM7: Algebraic and Combinatorial Approaches to Designs and Codes - Part II (Abstracts p. 63)

Organized by: Thaís Bardini Idalino , Jonathan Jedwab and Shuxing Li

15:30 - 15:55 Hadi Kharaghani (University of Lethbridge), *A class of balanced weighing matrices and the corresponding association scheme*

16:00 - 16:25 Jim Davis (University of Richmond, VA), *Designs with the Symmetric Difference Property*

16:30 - 16:55 Zeying Wang (Michigan Technological University, MI), *New necessary conditions on (negative) Latin square type partial difference sets in abelian groups*

17:00 - 17:25 Ian Wanless (Monash University, Australia), *Omniversal Latin squares*

17:30 - 17:55 Xiande Zhang (University of Science and Technology of China), *Optimal ternary constant weight codes in* l_1*-metric*

CM8: Chemical Graph Theory - Part II (Abstracts p. 65)

Organized by: Nino Bašić and Elizabeth Hartung

15:30 - 15:55 Patrick W. Fowler (University of Sheffield, UK), *The Chemical Significance of Graph Energy*

16:00 - 16:25 Dragan Stevanović (Mathematical Institute of the Serbian Academy of Sciences and Arts, Serbia), *On Hosoya's dormants and sprouts*

16:30 - 16:55 Irene Sciriha (University of Malta, Malta), *The conductivity of the connected sum of root graphs with a common nullspace*

17:00 - 17:25 Riste Škrekovski (University of Ljubljana, Slovenia), *On 12-regular nut graphs*

17:30 - 17:55 Jelena Sedlar (University of Split, Croatia), *Two types of indices and their extremal trees*

CM9: Cycles in Planar Graphs (Abstracts p. 67)

Organized by: Abhinav Shantanam and Carol T. Zamfirescu

15:30 - 15:55 Xiaonan Liu (Georgia Institute of Technology), *Number of Hamiltonian cycles in planar triangulations*

16:00 - 16:25 On-Hei Solomon Lo (University of Science and Technology of China), *Gaps in the cycle spectrum of polyhedral graphs*

16:30 - 16:55 Emily A. Marshall (Arcadia University), *Hamiltonicity of planar graphs with a forbidden minor*

17:00 - 17:25 Jens M. Schmidt (Hamburg University of Technology), *The Isolation Lemma*

17:30 - 17:55 Abhinav Shantanam (Simon Fraser University), *Pancyclicity in 4-connected planar graphs*

CM10: Graph Product Structure Theory (Abstracts p. 69)

Organized by: Pat Morin

15:30 - 15:55 Vida Dujmovic (University of Ottawa), *Product structure Theorem(s)*

16:00 - 16:25 David Wood (Monash University), *Planar graphs have bounded queue-number*

16:30 - 16:55 Louis Esperet (Laboratoire G-SCOP (CNRS, Univ. Grenoble Alpes)), *Planar graphs have bounded nonrepetitive chromatic number*

17:00 - 17:25 Piotr Micek (Jagiellonian University), *Centered colorings and vertex rankings*

17:30 - 17:55 Gwenaël Joret (Université Libre de Bruxelles), *Sparse universal graphs for planarity*

CM11: Movement and symmetry in graphs - Part I (Abstracts p. 71)

Organized by: Karen Gunderson , Karen Meagher and Joy Morris

15:30 - 15:55 Karen Gunderson (University of Manitoba), *Bootstrap percolation on infinite graphs*

16:00 - 16:25 Jeannette Janssen (Dalhousie University), *An approximation algorithm for finding the zero-forcing number of a graph*

16:30 - 16:55 Karen Meagher (University of Regina), *Open problems related to Erdős-Ko-Rado type results*

17:00 - 17:25 Joy Morris (University of Lethbridge), *Regular Representations*

CT2: Broadcasting and Domination (Abstracts p. 73)

15:30 - 15:55 Kieka Mynhardt (University of Victoria), *Boundary independent broadcasts in graphs*

16:00 - 16:25 Aaron Slobodin (University of Victoria), *2-Limited Broadcast Domination in Grids*

16:30 - 16:55 Virgélot Virgile (University of Victoria), *Eternal domination and clique covering*

17:00 - 17:25 Brendan Rooney (Rochester Institute of Technology), *Efficient k-Domination in Hamming Graphs*

17:30 - 17:55 Anna Bachstein (Clemson University), *Compelling Colorings: A generalization of the dominator chromatic number*

CT3: Spectral graph theory and distance-regular graphs (Abstracts p. 75)

15:30 - 15:55 Aysel Erey (Gebze Technical University), *Chromatic number and distance spectral radius*

16:00 - 16:25 Ahmad Mojallal (University of Regina), *The minimum number of distinct eigenvalues of threshold graphs*

16:30 - 16:55 Jesmina Pervin (Indian Institute of Technology(Banaras Hindu University), Varanasi), *Q-integral connected graphs with maximum edge-degrees less than or equal to 8*

17:00 - 17:25 Sanja Rukavina (Department of Mathematics, University of Rijeka, Croatia), *Self-orthogonal codes from equitable partitions of distance-regular graphs*

17:30 - 17:55 Ludmila Tsiovkina (IMM UB RAS), *On some classes of vertex-transitive distance-regular antipodal covers of complete graphs*

Wednesday May 26

Plenary Talk (Abstract p. 40)

10:00 - 11:00 Yufei Zhao (Massachusetts Institute of Technology), *Extremal problems in discrete geometry*, Plenary(p. 40)

IM4: Discrete Geometry (Abstracts p. 77)
Organized by: Yufei Zhao

11:20 - 11:45 Dor Minzer (Massachusetts Institute of Technology), *Optimal tiling of the Euclidean space using permutation-symmetric bodies*

11:50 - 12:15 Alexandr Polyanskii (Moscow Institute of Physics and Technology), *A cap covering theorem*

12:20 - 12:45 Yair Shenfeld (Massachusetts Institute of Technology), *Extremal structures of log-concave sequences via convex geometry*

12:50 - 13:15 Cosmin Pohoata (Yale University), *On the Zarankiewicz problem for graphs with bounded VC-dimension*

13:20 - 13:45 Josh Zahl (University of British Columbia), *Sphere tangencies, line incidences, and Lie's line-sphere correspondence*

IM5: Extremal Combinatorics (Abstracts p. 79)
Organized by: Natasha Morrison

11:20 - 11:45 Wojciech Samotij (Tel Aviv University), *Sharp thresholds for Ramsey properties*

11:50 - 12:15 Shoham Letzter (University College London), *Chi-boundedness of graphs with no cycle with exactly k chords*

12:20 - 12:45 Katherine Staden (University of Oxford), *Ringel's tree packing conjecture*

12:50 - 13:15 Rob Morris (Instituto de Matemática Pura e Aplicada), *Flat Littlewood Polynomials Exist*

13:20 - 13:45 Marcelo Campos (Instituto de Matemática Pura e Aplicada), *Singularity of random symmetric matrices revisited*

IM6: In honour of Pavol Hell - Part I (Abstracts p. 81)
Organized by: Gary MacGillivray

11:20 - 11:45 Xuding Zhu (Zhejiang Normal University), *On Hedetniemi's Conjecture*

11:50 - 12:15 Shenwei Huang (Nankai University), *k-critical graphs in P5-free graphs*

12:20 - 12:45 Jaroslav Nešetřil (Charles University), *In praise of homomorphisms*

12:50 - 13:15 Kathie Cameron (Wilfred Laurier University), *A Parity Theorem About Trees with Specified Degrees*

13:20 - 13:45 Arash Rafiey (Indiana State University), *2-SAT and Transitivity Clauses*

IM7: Invitation to Sparsity (Abstracts p. 83)
Organized by: Zdeněk Dvořák

11:20 - 11:45 Zdeněk Dvořák (Charles University), *Sparsity: Concepts and applications*

11:50 - 12:15 Felix Reidl (Birkbeck University of London), *Algorithmic aspects I*

12:20 - 12:45 Michał Pilipczuk (University of Warsaw), *Algorithmic aspects II*

12:50 - 13:15 Patrice Ossona de Mendez (CNRS, École des Hautes Études en Sciences Sociales), *A model theoretical approach to sparsity*

13:20 - 13:45 Sebastian Siebertz (University of Bremen), *Characterizing sparsity by games.*

CM12: Algebraic and Combinatorial Approaches to Designs and Codes - Part III (Abstracts p. 85)
Organized by: Thaís Bardini Idalino , Jonathan Jedwab and Shuxing Li

11:20 - 11:45 Marco Buratti (University of Perugia, Italy), *Old and new results on elementary abelian 2-designs*

11:50 - 12:15 Nikolay Kaleyski (University of Bergen, Norway), *Bounding the Hamming distance between APN functions*

12:20 - 12:45 Eimear Byrne (University College Dublin, Ireland), *New subspace designs from q-matroids*

12:50 - 13:15 Gohar Kyureghyan (University of Rostock, Germany), *Image sets of APN maps*

13:20 - 13:45 Alex Pott (Otto-von-Guericke University, Germany), *Designs and bent functions*

CM13: Arithmetic Combinatorics - Part II (Abstracts p. 87)

Organized by: Yifan Jing and Chieu-Minh Tran

11:20 - 11:45 Weikun He (Korea Institute for Advanced Study), *Sum-product estimates in semisimple algebras and random walks on the torus*

11:50 - 12:15 Simon Machado (University of Cambridge), *Approximate Subgroups, Meyer Sets and Arithmeticity*

12:20 - 12:45 Arturo Rodriguez Fanlo (University of Oxford), *On metric approximate subgroups*

12:50 - 13:15 Gabriel Conant (University of Cambridge), *Quantitative stable arithmetic regularity in arbitrary finite groups*

13:20 - 13:45 Chieu-Minh Tran (University of Notre Dame), *A nonabelian Brunn-Minkowski inequality*

CM14: Chemical Graph Theory - Part III (Abstracts p. 89)

Organized by: Nino Bašić and Elizabeth Hartung

11:20 - 11:45 Tomaž Pisanski (University of Ljubljana, Slovenia), *Flat benzenoid complexes*

11:50 - 12:15 Tomislav Došlić (University of Zagreb, Croatia), *Nice subgraphs of fullerene graphs with prescribed components*

12:20 - 12:45 Damir Vukičević (University of Split, Croatia), *Vukicevic, Boskovic: Adriatic graphs - mathematical properties and applications to correct NIST database*

12:50 - 13:15 Lavanya Selvaganesh (Indian Institute of Technology (BHU), India), *Bounds Of The Symmetric Division Deg Index For Graphs With Cyclomatic Number At Most 2 And With A Perfect Matching*

13:20 - 13:45 Nino Bašić (University of Primorska, Slovenia), *Pentagonal Clusters in Fullerenes*

CM15: The Metric Dimension of a Graph and its Variants - Part I (Abstracts p. 91)

Organized by: Shonda Dueck

11:20 - 11:45 Florent Foucaud (University Clermont Auvergne, France), *Bounds on the order of a graph of given metric dimension and diameter: studies for standard graph classes*

11:50 - 12:15 Ismael Gonzalez Yero (Universidad de Cadiz, Spain), *Comparing the metric and edge metric dimensions of graphs*

12:20 - 12:45 Tero Laihonen (Turku University, Finland), *On Vertices Belonging to Every Metric Basis*

12:50 - 13:15 Elizabeth Maritz (University of the Free State, South Africa), *On the partition dimension of circulant graphs*

13:20 - 13:45 Dorota Kuziak (Universidad de Cadiz, Spain), *The strong metric dimension of a graph*

CT4: Hamiltonicity (Abstracts p. 93)

11:20 - 11:45 Carol T. Zamfirescu (Ghent University, Belgium), *K_2-hamiltonian graphs*

11:50 - 12:15 Jan Goedgebeur (Ghent University), *Graphs with few hamiltonian cycles*

12:20 - 12:45 Alberto Espuny Díaz (Technische Universität Ilmenau), *Hamiltonicity of randomly perturbed graphs*

12:50 - 13:15 Radek Hušek (Charles University, Czech Republic), *Counting Circuit Double Covers*

13:20 - 13:45 Craig Larson (Virginia Commonwealth University), *Deming Decompositions and Egervary Graphs*

CT5: Scheduling and Algorithms (Abstracts p. 95)

11:20 - 11:45 Alane de Lima (Federal University of Paraná (UFPR)), *Sample Complexity in Graph Problems*

11:50 - 12:15 Sarah NOURI (RECITS laboratory, Faculty of Mathematics, USTHB University), *Scheduling on identical machines with conflict graphs*

12:20 - 12:45 Abdennour AZERINE (Université des Sciences et de la Technologie Houari Boumedienne, Alger, Algérie), *Two-machine no-wait flow shop with two agents and makespan criteria*

12:50 - 13:15 Nazim Sami (RECITS laboratory, faculty of Mathematics, Ushtb University), *New algorithms for the two-machine chain-reentrant shop problem with the no-wait constraint*

Plenary Talk (Abstract p. 41)

14:10 - 15:10 Caroline Colijn (Simon Fraser University), *Mathematics and policy in the COVID-19 pandemic*, Plenary(p. 41)

IM8: Combinatorial Optimization - Part II (Abstracts p. 97)

Organized by: László Végh

15:30 - 15:55 Vera Traub (ETH Zurich), *Improving the Approximation Ratio for Capacitated Vehicle Routing*

16:00 - 16:25 Zhuan Khye Koh (London School of Economics), *An Accelerated Newton-Dinkelbach Method and its Application to Two Variables Per Inequality Systems*

16:30 - 16:55 Sharat Ibrahimpur (University of Waterloo), *Approximation Algorithms for Stochastic Minimum Norm Combinatorial Optimization*

17:00 - 17:25 Nathan Klein (University of Washington), *Approximating the minimum k-edge connected multi-subgraph problem*

17:30 - 17:55 Sami Davies (University of Washington), *Scheduling with Communication Delays via LP Hierarchies and Clustering*

IM9: Discrete and algorithmic mathematics in biology and epidemiology - Part I (Abstracts p. 99)

Organized by: Pengyu Liu

15:30 - 15:55 Baptiste Elie (MIVGEC, Université Montpellier), *The source of individual heterogeneity shapes infectious disease outbreaks*

16:00 - 16:25 Xingru Chen (Dartmouth College), *Effectiveness of Massive Travel Restrictions on Mitigating Outbreaks of COVID-19 in China*

16:30 - 16:55 Wasiur KhudaBukhsh (Ohio State University), *Chemical reaction networks with covariates*

17:00 - 17:25 Joel Miller (La Trobe University), *Simulating epidemic spread on contact networks*

IM10: In honour of Pavol Hell - Part II (Abstracts p. 101)

Organized by: Gena Hahn and Gary MacGillivray

15:30 - 15:55 Richard Brewster (Thompson Rivers University), *Characterizing Circular Colouring Mixing for $p/q < 4$*

16:00 - 16:25 David Kirkpatrick (UBC), *Forbidden Induced Subgraphs for k-Nested Interval Graphs*

16:30 - 16:55 Jing Huang (University of Victoria), *Obstructions for local tournament orientation completions*

17:00 - 17:25 Cesar Hernandez-Cruz (Universidad Nacional Autónoma de México), *Strongly Chordal Digraphs*

17:30 - 17:55 Gary MacGillivray (University of Victoria), *Frugal homomorphisms*

CM16: Average Graph Parameters - Part I (Abstracts p. 103)

Organized by: Stijn Cambie

15:30 - 15:55 Peter Dankelmann (University of Johannesburg), *On the Wiener Index of Graphs with Large Maximum Degree*

16:00 - 16:25 Riste Skrekovski (University of Ljubljana), *Some problems and results on some graph parameters*

16:30 - 16:55 Eva Czabarka (University of South Carolina), *Minimum Wiener index of planar triangulations and quadrangulations*

17:00 - 17:25 Fadekemi Janet Osaye (Auburn University), *The average eccentricity of a graph with prescribed girth*

17:30 - 17:55 Lucas Mol (The University of Winnipeg), *The mean subtree order of graphs under edge addition*

CM17: Graph Polynomials - Part I (Abstracts p. 105)

Organized by: Iain Beaton and Ben Cameron

15:30 - 15:55 Iain Beaton (Dalhousie University), *On the Unimodality of Domination Polynomials*

16:00 - 16:25 Danielle Cox (Mount Saint Vincent University), *Chromatic Polynomials of 2-Edge-Coloured Graphs*

16:30 - 16:55 Samantha Dahlberg (Arizona State University), *Chromatic symmetric functions and e-positivity*

17:00 - 17:25 David Galvin (University of Notre Dame), *The independence polynomial of the random tree*

17:30 - 17:55 János Makowsky (Technion - Israel Institute of Technology), *Graph polynomials unimodular for almost all graphs.*

CM18: Recent aspects of sphere packings - Part I (Abstracts p. 107)

Organized by: Karoly Bezdek and Oleg Musin

15:30 - 15:55 Serge Vladut (Aix-Marseille University, France), *Lattices with exponentially large kissing numbers*

16:00 - 16:25 Alexander Kolpakov (University of Neuchatel, Neuchatel, Switzerland), *Kissing number in non-Euclidean spaces of constant sectional curvature*

16:30 - 16:55 Maria Dostert (Royal Institute of Technology (KTH), Stockholm, Sweden), *Kissing number of the hemisphere in dimension 8*

17:00 - 17:25 Alexey Glazyrin (The University of Texas Rio Grande Valley, USA), *Linear programming bounds revisited*

17:30 - 17:55 Oleg Musin (The University of Texas Rio Grande Valley, USA), *The SDP bound for spherical codes using their distance distribution*

CT6: Game Theory (Abstracts p. 109)

15:30 - 15:55 Alexander Clow (St. Francis Xavier University), *From Poset Games to Partially Ordered Games*

16:00 - 16:25 Mozhgan Farahani (Memorial University of Newfoundland), *The deduction game to capture robbers*

16:30 - 16:55 Ryan Hayward (University of Alberta), *Let's Play Hex: Some Open Problems*

17:00 - 17:25 Masood Masjoody (Simon Fraser University), *Confining the Robber on Cographs*

17:30 - 17:55 Jérémie Turcotte (McGill University), *Finding the smallest 4-cop-win graph(s)*

CT7: Graph Colouring I (Abstracts p. 111)

15:30 - 15:55 Mária Šurimová (Pavol Jozef Šafárik University), *Adynamic coloring of graphs*

16:00 - 16:25 John Gimbel (University of Alaska Fairbanks), *On Graphs with Proper Connection Number Two*

16:30 - 16:55 Zuzana Šárošiová (Pavol Jozef Šafárik University in Košice, Slovakia), *Algorithms for finding the interval chromatic number of trees*

17:00 - 17:25 Kyle MacKeigan (Dalhousie University), *Orthogonal Colourings of Random Geometric Graphs*

CT8: Patterns and Compositions (Abstracts p. 113)

15:30 - 15:55 Rachel Domagalski (Michigan State University), *Pattern Avoidance in Circular Permutations*

16:00 - 16:25 Jinting Liang (Michigan State University), *Generating functions over avoidance sets of circular permutations*

16:30 - 16:55 Gabriel Loos (Georgia Southern University), *Combinatorics of Cyclic Compositions*

17:00 - 17:25 Bruce Sagan (Michigan State University), *On a rank-unimodality conjecture of Morier-Genoud and Ovsienko*

17:30 - 17:55 Hua Wang (Georgia Southern University), *Counting colored compositions and tilings*

CT9: Polynomials and groups (Abstracts p. 115)

15:30 - 15:55 Logan Crew (University of Waterloo), *Identities of the Chromatic and Tutte Symmetric Functions*

16:00 - 16:25	Hossein Teimoori Faal (Allameh Tabataba'i University, Tehran, Iran), *The Generalized Face Handshaking Lemma and Higher Derivatives of Face Polynomials*
16:30 - 16:55	Foster Tom (UC Berkeley), *A combinatorial Schur expansion of triangle-free horizontal-strip LLT polynomials*
17:00 - 17:25	Laurence Wijaya (Institut Teknologi Bandung), *A Relationship Between Cayley-Dickson Process and The Generalized Study Determinant*
17:30 - 17:55	Ajay Kumar (Indian Institute of Technology (BHU), Varanasi, India), *Vertex connectivity of superpower graphs of dicyclic groups* T_{4n}

Back to Table of Contents

Thursday May 27

Plenary Talk (Abstract p. 41)

10:00 - 11:00 Mireille Bousquet-Mélou (CNRS, Université de Bordeaux), *Counting lattice walks confined to cones*, Plenary(p. 41)

IM11: Discrete and algorithmic mathematics in biology and epidemiology - Part II (Abstracts p. 117)

Organized by: Pengyu Liu

11:20 - 11:45 Jianrong Yang (Sun Yat-sen University), *Developmental cell lineage trees, and the quantitative comparisons between them*

11:50 - 12:15 Christoph Weitkamp (Universität Göttingen), *GROMOV-WASSERSTEIN BASED PHYLOGENETIC TREE SHAPE COMPARISON*

12:20 - 12:45 Louxin Zhang (National University of Singapore), *The Bourque Distances for Mutation Trees of Cancers*

12:50 - 13:15 Julia Palacios (Stanford University), *Distance-based summaries and modeling of evolutionary trees*

IM12: Generating series and confined lattice walks - Part I (Abstracts p. 119)

Organized by: Thomas Dreyfus and Andrew Elvey Price

11:20 - 11:45 Lucia Di Vizio (CNRS, Université de Versailles-St Quentin), *Differential transcendence for the Bell numbers and their relatives*

11:50 - 12:15 Helen Jenne (Université de Tours and Université d'Orléans), *Three-dimensional lattice walks confined to an octant: non-rationality of the second critical exponent*

12:20 - 12:45 Michael Singer (North Carolina State University), *Differentially Algebraic Generating Series for Walks in the Quarter Plane*

12:50 - 13:15 Michael Wallner (TU Wien), *More Models of Walks Avoiding a Quadrant*

CM19: Coherent configurations with few fibers - Part I (Abstracts p. 121)

Organized by: Alyssa Sankey

11:20 - 11:45 Stefan Gyurki (Slovak University of Technology), *The Paulus-Rozenfeld-Thompson graph on 26 vertices*

11:50 - 12:15 Bohdan Kivva (University of Chicago), *Robustness of the Johnson scheme under fusion and extension*

12:20 - 12:45 Mikhail Muzychuk (Ben-Gurion University of the Negev), *On Jordan schemes*

12:50 - 13:15 Grigory Ryabov (Novosibirsk State University), *Infinite family of nonschurian separable association schemes*

CM20: Spectral Graph Theory - Part I (Abstracts p. 123)

Organized by: Sebastian Cioaba and Michael Tait

11:20 - 11:45 Ferdinand Ihringer (Ghent University), *Strongly regular graphs satisfying the 4-vertex condition*

11:50 - 12:15 Jephian Lin (National Sun Yat-sen University), *The strong spectral property for graphs*

12:20 - 12:45 Aida Abiad (Eindhoven University of Technology), *Neumaier graphs with few eigenvalues*

12:50 - 13:15 Krystal Guo (University of Amsterdam), *Entanglement of free Fermions on distance-regular graphs*

CM21: The Metric Dimension of a Graph and its Variants - Part II (Abstracts p. 125)

Organized by: Shonda Dueck

11:20 - 11:45 Shonda Dueck (University of Winnipeg, Canada), *Logarithmic bounds on the threshold strong dimension of a graph*

11:50 - 12:15 Beth Novick (Clemson University, USA), *A geometric characterization of the threshold strong dimension of a graph*

12:20 - 12:45 Linda Eroh (University of Wisconsin, Oshkosh Campus, USA), *The threshold strong dimension of trees*

12:50 - 13:15	Richard Tillquist (University of Colorado, USA), *A Bound on the Metric Dimension of Hamming Graphs and Applications in Machine Learning*

CT10: Arithmetic Combinatorics (Abstracts p. 127)

11:20 - 11:45	Alexander Clifton (Emory University), *An exponential bound for exponential diffsequences*
11:50 - 12:15	Torin Greenwood (North Dakota State University), *Bounding monochromatic arithmetic progressions*
12:20 - 12:45	Glenn Hurlbert (Virginia Commonwealth University), *On intersecting families of independent sets in trees*
12:50 - 13:15	Stanisław Radziszowski (Rochester Institute of Technology), *On Some Generalized Vertex Folkman Numbers*

CT11: Hypergraphs (Abstracts p. 129)

11:20 - 11:45	Michal Stern (Academic College of Tel-Aviv Yaffo), *Minimum removal or insertion list for Clustered Spanning Tree by Paths*
11:50 - 12:15	James Ross (University of New South Wales), *Sampling hypergraphs with given degrees*
12:20 - 12:45	Sam Spiro (UC San Diego), *Cycle-free Subgraphs of Random Hypergraphs*
12:50 - 13:15	Christian Winter (Karlsruhe Institute of Technology, Karlsruhe, Germany), *Size-Ramsey Number of Tight Paths*

CT12: Orientations (Abstracts p. 131)

11:20 - 11:45	Natalie Behague (Ryerson University), *The Cerny Conjecture and Synchronizing Times for k-sets in Automata*
11:50 - 12:15	Ying Ying (Fay) Ye (University of Victoria), *Chordality of locally semicomplete and weakly quasi-transitive digraphs*
12:20 - 12:45	Santiago Guzmán Pro (Facultad de Ciencias, UNAM), *Hereditary properties and forbidden orientations*
12:50 - 13:15	Katarína Čekanová (Pavol Jozef Šafárik University, Košice, Slovakia), *Types of edges in embedded graphs with minimum degree 2*

CT13: Potage of algorithmic designs (Abstracts p. 133)

11:20 - 11:45	Mehrdad Ghadiri (Georgia Institute of Technology), *Socially Fair k-Means Clustering*
11:50 - 12:15	Nick Harvey (Univeristy of British Columbia), *How to make predictions using two experts, forever*
12:20 - 12:45	Richard Santiago (ETH Zürich), *Non-monotone weakly submodular function maximization subject to a cardinality constraint*
12:50 - 13:15	Bruce Shepherd (UBC), *Single Tree Cut Approximators and Disjoint Paths in Outerplanar Graphs*

CT14: Structures in Graphs (Abstracts p. 135)

11:20 - 11:45	Robert Hickingbotham (Monash University), *Stack-number is not bounded by queue-number*
11:50 - 12:15	Carl Feghali (Charles University), *Decomposing a triangle-free planar graph into a forest and a subcubic forest*
12:20 - 12:45	Tomáš Kaiser (University of West Bohemia), *Edge-critical subgraphs of Schrijver graphs*
12:50 - 13:15	Alexandre Blanché (LaBRI, Université de Bordeaux), *Gallai's path decomposition conjecture for planar graphs*

13:20 - 14:10	Women in Math Networking Event

Plenary Talk (Abstract p. 41)

14:10 - 15:10	William T. Trotter (Georgia Tech University), *Posets with Planar Cover Graphs*, Plenary(p. 41)

IM13: Combinatorics on Posets - Part I (Abstracts p. 137)

Organized by: Tom Trotter

15:30 - 15:55	Patrice Ossona de Mendez (CNRS, École des Hautes Études en Sciences Sociales), *Small, sparse and ordered*
16:00 - 16:25	Gwenaël Joret (Université Libre de Bruxelles), *The extension dimension and the linear extension polytope of a poset*
16:30 - 16:55	Bartłomiej Bosek (Jagellonian University), *Dilworth's Theorem for Borel Posets*
17:00 - 17:25	Jarosław Grytczuk (Technical University of Warsaw), *Variations on twins in permutations*
17:30 - 17:55	Piotr Micek (Jagellonian University), *Excluding a ladder*

IM14: Invitation to Reconfiguration - Part I (Abstracts p. 139)

Organized by: Nicolas Bousquet and Anna Lubiw

15:30 - 15:55	Erik Demaine & Nicole Wein (MIT & University of Waterloo), *Hardness of Token Swapping on Trees*
16:00 - 16:25	Colin R Defant & Noah Kravitz (Princeton University), *Random Friends and Strangers Walking on Random Graphs*
16:30 - 16:55	Emo Welzl (ETH Zurich), *Vertex-Connectivity of Triangulation Flip Graphs of Planar Point Sets*
17:00 - 17:25	Jean Cardinal (Université Libre de Bruxelles), *Flip Distances between Graph Orientations*
17:30 - 17:55	Linda Kleist (Technische Universität Braunschweig), *Flip graphs and Rainbow cycles*

IM15: Probabilistic Approaches (Abstracts p. 141)

Organized by: Jozef Skokan

15:30 - 15:55	Annika Heckel (Ludwig-Maximilians-Universität München), *How does the chromatic number of a random graph vary?*
16:00 - 16:25	Matthew Jenssen (University of Birmingham), *Singularity of random symmetric matrices revisited*
16:30 - 16:55	Jinyoung Park (Institute for Advanced Study), *On a problem of M. Talagrand*
17:00 - 17:25	Will Perkins (University of Illinois at Chicago), *Correlation decay, phase transitions, and enumeration*
17:30 - 17:55	Mehtaab Sawhney (Massachusetts Institute of Technology), *Friendly bisections of random graphs*

CM22: Coherent configurations with few fibers - Part II (Abstracts p. 143)

Organized by: Alyssa Sankey

15:30 - 15:55	Dennis Epple (University of Toronto), *The Shrikhande Graph on the Crossroads of Algebraic and Topological Graph Theory*
16:00 - 16:25	Sven Reichard (Dresden International University), *On Jordan Schemes II*
16:30 - 16:55	Alyssa Sankey (University of New Brunswick), *Strongly regular designs admitting fusion to strongly regular decomposition*
17:00 - 17:25	Jason Williford (University of Wyoming), *Coherent Configurations and Extremal Graph Theory*

CM23: Graph Polynomials - Part II (Abstracts p. 145)

Organized by: Iain Beaton and Ben Cameron

15:30 - 15:55	Ferenc Bencs (Alfréd Rényi Institute of Mathematics), *Zero-free regions for some graph polynomials.*
16:00 - 16:25	Jason Brown (Dalhousie University), *Recent Results in Network Reliability*
16:30 - 16:55	Ben Cameron (University of Guelph), *The largest real root of the independence polynomial of a unicyclic graph*
17:00 - 17:25	Péter Csikvári (Eötvös Loránd University), *Evaluations of Tutte polynomials of large girth regular graphs*
17:30 - 17:55	Stephan Wagner (Uppsala University), *Distribution of the coefficients of the subtree polynomial*

CM24: New Trends in Analytic Combinatorics (Abstracts p. 147)

Organized by: Stephen Melczer

15:30 - 15:55 Michael Wallner (TU Wein), *Compacted binary trees and minimal automata admit stretched exponentials*

16:00 - 16:25 Veronika Pillwein (RISC - Johannes Kepler University), *Algorithms beyond the holonomic universe*

16:30 - 16:55 Stephen Gillen (University of Pennsylvania), *Gillis-Reznick-Zeilberger's power series and the mysterious factor of 3*

17:00 - 17:25 Greta Panova (University of Southern California), *Unimodality and Kronecker asymptotics via random variables*

17:30 - 17:55 Marcus Michelen (University of Illinois at Chicago), *Maximum entropy and integer partitions*

CM25: Recent aspects of sphere packings - Part II (Abstracts p. 149)

Organized by: Karoly Bezdek and Oleg Musin

15:30 - 15:55 Robert Connelly (Cornell University, Ithaca, NY, USA), *Flipping and flowing*

16:00 - 16:25 Thomas Fernique (University of Paris 13, Paris, France), *Maximally dense sphere packings*

16:30 - 16:55 Philippe Moustrou (UiT – The Arctic University of Norway, Norway), *Coloring the Voronoi cell of a lattice*

17:00 - 17:25 Dustin G. Mixon (The Ohio State University, Columbus, USA), *Uniquely optimal codes of low complexity are symmetric*

17:30 - 17:55 Karoly Bezdek (University of Calgary, Canada), *Bounds for contact numbers of locally separable unit sphere packings*

CT15: Graph Colouring II (Abstracts p. 151)

15:30 - 15:55 Tomáš Madaras (Pavol Jozef Šafárik University in Košice, Slovakia), *Facial homogeneous colourings of graphs*

16:00 - 16:25 Simona Rindošová (Pavol Jozef Šafárik University in Košice), *Unique maximum and minimum (double maximum) coloring of plane graphs*

16:30 - 16:55 Alfréd Onderko (Pavol Jozef Šafárik University in Košice, Slovakia), *On* M_f*-edge colorings of cacti*

17:00 - 17:25 Jialu Zhu (Zhejiang Normal University), *Ohba type result on lambda choosability*

17:30 - 17:55 Rongxing Xu (Zhejiang Normal University), *The strong fractional choice number of graphs*

CT16: Structural Graph Theory (Abstracts p. 153)

15:30 - 15:55 Michael Barrus (University of Rhode Island), *Unigraphs and hereditary graph classes*

16:00 - 16:25 Fernando Esteban Contreras-Mendoza (Universidad Nacional Autónoma de México), *Forbidden subgraph characterization for* (∞, k)*-polar cographs*

16:30 - 16:55 Terry McKee (Wright State University, Dayton Ohio), *Graphs in which every cycle has a 'major chord'*

17:00 - 17:25 Elham Roshanbin (Alzahra University), *Burning number of some families of graphs*

17:30 - 17:55 Miloš Stojaković (University of Novi Sad), *Structural properties of bichromatic non-crossing matchings*

Friday May 28

PIL: Public Interest Lecture (Abstract p. 155)

10:00 - 11:00 Gil Kalai (Einstein Institute of Mathematics, Hebrew University), *The beautiful combinatorics of convex polytopes*, PIL(p. 155)

IM16: Combinatorics on Posets - Part II (Abstracts p. 156)

Organized by: Tom Trotter

11:20 - 11:45 Torsten Ueckerdt (Karlsruhe Institute of Technology), *The queue number of posets*

11:50 - 12:15 Łukasz Bożyk (University of Warsaw), *Vertex deletion into bipartite permutation graphs*

12:20 - 12:45 Michał Seweryn (Jagellonian University), *Dimension of posets with k-outerplanar cover graphs.*

12:50 - 13:15 Marcin Witkowski (Adam Mickiewicz University), *Adjacency posets of outerplanar graphs*

IM17: Generating series and confined lattice walks - Part II (Abstracts p. 158)

Organized by: Thomas Dreyfus and Andrew Elvey Price

11:20 - 11:45 Irène Markovici (Université de Lorraine), *Bijections between walks inside a triangular domain and Motzkin paths of bounded amplitude*

11:50 - 12:15 Alin Bostan (INRIA Saclay Île-de-France), *On the D-transcendence of generating functions for singular walks in the quarter plane*

12:20 - 12:45 Manuel Kauers (Johannes Kepler Universität), *Quadrant Walks Starting Outside the Quadrant*

12:50 - 13:15 Marni Mishna (Simon Fraser University), *Lattice Walk Classification: algebraic, analytic, and geometric perspectives*

CM26: Algorithms for interval graphs and related families - Part I (Abstracts p. 160)

Organized by: Yixin Cao and Derek G. Corneil

11:20 - 11:45 Derek G. Corneil (University of Toronto), *Early days of interval graph algorithms*

11:50 - 12:15 Akanksha Agrawal (Indian Institute of Technology Madras), *Polynomial Kernel for Interval Vertex Deletion*

12:20 - 12:45 Guillaume Ducoffe (University of Bucharest, Romania), *Faster computation of graph diameter by using one (or two) properties of the interval graphs*

12:50 - 13:15 Francisco Soulignac (University of Buenos Aires), *Representation problems for unit interval and unit circular-arc graphs*

13:20 - 13:45 Flavia Bonomo (University of Buenos Aires), *Algorithms for k-thin and proper k-thin graphs*

CM27: Flow polytopes of graphs (Abstracts p. 162)

Organized by: Carolina Benedetti , Christopher Hanusa , Pamela E. Harris and Alejandro Morales

11:20 - 11:45 Jihyeug Jang (Sungkyunkwan University), *Volumes of flow polytopes related to the caracol graphs*

11:50 - 12:15 Karola Mészáros (Cornell University), *Flow polytopes in combinatorics and algebra*

12:20 - 12:45 Avery St. Dizier (University of Illinois, Urbana-Champaign), *Flow Polytopes and Grothendieck polynomials*

12:50 - 13:15 Emily Barnard (DePaul University), *Pairwise Completability for 2-Simple Minded Collections*

13:20 - 13:45 Martha Yip (University of Kentucky), *A unifying framework for the ν-Tamari lattice and principal order ideals in Young's lattice*

CM28: Graph Colouring – surfaces, homomorphisms, and distinguishing (Abstracts p. 164)

Organized by: Rick Brewster and Benjamin Moore

11:20 - 11:45 Debra Boutin (Hamilton College), *Distinguishing Cube Families*

11:50 - 12:15 Zhouningxin Wang (IRIF, Universite de Paris), *Circular chromatic number of signed graphs*

12:20 - 12:45 Arnott Kidner (University of Victoria), *Switchable 2-Colouring is Polynomial*

12:50 - 13:15 Evelyne Smith-Roberge (University of Waterloo), *Local choosability of planar graphs*

13:20 - 13:45 Benjamin Moore (University of Waterloo), *A density bound for triangle free 4-critical graphs*

CM29: Movement and symmetry in graphs - Part II (Abstracts p. 166)

Organized by: Karen Gunderson , Karen Meagher and Joy Morris

11:20 - 11:45 Edward Dobson (University of Primorska), *Recognizing vertex-transitive digraphs which are wreath products and double coset digraphs*

11:50 - 12:15 Venkata Raghu Tej Pantangi (Southern University of Science and Technology), *Intersecting sets in Permutation groups.*

12:20 - 12:45 Jason Semeraro (University of Leicester), *Higher tournaments, hypergraphs, automorphisms and extremal results*

12:50 - 13:15 Mahsa Nasrollahi (University of Regina), *On a generalization of the Erdos-Ko-Rado theorem to intersecting and set-wise intersecting perfect matchings*

13:20 - 13:45 Gabriel Verret (University of Auckland), *Regular Cayley maps and skew morphisms of monolithic groups*

CM30: Practical Applications of Design Theory - Part I (Abstracts p. 168)

Organized by: Thaís Bardini Idalino , Jonathan Jedwab and Shuxing Li

11:20 - 11:45 Yasmeen Akhtar (IISER Pune, India), *Level-wise Screening via Locating Arrays*

11:50 - 12:15 Lucia Moura (University of Ottawa), *Variable-strength arrays and applications*

12:20 - 12:45 Maura Paterson (Birkbeck, University of London), *Authentication codes with perfect secrecy and algebraic manipulation detection codes*

12:50 - 13:15 Brett Stevens (Carleton University), *Single change covering designs*

13:20 - 13:45 Doug Stinson (University of Waterloo), *On equitably ordered splitting BIBDs*

CM31: Spectral Graph Theory - Part II (Abstracts p. 170)

Organized by: Sebastian Cioaba and Michael Tait

11:20 - 11:45 Sjanne Zeijlemaker (Eindhoven University of Technology), *Optimization of eigenvalue bounds for the independence and chromatic number of graph powers*

11:50 - 12:15 Nathan Lindzey (University of Colorado, Boulder), *Some Recent Applications of Association Schemes*

12:20 - 12:45 Sidhanth Mohanty (University of California, Berkeley), *On the relationship between spectra, girth and vertex expansion in regular graphs*

12:50 - 13:15 Theo McKenzie (University of California, Berkeley), *Support of Closed Walks and Second Eigenvalue Multiplicity of Graphs*

CT17: Contributed Talks II (Abstracts p. 172)

11:20 - 11:45 Andriy Prymak (University of Manitoba), *Spherical coverings and X-raying convex bodies of constant width*

11:50 - 12:15 Mária Maceková (P.J. Šafárik University in Košice, Slovakia), *Scarce and frequent cycles in polyhedral graphs*

12:20 - 12:45 Venkitesh S. (Indian Institute of Technology Bombay), *Covering Symmetric Subsets of the Cube by Affine Hyperplanes*

12:50 - 13:15 Zach Walsh (Louisiana State University), *Totally D-Modular Matroids*

13:20 - 13:45 Sean McGuinness (Thompson Rivers University), *Rota's Basis Conjecture for Binary Matroids: the case for constructing bases one-at-a-time.*

Plenary Talk (Abstract p. 42)

14:10 - 15:10 Sergey Norin (McGill University), *Recent progress towards Hadwiger's conjecture*, Plenary(p. 42)

Back to Table of Contents

IM18: Invitation to Reconfiguration - Part II (Abstracts p. 174)

Organized by: Nicolas Bousquet and Anna Lubiw

15:30 - 15:55 Satyan Devadoss (University of San Diego), *Associativity reconfigurations: Colors, Graphs, Polytopes*

16:00 - 16:25 Jonathan Narboni (Université de Bordeaux), *On Vizing's edge colouring question*

16:30 - 16:55 Daniel Cranston (Virginia Commonwealth University), *In Most 6-regular Toroidal Graphs All 5-colorings are Kempe Equivalent*

17:00 - 17:25 Marc Heinrich (University of Leeds), *Glauber dynamics for colourings of chordal graphs and graphs of bounded treewidth*

17:30 - 17:55 Kuikui Liu (University of Washington), *Markov Chain Analysis Through the Lens of High-Dimensional Expanders*

IM19: Structural Graph Theory (Abstracts p. 176)

Organized by: Sergey Norin

15:30 - 15:55 Rose McCarty (University of Waterloo), *Connectivity for adjacency matrices and vertex-minors*

16:00 - 16:25 Édouard Bonnet (CNRS, ÉNS Lyon), *Twin-width*

16:30 - 16:55 Richard Montgomery (University of Birmingham), *A solution to Erdős and Hajnal's odd cycle problem*

17:00 - 17:25 Sophie Spirkl (University of Waterloo), *Excluding a tree and a biclique*

17:30 - 17:55 Chun-Hung Liu (Texas A&M University), *Asymptotic dimension of minor-closed families and beyond*

CM32: Algorithms for interval graphs and related families - Part II (Abstracts p. 178)

Organized by: Yixin Cao and Derek G. Corneil

15:30 - 15:55 Yixin Cao (Hong Kong Polytechnic University), *Recognizing (unit) interval graphs by zigzag graph searches*

16:00 - 16:25 Celina de Figueiredo (Universidade Federal do Rio de Janeiro), *Maximum cut and Steiner tree restricted to interval graphs and related families*

16:30 - 16:55 Pavol Hell (Simon Fraser University), *Variants of interval graphs and related families*

17:00 - 17:25 Michel Habib (Paris University), *Grounded intersection graphs and forbidden patterns on 4 vertices*

17:30 - 17:55 Lalla Mouatadid (University of Toronto and Google), *(α, β)-Modules in Graphs*

CM33: Average Graph Parameters - Part II (Abstracts p. 180)

Organized by: Stijn Cambie

15:30 - 15:55 Iain Beaton (Dalhousie University), *The Average Order of Dominating Sets of a Graph*

16:00 - 16:25 Valisoa Misanantenaina (Stellenbosch University), *The average size of independent vertex/edge sets of a graph*

16:30 - 16:55 Andrew Vince (University of Florida), *The Average Size of a Connected Vertex Set of a Graph*

17:00 - 17:25 John Haslegrave (University of Warwick), *The average size of a connected set in a connected graph with degree constraints*

17:30 - 17:55 Suil O (The State University of New York, Korea), *The average connectivity matrix of a graph*

CM34: Enumerative and Extremal Graph Theory (Abstracts p. 182)

Organized by: Rachel Kirsch

15:30 - 15:55 Gabriela Araujo-Pardo (Universidad Nacional Autónoma de México), *The Moore and Cage Problems on Mixed Graphs*

16:00 - 16:25 Zhanar Berikkyzy (Fairfield University), *Rainbow solutions to the Sidon equation in cyclic groups and in the interval*

16:30 - 16:55 Jessica De Silva (California State University Stanislaus), *Image Segmentation via Hypergraph-based MRF Models*

17:00 - 17:25 Michael Guyer (Auburn University), *On clique immersions in line graphs*

17:30 - 17:55 Linda Lesniak (Western Michigan University), *On the necessity of Chvátal's hamiltonian degree condition*

CM35: Practical Applications of Design Theory - Part II (Abstracts p. 184)

Organized by: Thaís Bardini Idalino , Jonathan Jedwab and Shuxing Li

15:30 - 15:55 Charlie Colbourn (Arizona State University), *Popularity Block Ordering for Steiner Systems*

16:00 - 16:25 Peter Dukes (University of Victoria), *The use of graph decompositions for variance-balanced designs in the presence of correlated errors*

16:30 - 16:55 Guang Gong (University of Waterloo), *Polynomials, Sequences and Complementary Codes*

17:00 - 17:25 Kirsten Nelson (Carleton University), *Construction of Covering Arrays from Interleaved Sequences*

17:30 - 17:55 Daniel Panario (Carleton University), *LDPC codes based on trade designs*

CT18: Contributed Talks I (Abstracts p. 186)

15:30 - 15:55 MATTHEW SULLIVAN (University of Waterloo), *Simple Drawings of K_n from Rotation Systems*

16:00 - 16:25 MacKenzie Carr (Simon Fraser University), *Digital Convexity in Cycles and Cartesian Products*

16:30 - 16:55 Alexander Kolpakov (Université de Neuchâtel), *Space vectors forming rational angles*

17:00 - 17:25 James Tuite (Open University, UK), *The degree/geodecity problem for mixed graphs*

17:30 - 17:55 Aaron Williams (Williams College), *Constructing Universal Cycles for Fixed-Content Strings*

CT19: Contributed Talks III (Abstracts p. 188)

15:30 - 15:55 Rinovia Simanjuntak (Institut Teknologi Bandung), *Multiset Dimension of Cartesian Product Graphs*

16:00 - 16:25 Michael Yatauro (Penn State - Brandywine), *A Parameterized Extension of the Binding Number*

16:30 - 16:55 Katherine Moore (Wake Forest University), *Communities in Data via Partitioned Local Depths*

17:00 - 17:25 Farzane Amirzade (Carleton University), *Quasi-Cyclic Protograph-Based Raptor-Like LDPC Codes With Girth 6 and Shortest Length*

17:30 - 17:55 Christopher Mary, *Geometric datatypes for geometric parsing algorithms*

CT20: Flows and signed graphs (Abstracts p. 190)

15:30 - 15:55 Rafael González D'León (Universidad Sergio Arboleda, Colombia), *Column-convex 0,1-matrices, consecutive coordinate polytopes and flow polytopes*

16:00 - 16:25 Andrew Goodall (Charles University Prague), *Tutte's dichromate for signed graphs*

16:30 - 16:55 Robert Šámal (Charles University), *Many flows in the group connectivity setting*

17:00 - 17:25 Yiting Jiang (Université de Paris (IRIF), France and Zhejiang Normal University, China), *Colouring of generalized signed planar graphs*

17:30 - 17:55 Hiranya Kishore Dey (IIT Bombay, India), *Signed Alternating-runs Enumeration in Classical Weyl Groups*

CT21: Posets and lattices (Abstracts p. 192)

15:30 - 15:55 John Machacek (Hampden-Sydney College), *Lattice walks ending on a coordinate hyperplane using* ± 1 *steps*

16:00 - 16:25 Lluís Vena (Universitat Politècnica de Catalunya), *Characterization of extremal families for the shadow minimization problem in the Boolean lattice*

16:30 - 16:55 Andrew Beveridge (Macalester College), *de Finetti Lattices and Magog Triangles*

17:00 - 17:25	GaYee Park (University of Massachusettes Amherst), *Naruse hook formula for linear extensions of mobile posets*
17:30 - 17:55	Gara Pruesse (Vancouver Island University), *Plain Greed suffices to 2-approximate Jump Number for Interval Posets*

Back to Table of Contents

Abstracts

LÁSZLÓ VÉGH, London School of Economics

[Tuesday May 25, 10:00]

The circuit imbalance measure and its role in linear programming

The talk will give an overview of some recent progress on the strongly polynomial solvability of linear programs (LPs), extending classical results of Tardos, and Vavasis and Ye. A key concept turns out to be the 'circuit imbalance measure' κ_A of a matrix: this is the largest ratio between the absolute values between the nonzero entries of a support minimal vector in the kernel of the matrix. We explain different approaches to solve an LP given by an $n \times m$ constraint matrix A in time poly$(n, m, \log \kappa_A)$ (but independent of the cost and right hand side vectors), based on proximity results as well using layered-least squares interior-point methods. We give a combinatorial characterization of the column rescaling that obtains the smallest possible circuit imbalance value, as well as an efficient algorithm to find an approximately optimal rescaling; this yields a new class of LPs that can be solved in strongly polynomial time. The talk is based joint works with Daniel Dadush, Sophie Huiberts, and Bento Natura.

NATASHA MORRISON, University of Victoria

[Tuesday May 25, 14:10]

Uncommon systems of equations

A system of linear equations L over $\mathbb{F}_q$ is *common* if the number of monochromatic solutions to L in any two-colouring of $\mathbb{F}_q^n$ is asymptotically at least the expected number of monochromatic solutions in a random two-colouring of $\mathbb{F}_q^n$. Motivated by existing results for specific systems (such as Schur triples and arithmetic progressions), as well as extensive research on common and Sidorenko graphs, the systematic study of common systems of linear equations was recently initiated by Saad and Wolf. Building on earlier work of of Cameron, Cilleruelo and Serra, as well as Saad and Wolf, common linear equations have been fully characterised by Fox, Pham and Zhao.

In this talk I will discuss some recent progress towards a characterisation of common systems of two or more equations. In particular we prove that any system containing an arithmetic progression of length four is uncommon, confirming a conjecture of Saad and Wolf. This follows from a more general result which allows us to deduce the uncommonness of a general system from certain properties of one- or two-equation subsystems.

This is joint work with Nina Kamčev and Anita Liebenau.

YUFEI ZHAO, Massachusetts Institute of Technology

[Wednesday May 26, 10:00]

Extremal problems in discrete geometry

I present recent progress on several problems in discrete geometry, including equiangular lines, joints, extension complexity, and transitive sets in high dimensions.

Back to Table of Contents

CAROLINE COLIJN, Simon Fraser University

[Wednesday May 26, 14:10]

Mathematics and policy in the COVID-19 pandemic

Mathematics and modelling have had unprecedented levels of attention from policy makers, public health, the media and the public during the COVID-19 pandemic. While we always anticipated that another pandemic would come one day, we did not anticipate that Ro, herd immunity, flattening the curve and other mathematical concepts would be so much in the public eye. In this talk I will describe some of the work our group has done on the COVID-19 pandemic, from deterministic to stochastic modelling, and I will make reference in particular to discrete mathematics and its growing role in evolving pandemics.

MIREILLE BOUSQUET-MÉLOU, CNRS, Université de Bordeaux

[Thursday May 27, 10:00]

Counting lattice walks confined to cones

The study of lattice walks confined to cones is a lively topic in enumerative combinatorics, and has witnessed rich developments in the past 20 years. Typically, one is given a finite set of steps S in Z^d, and a cone C in R^d. Exactly $|S|^n$ walks of length n start from the origin and take their steps in S. But how many remain in the cone C?

One of the motivations for studying such questions is that such walks encode many objects in discrete mathematics, statistical physics, probability theory, among other fields.

In the past 20 years, several approaches have been combined to understand how the choice of the steps and of the cone influence the nature of the counting sequence $a(n)$, or of the the associated series $A(t) = \sum a(n)t^n$. Is $A(t)$ rational, algebraic, or solution of a differential equation? This is now completely understood when C is the first quadrant of the plane and S only consists of "small" steps. This "simple" case involves tools coming from an attractive variety of fields: algebra on formal power series, complex analysis, computer algebra, differential Galois theory. Much remains to be done, for other cones and sets of steps.

WILLIAM T. TROTTER, Georgia Tech University

[Thursday May 27, 14:10]

Posets with Planar Cover Graphs

For nearly 50 years, my favorite research topic has been combinatorial problems for posets. Often, but not always, there are analogous problems in graph theory, but the poset versions are typically more challenging. A great example is bounding chromatic number and dimension in terms of maximum degree.

In the last five years, there has been increasing attention paid to problems that bound the dimension of a poset in terms of the largest standard example it contains. The analogous problem in graph theory is bounding chromatic number in terms of maximum clique size. Of course, in the most general setting, there is no such bound, but researchers have found many interesting classes where one can be shown to exist.

For posets, it has been conjectured for more than 40 years that dimension is bounded in terms of the largest standard example for posets with planar cover graphs, and there has been a sequence of results that hold promise to providing a pathway to the final resolution of the conjecture. Surveying these results will be the primary focus of this talk.

SERGEY NORIN, McGill University

[Friday May 28, 14:10]

Recent progress towards Hadwiger's conjecture

Hadwiger's conjecture from 1943 is a far-reaching strengthening of the Four Color Theorem. It states that every simple graph with no K_t minor can be properly colored using $t-1$ colors. In this talk we will survey recent progress towards the conjecture, as well as the remaining (major) obstacles.

Back to Table of Contents

Org: László Végh (London School of Economics)

Abstracts

CHRISTOPH HUNKENSCHRÖDER, TU Berlin

[Tuesday May 25, 11:20]

Block-Structured Integer and Linear Programming in Near Linear Time

We consider *integer* and *linear programming* problems for which the linear constraints exhibit a block-structure: The problem decomposes into independent small subproblems if a few constraints are deleted.

For linear programming, our algorithm relies on the *parametric search* framework by Norton, Plotkin, and Tardos in combination with Megiddo's multidimensional search technique. This also forms a subroutine for integer programming. We use a strong linear relaxation and present a *proximity bound* between the respective optima that is independent of the dimension.

We apply our results to n-fold integer programs, obtaining algorithms that are near-linear in the dimension and strongly polynomial.

EDIN HUSIĆ, London School of Economics

[Tuesday May 25, 11:50]

Approximating Nash Social Welfare under Rado Valuations

Nash social welfare (NSW) is defined as the geometric mean of agents' valuations. We consider the problem of approximating maximum NSW while allocating indivisible items to agents. We present the first constant-factor approximation algorithm for the problem when agents have Rado valuations – a general class of valuation functions that arise from maximum cost independent matching problems, including as special cases assignment (OXS) valuations and weighted matroid rank functions. Our approach also extends to the asymmetric NSW (weighted geometric mean) under Rado valuations with approximation guarantees depending on the maximum weight.

JASON LI, Carnegie Mellon University

[Tuesday May 25, 12:20]

Deterministic Mincut in Almost-Linear Time

We present a deterministic (global) mincut algorithm for weighted, undirected graphs that runs in $m^{1+o(1)}$ time, answering an open question of Karger from the 1990s. To obtain our result, we de-randomize the construction of the skeleton graph in Karger's near-linear time mincut algorithm, which is its only randomized component. In particular, we partially de-randomize the well-known Benczur-Karger graph sparsification technique by random sampling, which we accomplish by the method of pessimistic estimators. Our main technical component is designing an efficient pessimistic estimator to capture the cuts of a graph, obtained by the expander decomposition framework (Goranci et al.)

Back to Table of Contents

KENT QUANRUD, Purdue University

[Tuesday May 25, 12:50]

Faster Algorithms for Rooted Connectivity in Directed Graphs

We consider the fundamental problems of determining the rooted and global edge and vertex connectivities (and computing the corresponding cuts) in *directed* graphs. For rooted (and hence also global) edge connectivity we give a new randomized Monte Carlo reduction to (s,t)-flow, resulting in new randomized algorithms for simple graphs. Similarly we obtain new randomized running times for rooted and global vertex connectivity in directed graphs. Our results are based on a simple combination of sampling coupled with sparsification that appears new, and could lead to further tradeoffs for directed graph connectivity problems.

This is joint work with Chandra Chekuri.

SAHIL SINGLA, Princeton University and Institute for Advanced Study

[Tuesday May 25, 13:20]

Improved Truthful Mechanisms for Combinatorial Auctions

A longstanding open problem in Algorithmic Mechanism Design is to design computationally efficient truthful mechanisms for (approximately) maximizing welfare in combinatorial auctions with submodular/subadditive bidders. This problem has been studied extensively since the first mechanisms by Dobzinski, Nisan, and Schapira [STOC'05, STOC'06], culminating in an $O(\sqrt{\log m})$-approximation for submodular and an $O(\log m \cdot \log\log m)$-approximation for subadditive bidders, where m is the number of items. We present computationally-efficient truthful mechanisms with exponentially improved approximation ratios: an $O((\log\log m)^3)$-approximation for subadditive and an $O((\log\log m)^2)$-approximation for submodular bidders.

Based on joint works with Sepehr Assadi and Thomas Kesselheim [FOCS'19, SODA'21].

Back to Table of Contents

Org: Jara Uitto (Aalto University)

Abstracts

YANNIC MAUS, Technion, Israel Institute of Technology

[Tuesday May 25, 11:20]

Distributed Graph Coloring Made Easy

The LOCAL model was introduced by Linial [FOCS'87] and studies how far messages need to travel in message passing algorithms to solve some problem in a given communication network. Linial also gave an extremely fast algorithm to color a network (graph) with $O(\Delta^2)$ colors where Δ is the graph's maximum degree. It became a central research question to efficiently reduce the $O(\Delta^2)$ colors to $\Delta + 1$ colors, which is the existential minimum. We survey results and show that, surprisingly, the state of the art algorithm is in close relation to Linial's original algorithm.

SEBASTIAN BRANDT, ETH Zurich

[Tuesday May 25, 11:50]

Round Elimination: A Technique for Proving Distributed Lower Bounds

Traditionally, proving substantial time complexity lower bounds in the LOCAL model of distributed computing has been a challenging and little-understood task. The last years, however, have seen the emergence of a conceptually simple, yet powerful technique, called Round Elimination, that provides a blueprint for proving such lower bounds and has been responsible for a number of lower bounds for problems central to the LOCAL model, such as Lovász Local Lemma, Maximal Matching, or Maximal Independent Set. In this talk, we will take a close look at the round elimination technique, its inner workings, potential and limitations.

SERI KHOURY, Simons Institute, UC Berkeley

[Tuesday May 25, 12:20]

The congest model: a glimpse into the challenges that arise due to bandwidth limitations.

Given a synchronized communication network of n nodes, and a function f of its topology, how fast can the nodes compute f? Questions of this kind are central in the study of distributed graph algorithms. Typically, two variants are considered: In the first, the bandwidth of a single message is unlimited (the LOCAL model), and in the second, it is limited by $O(\log n)$ bits (the CONGEST model).

In this talk we discuss the challenges that arise due to bandwidth limitations. In particular, we show that even functions that admit $O(1)$-round algorithms in LOCAL, can be very hard in CONGEST.

Back to Table of Contents

SOHEIL BEHNEZHAD, University of Maryland

[Tuesday May 25, 12:50]

Locality and the Stochastic Matching Problem

In the stochastic matching problem, we are given an arbitrary graph G, and the goal is to find a matching of an unknown random subgraph G' of G by querying only a small number of edges in G.

In this talk, we show how with the machinery of distributed local algorithms, one can analyze a (non-distributed and global) Monte Carlo algorithm for the stochastic matching problem and prove that it obtains an almost maximum size matching.

Based on joint works with M. Hajiaghayi and M. Derakhshan (STOC'20, FOCS'20).

HUANG LINGXIAO, Institute for Interdisciplinary Information Sciences

[Tuesday May 25, 13:20]

Coreset construction for clustering: offline and distributed settings

Coreset is a commonly used data reduction technique that is a weighted subset of the data that allow for fast approximate inference for a large dataset by solving the problem on the smaller coreset. In this talk, I will take the clustering problem as an example and introduce a useful framework for coreset construction, called importance sampling. Then I will discuss the connection between coreset and distributed computing, including the composability of coreset, a general "merge-and-reduce" reduction technique, and related applications in distributed settings.

Org: Thaís Bardini Idalino (Universidade Federal de Santa Catarina, Brazil), **Jonathan Jedwab** (Simon Fraser University) and **Shuxing Li** (Simon Fraser University)

Designs and codes are closely intertwined studies that share many common discrete structures. This minisymposium explores algebraic and combinatorial approaches to the construction, analysis, and classification of designs and codes, with particular emphasis on these common discrete structures.

Abstracts

JINGZHOU NA, Simon Fraser University

[Tuesday May 25, 11:20]

Perfect Sequence Covering Arrays

What is a cost-efficient way to design balanced sequential testing? This minisymposium will introduce you to a combinatorial design object as a potential answer, which has a subtly balanced containment property that can be preserved by group actions. The first "special" example published by Raphael Yuster in 2019 and an efficient algorithm to search for the object introduced by Rudolf Mathon and Tran van Trung will be presented. You are invited to complete this minisymposium by playing examples together. This is joint work with Jonathan Jedwab and Shuxing Li.

KAREN MEAGHER, University of Regina

[Tuesday May 25, 11:50]

Erdős-Ko-Rado theorems for 2-transitive groups

Two permutations are *intersecting* if there is at least one element on which the permutations agree. For any permutation group, we can ask what is the size of the largest set of intersecting permutations? If a group has the property that a point stabilizer is a largest intersecting set in the group, then we say the group has the *EKR property*. In this talk I will show that all 2-transitive groups have the EKR property, and also have a further property that partially characterizes the maximum intersecting sets in the group.

ANDRIAHERIMANANA RAZAFIMAHATRATRA, University of Regina

[Tuesday May 25, 12:20]

On transitive groups that do not have the Erdős-Ko-Rado property

A family of permutations $\mathcal{F}$ of a finite transitive group $G \leq \mathrm{Sym}(\Omega)$ is *intersecting* if any two permutations in $\mathcal{F}$ agree on an element of Ω. The group G is said to have the *Erdős-Ko-Rado (EKR) property* if any intersecting family of G is of size at most $\frac{|G|}{|\Omega|}$.
In this talk, I will present some constructions of transitive groups that do not have the EKR property. My main focus will be on the transitive groups corresponding to multipartite graphs. I will also talk about a measure of how far from having the EKR property a transitive group can be.

Back to Table of Contents

AIDAN W. MURPHY, Virginia Tech, VA

[Tuesday May 25, 12:50]

Codes from curves and repair

Classical codes with minimum distance $d \geq 3$ provide structures which support both erasure recovery and error correction. In modern settings, such as in distributed storage, it is useful to be able to accomplish these tasks with fewer symbols than classical codes necessitate. In this talk, we consider constructions of such codes using polynomials and curves over finite fields. This is joint work with Gretchen Matthews.

BILL MARTIN, Worcester Polytechnic Institute, MA

[Tuesday May 25, 13:20]

Selecting resilient functions for fault-tolerant random bit generation

Random number generation in constrained environments is a challenge of increasing importance in embedded security. High-security implementations call for hundreds of random bits per clock cycle. We need both high-rate physical entropy sources and robust post-processing tools that protect against adversaries.

This talk revisits a design of Sunar, Martin and Stinson which employs phase jitter in ring oscillators as entropy source and resilient functions in order to strengthen the output entropy. How gracefully do resilient functions fail when the entropy of the source is too low? What families of orthogonal arrays provide the best resilient functions to handle side-channel attacks?

Back to Table of Contents

Org: Yifan Jing (University of Illinois at Urbana-Champaign) and **Chieu-Minh Tran** (University of Notre Dame)

Arithmetic Combinatorics is a rapidly growing discipline, with interactions with many other areas of mathematics, including ergodic theory, harmonic analysis, number theory, model theory, etc.
In this mini-symposium, we aim to bring researchers in arithmetic combinatorics in order to present recent developments in this field, exchange research ideas, and initiate new collaborations.

Abstracts

SARAH PELUSE, Institute for Advanced Study

[Tuesday May 25, 11:20]

An asymptotic version of the prime power conjecture for perfect difference sets

A set $D \subset \mathbb{Z}/m\mathbb{Z}$ is called a "perfect difference set" if every nonzero element of $\mathbb{Z}/m\mathbb{Z}$ can be written uniquely as the difference of two elements of D. If such a set exists, then $m = n^2 + n + 1$ for some nonnegative integer n. Singer constructed perfect difference sets in $\mathbb{Z}/(n^2 + n + 1)\mathbb{Z}$ whenever n is a prime power, and it is an old conjecture that these are the only such n for which a perfect difference set exists. I will discuss a proof of an asymptotic version of this conjecture: the number of $n \le N$ for which $\mathbb{Z}/(n^2 + n + 1)\mathbb{Z}$ contains a perfect difference set is $\sim \frac{N}{\log N}$.

GEORGE SHAKAN, University of Oxford

[Tuesday May 25, 11:50]

Effective Khovanskii Theorems

Let A be a subset of the d dimensional integer lattice and NA be the N-fold sumset. In 1992, Khovanskii proved that $|NA|$ can be written as a polynomial in N of degree at most d, provided N is sufficiently large. We provide an effective bound for “sufficiently large”, and discuss some related results. This is joint work with Andrew Granville and Aled Walker.

MAX WENQIANG XU, Stanford University

[Tuesday May 25, 12:20]

Discrepancy in Modular Arithmetic Progressions

Celebrated theorems of Roth and Matousek-Spencer show that the discrepancy of arithmetic progressions in the first n positive integers is $\Theta(n^{1/4})$. We study the analogous problem in $\mathbb{Z}_n$. We asymptotically determine the logarithm of the discrepancy of arithmetic progressions in $\mathbb{Z}_n$ for all n. We further determine up to a constant factor the discrepancy for many n. For example, if $n = p^k$ is a prime power, then the discrepancy is $\Theta(n^{1/3+r_k/(6k)})$, where $r_k \in \{0, 1, 2\}$ is the remainder when k is divided by 3. This solves a problem posed by Hebbinghaus-Srivastav. This work is joint with Jacob Fox and Yunkun Zhou.

Back to Table of Contents

COSMIN POHOATA, Yale University

[Tuesday May 25, 12:50]

Zero-sum subsets in vector spaces over finite fields

For a subset A of an additive group G, consider the set of all nonempty subsums

$$\Sigma^*(A) := \left\{ \sum_{x \in B} x \mid B \subset A, B \neq \emptyset \right\}.$$

The Olson constant $\mathcal{O}L(G)$ represents the minimum t such that every subset $A \subset G$ of cardinality t satisfies $0 \in \Sigma^*(A)$. This is a well-known parameter in additive combinatorics, which is tantalizingly difficult to compute even for the small groups. In this talk, we will discuss some new results about $\mathcal{O}L(G)$ when G is the additive group of a finite dimensional vector space over a(n arbitrarily large) finite field. Joint work with Dmitriy Zakharov.

YIFAN JING, University of Illinois at Urbana-Champaign

[Tuesday May 25, 13:20]

Minimal and nearly minimal measure expansions in connected unimodular groups

Let G be a connected unimodular group equipped with a Haar measure μ, and suppose $A, B \subseteq G$ are nonempty and compact. An inequality by Kemperman gives us

$$\mu(AB) \geq \min\{\mu(A) + \mu(B), \mu(G)\}.$$

We obtain characterizations of G, A, and B such that the equality holds, answering a question asked by Kemperman in 1964. We also get near equality versions of the above results with sharp exponent bound for connected compact groups. This confirms conjectures made by Griesmer and by Tao and can be seen as a Freiman $(3k-4)$-theorem up to a constant factor for this setting. (Joint with Chieu-Minh Tran)

Back to Table of Contents

Org: Nino Bašić (University of Primorska, Slovenia) and **Elizabeth Hartung** (Massachusetts College of Liberal Arts, USA)

This minisymposium in chemical graph theory explores various applications of graph theory to chemistry. A molecule can be described as a graph, where vertices represent atoms and edges represent chemical bonds: benzenoids and fullerenes are two examples of such graph classes. Properties of those graphs, such as perfect matchings and graph spectra, can be used to model characteristics of molecules, including stability, reactivity, and electronic structure. Other related topics in chemical graph theory include enumeration of graphs classes and algorithms for their enumeration. Graphs are also important for biosciences, such as phylogenetics where they are used to study phylogenetic trees and related structures, and synthetic biology where graphs proved to be useful for modeling self-assembly of DNA and protein nanostructures.

Abstracts

ELIZABETH HARTUNG, Massachusetts College of Liberal Arts, USA

[Tuesday May 25, 11:20]

Resonance Structures and Aromaticity in Capped Carbon Nanotubes

A fullerene is a 3-regular plane graph with only hexagonal and pentagonal faces, and models a pure carbon molecule. Nanotubes are a class of fullerenes that are cylindrical in shape and extremely useful in applications. The Clar number of a fullerene is a parameter related to its aromaticity and stability. In this talk, we partition nanotubes into two classes, those with relatively small and with relatively large Clar numbers. We describe the double bond structures, or perfect matchings, capable of forming in these two classes. This is joint work with Jack Graver (Syracuse University) and Aaron Williams (Williams College).

JACK GRAVER, Syracuse University, USA

[Tuesday May 25, 11:50]

The Clar - Fries Mystery

Given a fullerene, the maximum number of benzene rings over all Kekule structures is the Fries number; the maximum number of pairwise disjoint benzene rings over all Kekule structures is the Clar number. Graver and Hartung constructed a fullerene family where the benzene rings giving the Clar number could not be a subset of the Fries faces. Fowler and Myrvold developed a program for computing the Clar number directly and discovered many fullerenes in which this discrepancy occurred. Comparing constructions developed for Clar chains and Fries chains by Hartung and Fenton enables us to shed light on this mystery.

PETRA ŽIGERT PLETERŠEK, University of Maribor, Slovenia

[Tuesday May 25, 12:20]

Topological indices of unsaturated hydrocarbons

Hydrocarbons are modeled with simple graphs but in the case of unsaturated hydrocarbons with multiple bonds the corresponding graphs should be multigraphs. There is some ambiguity in modeling such graphs, and consequently in the calculation of certain topological indices. We introduce a model of edge-weighted graphs where distances in a graph are defined in three different ways using the topological distance, the relative topological distance and the relative distance (actual lengths of bonds). The regression analysis on the obtained weighted Wiener indices is performed and gives a good model for the prediction of boiling points of alkenes and alkadienes.

DONG YE, Middle Tennessee State University, USA

[Tuesday May 25, 12:50]

Resonance graphs on perfect matchings

Let G be a graph on a surface, and $\mathcal{F}$ is a set of faces bounded by even cycles. The resonance graph of G with respect to $\mathcal{F}$, denoted by $R(G;\mathcal{F})$, is a graph such that its vertex set is the set of all perfect matchings of G and two vertices M_1 and M_2 are adjacent if and only if the symmetric difference $M_1 \oplus M_2$ is a cycle bounding some face in $\mathcal{F}$. In this talk, we will focus on resonance graphs for graphs on surfaces. This talk is based on joint work with Niko Tratnik.

VESNA ANDOVA, Ss. Cyril and Methodius University, Northern Macedonia

[Tuesday May 25, 13:20]

On Three Constructions of Nanotori

There are three different approaches for constructing nanotori in the literature: one with three parameters suggested by Altshuler, another with four parameters used mostly in chemistry and physics, and one with three parameters used in computer science (known as generalized honeycomb tori).

Altshuler showed that his method gives all non-isomorphic nanotori, but this was not known for the other two constructions. We show that these three approaches are equivalent and give explicit formulas that convert parameters of one construction into the parameters of the other two constructions.

Org: James Currie (University of Winnipeg), **Narad Rampersad** (University of Winnipeg) and **Jeffrey Shallit** (University of Waterloo)

Combinatorics on words is an old area that studies the properties of words (finite strings of symbols over a finite alphabet), but one where the available techniques have recently been supplemented by the use of various computational ideas, such as decision algorithms, SAT solvers, and proof assistants. With these techniques, proofs of conjectures can sometimes be obtained purely mechanically, with little work by humans. This mini-symposium will feature introductory talks on these ideas, illustrated by many examples.

Abstracts

CURTIS BRIGHT, University of Windsor

[Tuesday May 25, 11:20]

SAT solvers and combinatorics problems

Solvers for the Boolean satisfiability (SAT) problem have been increasingly used to resolve problems in combinatorics. This talk will outline how SAT solvers can be used to effectively search for combinatorial objects as well as produce computer-verifiable proofs of nonexistence. Some simple examples of using a SAT solver will be presented and some noteworthy SAT-based results will be discussed—such as a recent resolution of Lam's problem which produced certificates demonstrating the nonexistence of a projective plane of order ten.

JOEL D. DAY, Loughborough University

[Tuesday May 25, 11:50]

Computational methods for solving word equations

Word equations are equations in which each side is a word consisting of terminal symbols (constants) and variables. Solutions are substitutions of the variables for words containing only terminal symbols which result in both sides becoming identical. E.g. X=bab is a solution to Xab=baX.

Motivated by applications in software analysis, several tools called string solvers have been developed for automatically deciding the truth of various statements concerning strings, which often involve combinations of word equations with other constraints (regular language membership, comparing lengths of words...). I will discuss some approaches for solving word equations in this setting.

STEPAN HOLUB, Charles University, Prague

[Tuesday May 25, 12:20]

Proof assistants in combinatorics on words

Combinatorics of (finite) words is an area where computer assisted formalization may be very helpful. Proofs of even fairly simple results tend to be tedious and repetitive, featuring complicated analysis of cases, which makes them hard (both for referees and readers) to verify. Moreover, despite the short history of the field, important results are sometimes forgotten and rediscovered, or simply repeatedly proven in many papers. Some easily stated problems are vast classification tasks.

We shall discuss how proof assistants can help to tackle these issues and illustrate it by an ongoing formalization project in Isabelle/HOL.

Back to Table of Contents

JEFFREY SHALLIT, University of Waterloo

[Tuesday May 25, 12:50]

Proving theorems in combinatorics on words with Walnut

Walnut is free software, written by Hamoon Mousavi and recently modified by Aseem Baranwal, for proving (or disproving) statements about combinatorics on words. Specifically, it can prove or disprove any first-order claim about automatic sequences s that is phrased in terms operations like addition, subtraction, comparison, boolean connectives, and indexing into s. In this talk, I will briefly give the theory behind Walnut and give many examples of the kinds of things one can prove with it. Both existing results and new results will be covered.

REED OEI, University of Illinois

[Tuesday May 25, 13:20]

Design and use of the Pecan system

Pecan is an automated theorem prover for reasoning about properties of automatic sequences, most notably including Sturmian words. It is capable of efficiently proving non-trivial mathematical theorems about all Sturmian words using a decision procedure based on Büchi automata. We give an overview of the Pecan system and show how to use it to prove some interesting theorems about Sturmian words.

Org: **Frederik Garbe** (Masaryk University)

Compared to the graph case, extremal problems in the context of hypergraphs often exhibit an additionally nuanced behaviour. This minisymposium covers a wide range of recent results from this area - including hypergraph Turán numbers, Dirac-type results, and hypergraph colouring problems.

Abstracts

STEFAN GLOCK, ETH Zürich

[Tuesday May 25, 11:20]

The intersection spectrum of 3-chromatic intersecting hypergraphs

The intersection spectrum of a hypergraph is the set of all intersection sizes of pairs of edges. In their seminal paper from 1973 which introduced the local lemma, Erdős and Lovász asked: how large must the intersection spectrum of a k-uniform 3-chromatic intersecting hypergraph be? They showed that such a hypergraph must have at least three intersection sizes, and conjectured that the size of the intersection spectrum tends to infinity with k. We prove this conjecture in a strong form, by showing that there are at least $k^{1/2-o(1)}$ intersection sizes. Joint work with Matija Bucić and Benny Sudakov

---

TOM KELLY, University of Birmingham

[Tuesday May 25, 11:50]

A proof of the Erdős–Faber–Lovász conjecture

The Erdős-Faber-Lovász conjecture (posed in 1972) states that the chromatic index of any linear hypergraph on n vertices is at most n. We prove this conjecture for sufficiently large n. Joint work with Dong Yeap Kang, Daniela Kühn, Abhishek Methuku, and Deryk Osthus.

ANDER LAMAISON, Masaryk University

[Tuesday May 25, 12:20]

Hypergraphs with minimum uniform Turán density

Reiher, Rödl and Schacht showed that the uniform Turán density of every 3-uniform hypergraph is either 0 or at least $1/27$, and asked whether there exist 3-uniform hypergraphs with uniform Turán density equal or arbitrarily close to $1/27$. We construct 3-uniform hypergraphs with uniform Turán density equal to $1/27$. Joint work with Frederik Garbe and Dan Král.

RICHARD LANG, Heidelberg University

[Tuesday May 25, 12:50]

Minimum degree conditions for tight Hamilton cycles

We study the existence of tight Hamilton cycles in k-uniform hypergraphs under minimum d-degree conditions. The case of $k = 2$ and $d = k - 1$ corresponds to Dirac's classic theorem. A well-known result of Rödl, Ruciński and Szemerédi extends this to all $k \geq 3$. Here, we develop a general framework to approach this problem and use it to resolve the case of $d = k - 2$ and $k \geq 3$.

Back to Table of Contents

NICOLÁS SANHUEZA-MATAMALA, Czech Academy of Sciences

[Tuesday May 25, 13:20]

Spanning bounded-degree tight k-trees

A k-graph is a tight k-tree if its edges can be ordered such that the following holds for all edges e except the first: e has a vertex v which is not in any previous edge, and $e \setminus \{v\}$ is contained in some previous edge. We determine asymptotically-optimal codegree conditions which ensure the containment of all spanning bounded-degree tight k-trees. This generalises a well-known result of Komlós, Sárközy and Szemerédi. Joint work with Matías Pavez-Signé and Maya Stein.

Org: Anthony Bonato (Ryerson University) and **Nancy Clarke** (Acadia University)

In graph searching, a set of pursuers attempts to locate or eliminate the threat posed by an evader in the network. The rules greatly determine the difficulty of the questions posed above. For example, the evader may be visible, but the pursuers may have limited movement speed, only moving to nearby vertices adjacent to them. Such a paradigm leads to the game of Cops and Robbers, and deep questions like Meyniel's conjecture on the cop number of a graph. Central to all graph searching questions is the idea of optimizing certain parameters, whether they are the cop number, burning number, or localization number, for example. Finding the exact values, bounds, and algorithms to compute these graph parameters leads to fascinating topics intersecting with classical graph theory, combinatorial designs, and probabilistic methods.
The proposed minisymposium brings together leading researchers in graph searching, who will present state-of-the-art research in this direction.

Abstracts

FIONN MC INERNEY, CISPA Helmholtz Center for Information Security

[Tuesday May 25, 11:20]

Eternal Domination in D-Dimensional Grids

In eternal domination, a vertex is attacked at each turn, and a team of guards must move a guard to that vertex to defend it. The guards may only move to adjacent vertices on their turn. The eternal domination number γ_{all}^{∞} of a graph is the minimum number of guards required to defend against an infinite sequence of attacks. I show a technique to prove that $\gamma_{all}^{\infty}(G) = \gamma(G) + o(\gamma(G))$ for all graphs $G \in \mathcal{F}$, where $\mathcal{F}$ is a large family of D-dimensional grids which are supergraphs of the D-dimensional Cartesian grid and subgraphs of the D-dimensional strong grid.

BOJAN MOHAR, Simon Fraser University

[Tuesday May 25, 11:50]

Cops and robbers on surfaces

Pursuit-evasion games in subspaces of the Euclidean space have been studied extensively, especially in the framework of differential games. However, differential pursuit-evasion games behave differently from the combinatorial game of Cops and Robbers played on graphs. The speaker will discuss how to define the game of cops and robbers on a Riemannian surface with intention to preserve all the beauty of the game played on graphs.

NANCY CLARKE, Acadia University

[Tuesday May 25, 12:20]

A variation of the Cops and Robber game with a new capture condition

Surrounding Cops and Robber is a variation of the game in which the cops win by occupying each of the robber's neighbouring vertices. The surrounding copnumber is analogous to the copnumber. We present a variety of results for this parameter, including exact values for several classes of graphs as well as more general bounds. Classes of interest include graph products, graphs arising from combinatorial designs, and generalized Petersen graphs. This is joint work with A. Burgess, R. Cameron, P. Danziger, S. Finbow, C. Jones, and D. Pike.

Back to Table of Contents

WILLIAM KINNERSLEY, University of Rhode Island

[Tuesday May 25, 12:50]

Infinitely fast robbers on grids

Recently, there has been considerable interest on variants of Cops and Robbers in which the robber is more mobile than the cops. In the *infinite-speed robber* variant, the robber may, on their turn, traverse an arbitrarily long cop-free path. In this talk, we present some recent work on this game. In particular, we determine the infinite-speed cop number of two-dimensional Cartesian grids up to a small additive constant, and we give asymptotic bounds for several families of grid-like graphs, including higher-dimensional Cartesian grids and hypercubes. This is joint work with Niko Townsend.

MELISSA HUGGAN, Ryerson University

[Tuesday May 25, 13:20]

Locating an invisible adversary

The localization game is a variant of Cops and Robbers where the robber is invisible and the cops use distance probes to determine the robber's location. The localization number of a graph is the minimum number of cops required to ensure the robber's capture. In this talk, we present bounds on the localization number of incidence graphs of certain classes of combinatorial designs. This is joint work with Anthony Bonato and Trent Marbach.

Abstracts

DAVID DE BOER, Korteweg-de Vries Institute, UvA

[Tuesday May 25, 11:20]

Uniqueness of the Gibbs measure for the 4*-state anti-ferromagnetic Potts model on the regular tree*

We show that the 4-state anti-ferromagnetic Potts model with interaction parameter $w \in (0,1)$ on the infinite $(d+1)$-regular tree has a unique Gibbs measure for all $w \geq 1 - \frac{4}{d+1}$ and $d \geq 4$. This is tight since it is known that there are multiple Gibbs measures when $0 \leq w < 1 - \frac{4}{d+1}$ and $d \geq 4$. The transition from having a unique to several Gibbs measures is closely connected to phase transitions in statistical physics.

Our method also gives a new proof of the uniqueness of the Gibbs measure for the 3-state Potts model on the $(d+1)$-regular tree for $w \geq 1 - \frac{3}{d+1}$ when $d \geq 3$ and for $w \in (0,1)$ when $d = 2$.

JEROEN HUIJBEN, University of Amsterdam

[Tuesday May 25, 11:50]

Sampling from the low temperature Potts model through a Markov chain on flows

We consider the algorithmic problem of sampling from the Potts model and computing its partition function at low temperatures. Instead of directly working with spin configurations, we consider the equivalent problem of sampling flows. We show, using path coupling, that a simple and natural Markov chain on the set of flows is rapidly mixing. As a result we find an ε-approximate sampling algorithm for the Potts model at low enough temperatures, whose running time is bounded by $O(m \log(m) \log(m\varepsilon^{-1}))$ for graphs G with m edges.

AMEDEO SGUEGLIA, London School of Economics

[Tuesday May 25, 12:20]

Clique factors in randomly perturbed graphs

We study the model of randomly perturbed dense graphs, which is the union of any n-vertex graph G_α with minimum degree αn and the binomial random graph $G(n,p)$. In this talk, we shall examine the following central question in this area: to determine when $G_\alpha \cup G(n,p)$ contains clique factors, i.e. spanning subgraphs consisting of vertex disjoint copies of the complete graph K_k. We offer several new sharp and stability results. This is joint work with Julia Böttcher, Olaf Parczyk, and Jozef Skokan.

Back to Table of Contents

MAKSIM ZHUKOVSKII, MIPT

[Tuesday May 25, 12:50]

Cycle saturation in random graphs

Given two graphs G and F, an inclusion-maximum F-free spanning subgraph $H \subset G$ is called an *F-saturated subgraph of G*. The minimum number of edges in an F-saturated subgraph of G is called *F-saturation number of G* and denoted by $\mathrm{sat}(G, F)$. The stability of $\mathrm{sat}(K_n, F)$ was studied by Korandi and Sudakov in 2017 for complete graphs and by Mohammadian and Tayfeh-Rezaie in 2018 for star graphs.

In 1972, Ollmann proved that $\mathrm{sat}(K_n, C_4) = \lfloor \frac{3n-5}{2} \rfloor$ for all $n \geq 5$. In 2009, Chen proved that $\mathrm{sat}(K_n, C_5) = \lceil \frac{10}{7}(n-1) \rceil$ for $n \geq 21$. For all other ℓ, the exact value of $\mathrm{sat}(K_n, C_\ell)$ is not known. However, several non-trivial bounds are obtained. In particular, $\mathrm{sat}(K_n, C_\ell) > (1+\varepsilon(\ell))n$ for some $\varepsilon(\ell) > 0$. We have proved that $\mathrm{sat}(K_n, C_\ell)$ is not asymptotically stable for all $\ell \geq 5$: with high probability $\mathrm{sat}(G(n,p), C_\ell) = n(1+o(1))$. We have also proved that there exists γ such that with high probability $\mathrm{sat}(G(n,p), C_4) \leq \gamma n$.

This is joint work with Yury Demidovich.

R W R DARLING, U.S. Department of Defense

[Tuesday May 25, 13:20]

Efficient comparison-based learning via partitioned local depth for near neighbors

A triplet comparison on a set S takes $x \in S$, and for any pair $\{y, z\} \subset S \setminus \{x\}$ declares which of y and z is more similar to x. Such triplet comparisons supply an orientation to the line graph of the complete graph on S: $\{x, y\} \longrightarrow \{x, z\}$ means y is more similar to x than z is. No metric is involved. Partitioned local depth (PaLD) supplies a non-parametric partitioning of S, under such triplet comparisons, but suffers from a run time cubic in $n := |S|$. We use the Bounded Differences Inequality to analyze the quality of approximation obtained by restricting PaLD to the K-nearest neighbors of each object. Run time is $O(nK^2)$, while error decays exponentially in $-K^2$. The statistics of uniform random orientations of the line graph play a major role. Examples from spatial data at inhomogenous scales are examined.

Org: Chaitanya Swamy (University of Waterloo)

Abstracts

DEEPARNAB CHAKRABARTY, Dartmouth College

[Tuesday May 25, 15:30]

Algorithms for minimum norm combinatorial optimization

In many optimization problems, a feasible solution induces a multi-dimensional cost vector. For example, in load-balancing a schedule induces a load vector across the machines. In k-clustering, opening k facilities induces an assignment cost vector across the clients. In this paper we consider the following minimum norm optimization problem : given an arbitrary monotone, symmetric norm, find a solution which minimizes the norm of the induced cost-vector. This generalizes many fundamental NP-hard problems. We give a general framework to tackle the minimum norm problem, and illustrate its efficacy in load balancing and, time permitting, in the clustering setting.

CHANDRA CHEKURI, University of Illinois, Urbana-Champaign

[Tuesday May 25, 16:00]

Covering Multiple Submodular Constraints and Applications

Given a finite ground set N, a weight function $w : N \to \mathbb{R}_+$, r monotone submodular functions $f_1, f_2, \ldots, f_r$ over N and requirements $k_1, k_2, \ldots, k_r$, we consider the problem of finding a min-weight subset $S \subseteq N$ such that $f_i(S) \geq k_i$ for $1 \leq i \leq r$. This generalizes the well-known Submodular Set Cover problem. A simple greedy algorithm gives an $O(\log(kr))$ approximation where $k = \sum_i k_i$. We improve the greedy approximation via mathematical programming relaxations in several interesting special cases, and point out various applications. Joint work with Tanmay Inamdar, Kent Quanrud, Kasturi Varadarajan and Zhao Zhang.

ANUPAM GUPTA, Carnegie Mellon University

[Tuesday May 25, 16:30]

Matroid-Based TSP Rounding for Half-Integral Solutions

We show how to round any half-integral solution to the subtour-elimination relaxation for the TSP, while losing a less-than-1.5 factor. Such a rounding algorithm was recently given by Karlin, Klein, and Oveis Gharan based on sampling from max-entropy distributions. Our result is based on sampling from the matroid intersection polytope.

This is based on joint work with Euiwoong Lee, Jason Li, and Marcin Mucha.

Back to Table of Contents

ALEKSANDAR NIKOLOV, University of Toronto

[Tuesday May 25, 17:00]

Maximizing Determinants under Combinatorial Constraints

Given a set of rank-one PSD matrices matrices $v_1 v_1^T, \ldots, v_n v_n^T$, we consider the problem of selecting a subset S of them whose sum has maximum determinant, under combinatorial constraints on S. This problem appears in a diverse set of areas such as experimental design, fair allocation of goods, and network design. I will outline some of these connections, and describe how randomized rounding, convex optimization, and the theory of completely log-concave polynomials lets us design approximation and estimation algorithms for this problem.

The talk is based on works with Mohit Singh, Uthaipon (Tao) Tantipongpipat, and Vivek Madan.

OLA SVENSSON, Ecole Polytechnique Fédérale de Lausanne

[Tuesday May 25, 17:30]

The Primal-Dual method for Learning Augmented Algorithms

We extend the primal-dual method for online algorithms in order to incorporate predictions that advise the online algorithm about the next action to take. We use this framework to obtain novel algorithms for a variety of online covering problems. We compare our algorithms to the cost of the true and predicted offline optimal solutions and show that these algorithms outperform any online algorithm when the prediction is accurate while maintaining good guarantees when the prediction is misleading.

This is joint work with Étienne Bamas and Andreas Maggiori.

Back to Table of Contents

Org: Thaís Bardini Idalino (Universidade Federal de Santa Catarina, Brazil), **Jonathan Jedwab** (Simon Fraser University) and **Shuxing Li** (Simon Fraser University)

Designs and codes are closely intertwined studies that share many common discrete structures. This minisymposium explores algebraic and combinatorial approaches to the construction, analysis, and classification of designs and codes, with particular emphasis on these common discrete structures.

Abstracts

HADI KHARAGHANI, University of Lethbridge

[Tuesday May 25, 15:30]

A class of balanced weighing matrices and the corresponding association scheme

Balanced weighing matrices with parameters

$$\left(1 + 18 \cdot \frac{9^{m+1} - 1}{8}, 9^{m+1}, 4 \cdot 9^m\right),$$

for each nonzero integer m is constructed. This seems to be the first infinite class not belonging to those with classical parameters. It is shown that any balanced weighing matrix is equivalent to a five-class association scheme.

This is joint work with Thomas Pender and Sho Suda.

JIM DAVIS, University of Richmond, VA

[Tuesday May 25, 16:00]

Designs with the Symmetric Difference Property

The recently completed search for existence of difference sets in small 2-groups has provided a wealth of data to explore other questions. One classical question asks which designs have the symmetric difference property (the symmetric difference of any three blocks is either a block or the complement of a block). We show in this talk that the groups $C_8 \times C_4^t \times C_2$ all have difference sets whose designs have the symmetric difference property, $t \geq 1$, and that these designs are nonisomorphic to the symplectic designs. Joint with Smith, Hoo, Kissane, Liu, Reedy, Sharma, and Sun.

ZEYING WANG, Michigan Technological University, MI

[Tuesday May 25, 16:30]

New necessary conditions on (negative) Latin square type partial difference sets in abelian groups

A partial difference sets (in short, PDS) with parameters $(n^2, r(n-\epsilon), \epsilon n + r^2 - 3\epsilon r, r^2 - \epsilon r)$ is called a *Latin square type* PDS if $\epsilon = 1$ (respectively, a *negative Latin square type* PDS if $\epsilon = -1$). Recently we obtained some restrictions on the parameter r of a (negative) Latin square type partial difference set in an abelian group of order a^2b^2, where $\gcd(a, b) = 1$, $a > 1$, and b is an odd positive integer ≥ 3. As far as we know no previous general restrictions on r were known. Our restrictions are particularly useful when a is much larger than b.

Back to Table of Contents

IAN WANLESS, Monash University, Australia

[Tuesday May 25, 17:00]

Omniversal Latin squares

A partial transversal of a Latin square is a set of entries in which no row, column or symbol is repeated. It is maximal if it is not contained in a larger partial transversal. A Latin square of order n is omniversal if it possesses a maximal partial transversal of every size from $\lceil \frac{n}{2} \rceil$ to n. We show that omniversal Latin squares exist iff $n \not\equiv 2 \bmod 4$ and $n \notin \{3, 4\}$. We also show that group tables are very far from omniversal (as are random Latin squares). In the process we encounter an interesting problem in combinatorial group theory.

XIANDE ZHANG, University of Science and Technology of China

[Tuesday May 25, 17:30]

Optimal ternary constant weight codes in l_1-metric

In this talk, we discuss our recent progress on the existence of optimal ternary constant weight codes in l_1-metric. We determine the maximum size of ternary codes of constant weight w and distance $2w-2$ for all large length n. For distance $2w-4$, we determine the coefficients of n^2 by constructing asymptotially optimal codes. The motivation of studying constant weight codes in l_1-metric is from data storage in live DNA.

Back to Table of Contents

Org: Nino Bašić (University of Primorska, Slovenia) and **Elizabeth Hartung** (Massachusetts College of Liberal Arts, USA)

This minisymposium in chemical graph theory explores various applications of graph theory to chemistry. A molecule can be described as a graph, where vertices represent atoms and edges represent chemical bonds: benzenoids and fullerenes are two examples of such graph classes. Properties of those graphs, such as perfect matchings and graph spectra, can be used to model characteristics of molecules, including stability, reactivity, and electronic structure. Other related topics in chemical graph theory include enumeration of graphs classes and algorithms for their enumeration. Graphs are also important for biosciences, such as phylogenetics where they are used to study phylogenetic trees and related structures, and synthetic biology where graphs proved to be useful for modeling self-assembly of DNA and protein nanostructures.

Abstracts

PATRICK W. FOWLER, University of Sheffield, UK

[Tuesday May 25, 15:30]

The Chemical Significance of Graph Energy

Energy is a well-defined physical quantity with discrepant definitions in the mathematical chemistry of π systems. In an extensive mathematical literature, graph energy, $E_{\mathrm{G}}(G)$, is the sum of absolute values of adjacency eigenvalues of graph G. This is a tractable but imperfect mimic of the physical Hückel energy, $E_\pi(G,N)$, a quantity that depends on both G, the molecular graph of the conjugated carbon framework, and the π electron count, N. Discrepancies between $E_{\mathrm{G}}(G)$ and $E_\pi(G,N)$ can be arbitrarily large, but we reconcile the two definitions with a natural connection to the chemical concept of bond number.

DRAGAN STEVANOVIĆ, Mathematical Institute of the Serbian Academy of Sciences and Arts, Serbia

[Tuesday May 25, 16:00]

On Hosoya's dormants and sprouts

Study of cospectral graphs is a traditional topic of spectral graph theory. Haruo Hosoya recently drew attention to a particular aspect of constructing cospectral graphs using coalescences: that cospectral graphs can be constructed by attaching multiple copies of the same rooted graph in different ways to subsets of vertices of an underlying graph. We address expectations and questions raised in Hosoya's papers, and present an explicit formula for the characteristic polynomial of such multiple coalescences, establishing a necessary and sufficient condition for their cospectrality in the case when the attached rooted graph may be arbitrary.

(Joint work with Salem Al-Yakoob.)

IRENE SCIRIHA, University of Malta, Malta

[Tuesday May 25, 16:30]

The conductivity of the connected sum of root graphs with a common nullspace

Two connected root–graphs, H_1 and H_2, with isomorphic subgraphs $H_1 - z_1$ and $H_2 - z_2$, are glued together to form their connected-sum Z. If their μ–eigenspace is generated by vector $\mathbf{y}$ for some eigenvalue μ of their 0-1-adjacency matrix, then the μ-multiplicity of Z is shown to depend on the μ–type of z_1 and z_2 in the root–graphs. A sufficient condition for the uniqueness of $H_1 (\simeq H_2)$, for a given $\mathbf{y}$, when constructed from $H_1 - z_1$, is also established. The SSP model for ballistic conduction in a pi-molecule predicts that 5 out of the 11 feasible MEDs can be Z.

RISTE ŠKREKOVSKI, University of Ljubljana, Slovenia

[Tuesday May 25, 17:00]

On 12-regular nut graphs

A nut graph is a simple graph whose adjacency matrix is singular with 1-dimensional kernel and corresponding eigenvector with no zero elements. For each $d \in \{3, 4, \ldots, 11\}$ are known all values n for which there exists a d-regular nut graph of order n. In the talk, we consider all values n for which there exists a 12-regular nut graph of order n. (This is a joint work Nino Bašić and Martin Knor.)

JELENA SEDLAR, University of Split, Croatia

[Tuesday May 25, 17:30]

Two types of indices and their extremal trees

We introduce the ordering of tree graphs so that the star S_n is minimal and the path P_n is maximal graph. Topological indices are of Wiener or anti-Wiener type, if they are increasing or decreasing functions with respect to the introduced ordering. If an index is of Wiener type S_n is minimal and P_n is maximal tree, for anti-Wiener type the reverse holds. We introduce a simple criterion to establish if a topological index is of Wiener or anti-Wiener type and apply our result to several generalizations of Wiener index.

Back to Table of Contents

Org: Abhinav Shantanam (Simon Fraser University) and **Carol T. Zamfirescu** (Ghent University)

The talks focus on recent developments concerning cycles in planar graphs – fundamental topics in graph theory – with an emphasis on longest cycles and Hamiltonicity.

Abstracts

XIAONAN LIU, Georgia Institute of Technology

[Tuesday May 25, 15:30]

Number of Hamiltonian cycles in planar triangulations

Hakimi, Schmeichel, and Thomassen conjectured in 1979 that if G is a 4-connected planar triangulation with n vertices then G contains at least $2(n-2)(n-4)$ Hamiltonian cycles, with equality if and only if G is a double wheel. Alahmadi, Aldred, and Thomassen recently proved that there are exponentially many Hamiltonian cycles in 5-connected planar triangulations. We consider 4-connected planar n-vertex triangulations G that do not have too many separating 4-cycles or have minimum degree 5. We show that if G has $O(n/\log_2 n)$ separating 4-cycles then G has $\Omega(n^2)$ Hamiltonian cycles, and if $\delta(G) \geq 5$ then G has $2^{\Omega(n^{1/4})}$ Hamiltonian cycles.

ON-HEI SOLOMON LO, University of Science and Technology of China

[Tuesday May 25, 16:00]

Gaps in the cycle spectrum of polyhedral graphs

It was recently initiated by Merker to study whether every polyhedral graph must have a cycle length in some certain integer interval. For any positive integer k, define $f(k)$ (respectively, $f_3(k)$) to be the minimum integer $\geq k$ such that every 3-connected planar graph (respectively, 3-connected cubic planar graph) of circumference $\geq k$ has a cycle whose length is in the interval $[k, f(k)]$ (respectively, $[k, f_3(k)]$). We will describe how the values of $f(k)$ and $f_3(k)$ can be determined. This is a joint work with Qing Cui.

EMILY A. MARSHALL, Arcadia University

[Tuesday May 25, 16:30]

Hamiltonicity of planar graphs with a forbidden minor

Tutte proved that all 4-connected planar graphs are Hamiltonian, but it is well-known that 3-connected planar graphs are not necessarily Hamiltonian. In this talk, we discuss the Hamiltonicity of certain 3-connected planar graphs with forbidden minors.

JENS M. SCHMIDT, Hamburg University of Technology

[Tuesday May 25, 17:00]

The Isolation Lemma

A cycle C of a graph G is *isolating* if every component of $G - V(C)$ consists of a single vertex. We show that isolating cycles in polyhedral graphs can be extended to larger ones: every isolating cycle C of length $6 \leq |E(C)| < \left\lfloor \frac{2}{3}(|V(G)| + 4) \right\rfloor$ implies an isolating cycle C' of larger length that contains $V(C)$. By "hopping" iteratively to such larger cycles, we obtain a powerful and very general inductive motor for proving long cycles and computing them (in quadratic runtime).

This is joint work with Jan Kessler.

ABHINAV SHANTANAM, Simon Fraser University

[Tuesday May 25, 17:30]

Pancyclicity in 4-connected planar graphs

A graph on n vertices is said to be pancyclic if, for each $k \in \{3, \ldots, n\}$, it contains a cycle of length k. Following Bondy's meta-conjecture that almost any nontrivial condition on a graph which implies Hamiltonicity also implies pancyclicity, Malkevitch conjectured that a 4-connected planar graph is pancyclic if it contains a cycle of length 4. We show that, for any edge e in a 4-connected planar graph G, there exist at least $\lambda(n-2)$ cycles of pairwise distinct lengths containing e, where $\lambda = 5/12$. We also show that λ can be $2/3$ at best. Joint work with Bojan Mohar.

Org: Pat Morin (Carleton University)

Dujmović, Joret, Micek, Morin, Ueckerdt and Wood (2019) showed that every planar graph is contained in the strong product of a bounded treewidth graph and a path. This mini-symposium will first introduce this *product structure theorem* and its generalizations and present a number of applications, including new asymptotically optimal results for <ul> queue number (Heath, Leighton, Rosenberg 1992); nonrepetitive chromatic number (Alon, Grytczuk, Hałuszczak, and Riordan 2002); p-centered colourings (Nešetřil and Ossona de Mendez 2006, Dvořák 2016) and ℓ-vertex rankings (Karpas, Neiman, and Smorodinsky 2016); and adjacency labelling and universal graphs (Kannan, Naor, and Rudich 1988; Babai, Erdős, Chung, Graham, and Spencer 1982). The introductory talk will also discuss several generalization of the product structure theorem that extend these applications to broader graph classes, including bounded genus graphs, apex-minor-free graphs, bounded-degree graphs from minor-closed families, and k-planar graphs for fixed k.

Abstracts

VIDA DUJMOVIC, University of Ottawa

[Tuesday May 25, 15:30]

Product structure Theorem(s)

Dujmović, Joret, Micek, Morin, Ueckerdt and Wood (2019) showed that every planar graph is a subgraph of the strong product of a bounded treewidth graph and a path. This introductory mini-symposium talk will introduce this *product structure theorem* and its generalizations.

DAVID WOOD, Monash University

[Tuesday May 25, 16:00]

Planar graphs have bounded queue-number

We show that planar graphs have bounded queue-number, thus proving a conjecture of Heath et al. from 1992. The key to the proof is the following result: every planar graph is a subgraph of the strong product of some treewidth 8 graph and some path. We generalise the first result to show that every proper minor-closed class has bounded queue-number. This is joint work with Vida Dujmović, Gwenaël Joret, Piotr Micek, Pat Morin and Torsten Ueckerdt [J. ACM 67.4:22, 2020].

LOUIS ESPERET, Laboratoire G-SCOP (CNRS, Univ. Grenoble Alpes)

[Tuesday May 25, 16:30]

Planar graphs have bounded nonrepetitive chromatic number

A colouring of a graph is "nonrepetitive" if for every path of even order, the sequence of colours on the first half of the path is different from the sequence of colours on the second half. Using the planar graph product structure theorem, we show that planar graphs have nonrepetitive colourings with a bounded number of colours, thus solving a problem raised by Alon, Grytczuk, Haluszczak and Riordan in 2002. We also generalise this result to graphs excluding a fixed minor or topological minor.

This is joint work with V. Dujmović, G. Joret, B. Walczak, and D.R. Wood.

Back to Table of Contents

PIOTR MICEK, Jagiellonian University

[Tuesday May 25, 17:00]

Centered colorings and vertex rankings

A vertex coloring ϕ of a graph G is *p-centered* if for every connected subgraph H of G either ϕ uses more than p colors on H or there is a color that appears exactly once on H.

A vertex coloring ϕ of a graph G is an *ℓ-ranking* of G if for every connected subgraph H of G of diameter at most ℓ there is exactly one vertex of maximum color used by ϕ on H.

We are going to use the product structure theorem to deliver the best-known bounds on these parameters for planar graphs.

GWENAËL JORET, Université Libre de Bruxelles

[Tuesday May 25, 17:30]

Sparse universal graphs for planarity

This talk focuses on the following two problems:

(1) What is the minimum number of edges in a graph containing all n-vertex planar graphs as subgraphs? The best known bound is $O(n^{3/2})$, due to Babai, Chung, Erdös, Graham, and Spencer (1982).

(2) What is the minimum number of *vertices* in a graph containing all n-vertex planar graphs as *induced* subgraphs? Here Bonamy, Gavoille, and Pilipczuk (2019) recently established a $O(n^{4/3})$ bound.

We show that a bound of $n^{1+o(1)}$ can be achieved for these two problems. Joint work with Vida Dujmović, Louis Esperet, Cyril Gavoille, Piotr Micek, and Pat Morin.

Org: Karen Gunderson (University of Manitoba), **Karen Meagher** (University of Regina) and **Joy Morris** (University of Lethbridge)

In algebraic graph theory, combinatorial matrix theory, infection processes on graphs, and extremal combinatorics, the best modern results are often found using an interdisciplinary approach, leveraging tools and techniques from these other fields. The tools developed in solving these types of problems are often strong and transferable. Algebraic techniques, a deeper understanding of graph symmetries, probabilistic techniques and structural extremal results show a great promise to develop a deep and general theory that encompasses many graph and hypergraph classes all at once.
This minisymposium will be highlighting recent results in these areas that connect to the planned research topics and projects for the PIMS-funded CRG "Movement and symmetry in graphs".

Abstracts

KAREN GUNDERSON, University of Manitoba

[Tuesday May 25, 15:30]

Bootstrap percolation on infinite graphs

In r-neighbour bootstrap percolation, vertices of a graph are either 'healthy' or 'infected' and infection spreads to a healthy vertex with at least r infected neighbours. Percolation is said to occur if all vertices are eventually infected. When vertices are infected initially at random, the main question is the value of the critical probability – where percolation becomes more likely than not. I will present results on how the variance of vertex degrees affects the value of the critical probability in Galton–Watson trees and discuss some open problems on the critical probabilities for infinite regular graphs including Cayley graphs.

JEANNETTE JANSSEN, Dalhousie University

[Tuesday May 25, 16:00]

An approximation algorithm for finding the zero-forcing number of a graph

Consider the following graph process: Given a graph with vertices coloured black or white. At each step, if a black vertex has exactly one white neighbour, then this neighbour turns black. If the process turns all vertices black, then the initial set of black vertices is a zero-forcing set. The minimum size of a zero-forcing set in a graph G is called the zero-forcing number $z(G)$. We give an approximation algorithm that finds a zero-forcing set of size at most $(pw+1)z(G)$, where pw is the path-width of G. This is joint work with Ben Cameron, Rogers Mathew, and Zhiyuan Zhang.

KAREN MEAGHER, University of Regina

[Tuesday May 25, 16:30]

Open problems related to Erdős-Ko-Rado type results

I have been working on Erdős-Ko-Rado type results using methods from Algebraic Graph Theory for many years. In this talk I will describe several problems and conjectures related to this work where my standard methods fail and I need new tools! These are all problems I am hoping to make progress on with the collaborative research group Movement and Symmetry in Graphs.

JOY MORRIS, University of Lethbridge

[Tuesday May 25, 17:00]

Regular Representations

A regular representation is a combinatorial object whose automorphism group is acting regularly (generally on the points). A regular action is one that is sharply transitive: i.e., there is precisely one automorphism taking any point to any other. I will give an overview of some of the results on regular representations (graphical, digraphical, tournament, etc.), including asymptotic results and results about when they can be easily detected.

Abstracts

KIEKA MYNHARDT, University of Victoria

[Tuesday May 25, 15:30]

Boundary independent broadcasts in graphs

A broadcast on a connected graph $G = (V, E)$ is a function $f : V \longrightarrow \{0, 1, \ldots, diam(G)\}$ such that $f(v) \leq e(v)$ (the eccentricity of v) for all $v \in V$ if $|V| \geq 2$, and $f(v) = 1$ if $V = \{v\}$. If X is an independent set of vertices of G, then no edge of G is incident with, or covered by, more than one vertex in X. This property generalizes to so-called boundary independent, or bn-independent, broadcasts in which the neighbourhoods of two broadcasting vertices either do not overlap, or overlap only at their boundaries; that is, no edge is covered by more than one broadcasting vertex. The parameters associated with bn-independent broadcasts are $i_{bn}(G) = \min\{\sum_{v \in V} f(v) : f$ is a maximal bn-independent broadcast on $G\}$ and $\alpha_{bn}(G) = \max\{\sum_{v \in V} f(v) : f$ is a bn-independent broadcast on $G\}$. We survey recent results concerning i_{bn} and α_{bn}.

AARON SLOBODIN, University of Victoria

[Tuesday May 25, 16:00]

2-Limited Broadcast Domination in Grids

Suppose there is a transmitter located at each vertex of a graph G. A k-limited broadcast on G is an assignment of the integers $0, 1, \ldots, k$ to the vertices of G. The integer assigned to the vertex x represents the strength of the broadcast from x, where strength 0 means the transmitter at x is not broadcasting. A broadcast of positive strength s from x is heard by all vertices at distance at most s from x. A k-limited broadcast is called dominating if every vertex assigned 0 is within distance d of a vertex whose transmitter is broadcasting with strength at least d. The k-limited broadcast domination number of G is the minimum possible value of the sum of the strengths of the broadcasts in a k-limited dominating broadcast of G.

We give tight bounds for the 2-limited broadcast domination number in grids.

VIRGÉLOT VIRGILE, University of Victoria

[Tuesday May 25, 16:30]

Eternal domination and clique covering

The eternal domination number of a graph is the minimum number of guards necessary to defend the graph against any sequence of attacks on its vertices. It is well known that the clique covering number of a graph is an upper bound on its eternal domination number. In this talk, we will show that the smallest order of a graph having eternal domination number strictly less than its clique covering number is 10 and discuss related results.

This is joint work with Gary MacGillivray and Kieka Mynhardt.

Back to Table of Contents

BRENDAN ROONEY, Rochester Institute of Technology

[Tuesday May 25, 17:00]

Efficient k-Domination in Hamming Graphs

A (j,k)-*dominating function* on X as a function $f : V(X) \to \{0,\ldots,j\}$ so that for each $v \in V(X)$, $f(N[v]) \geq k$, where $N[v]$ is the closed neighbourhood of v. Such a function is *efficient* if all of the vertex inequalities are met with equality. They give a simple necessary condition for efficient domination, namely: if X is a d-regular graph on n vertices that has an efficient $(1,k)$-dominating function, then the size of the corresponding dominating set divides $n \cdot k$.

The Hamming graph $H(q,d)$ is the graph on the vectors $\mathbb{Z}_q^d$ where two vectors are adjacent if and only if they are at Hamming distance 1. We show that if q is a prime power, then the previous necessary condition is sufficient for $H(q,d)$ to have an efficient $(1,k)$-dominating function. This result extends a result of Lee from 2001 on independent perfect domination in hypercubes.

ANNA BACHSTEIN, Clemson University

[Tuesday May 25, 17:30]

Compelling Colorings: A generalization of the dominator chromatic number

We define a $\mathcal{P}$-compelling coloring as a proper coloring of the vertices of a graph such that every subset consisting of one vertex of each color has property $\mathcal{P}$. The $\mathcal{P}$-compelling chromatic number is the minimum number of colors in such a coloring. We show that this notion generalizes the dominator and total dominator chromatic numbers, and provide some general bounds and algorithmic results. We also investigate the specific cases where $\mathcal{P}$ is that the subset contains at least one edge or that the subset is connected. Joint work with Wayne Goddard, Michael A. Henning, and John Xue.

Abstracts

AYSEL EREY, Gebze Technical University

[Tuesday May 25, 15:30]

Chromatic number and distance spectral radius

The distance spectral radius of a graph is the largest eigenvalue of its distance matrix. We discuss the problem of maximizing the distance spectral radius of a connected graph with fixed chromatic number and order, and we determine the unique extremal graph among all connected 4-chromatic planar graphs of fixed order.

AHMAD MOJALLAL, University of Regina

[Tuesday May 25, 16:00]

The minimum number of distinct eigenvalues of threshold graphs

For a graph G, we associate a family of real symmetric matrices, $S(G)$, where for any $M \in S(G)$, the location of the nonzero off-diagonal entries of M are governed by the adjacency structure of G. The minimum number of distinct eigenvalues, taken over $S(G)$ compatible with the graph G is denoted by $q(G)$.

Threshold graphs can be characterized in many ways. One way of obtaining a threshold graph is through an iterative process that starts with an isolated vertex, and where, at each step, either a new isolated vertex is added, or a vertex adjacent to all previous vertices (dominating vertex) is added.

In this talk, we study the spectral invariant of $q(G)$ for connected threshold graphs of a fixed order n.

JESMINA PERVIN, Indian Institute of Technology(Banaras Hindu University), Varanasi

[Tuesday May 25, 16:30]

Q-integral connected graphs with maximum edge-degrees less than or equal to 8

Graphs with integral signless Laplacian spectrum are called Q-integral graphs. The number of adjacent edges to an edge defines the edge-degree of that edge. The Q-spectral radius of a graph is the largest eigenvalue of its signless Laplacian. In 2019, Jongyook Park and Yoshio Sano studied Q-integral connected graphs with edge-degrees at most six. In this article, we extend this result and study the Q-integral connected graph with maximum edge-degree less than or equal to eight. Further, we give an upper and lower bound for the maximum edge-degree of a Q-integral connected graph with respect to its Q-spectral radius. As a corollary, we also show that the Q-spectral radius of the edge-non-regular Q-integral connected graph with maximum edge-degree five is six which we anticipate to be a key for solving the unsolved problem of characterizing such graphs.

SANJA RUKAVINA, Department of Mathematics, University of Rijeka, Croatia

[Tuesday May 25, 17:00]

Self-orthogonal codes from equitable partitions of distance-regular graphs

We give two methods for a construction of self-orthogonal codes using equitable partitions of distance-regular graphs. In the case of 2-class association schemes one of the methods coincides with the construction from strongly regular graphs given in [1], and in the case when all cells of the partition are of the same size it coincides with the construction presented in [2]. We apply these methods to construct self-orthogonal codes from some distance-regular graphs.

This is a joint work with Dean Crnković and Andrea Švob.

References:

[1] Crnković, D., Maksimović, M., Rodrigues, B. G., Rukavina, S.: Self-orthogonal codes from the strongly regular graphs on up to 40 vertices, Adv. Math. Commun. 10 (2016), 555-582.

[2] Crnković, D., Rukavina, S., Švob, A.: Self-orthogonal codes from equitable partitions of association schemes, ArXiv preprint, https://arxiv.org/pdf/1903.01832.pdf

LUDMILA TSIOVKINA, IMM UB RAS

[Tuesday May 25, 17:30]

On some classes of vertex-transitive distance-regular antipodal covers of complete graphs

Distance-regular antipodal cover of a complete graph (called briefly an (n, r, μ)-cover) is equivalently defined as a graph whose vertex set admits a partition into n cells of the same size r such that (i) each its cell induces a r-coclique, (ii) the union of any two distinct cells induces a perfect matching, and (iii) any two non-adjacent vertices that lie in distinct cells have exactly μ common neighbors. In general, such graphs do not have a universal construction, and one of most important tasks in their study is to classify (n, r, μ)-covers with vertex-transitive automorphism groups. In this talk, I will present some recent results on construction and classification of (n, r, μ)-covers with vertex-transitive automorphism groups of some special types.

Org: Yufei Zhao (MIT)

Abstracts

DOR MINZER, Massachusetts Institute of Technology

[Wednesday May 26, 11:20]

Optimal tiling of the Euclidean space using permutation-symmetric bodies

What is the least surface area of a body B whose $\mathbb{Z}^n$ translations tile $\mathbb{R}^n$? The isoperimetric inequality gives the bound $\Omega(\sqrt{n})$, and remarkably Kindler et al. showed that this is achievable.

In this work, we consider permutation-symmetric tilings. We show that in this case the answer is $\Theta(n/\sqrt{\log n})$.

Our work is motivated by the study of strong versions of the parallel repetition theorem, which if true would have significant applications. Unfortunately, strong parallel repetition fails in general [Raz]. Our result suggests there may be important special cases where it still applies.

Joint work with Mark Braverman.

ALEXANDR POLYANSKII, Moscow Institute of Physics and Technology

[Wednesday May 26, 11:50]

A cap covering theorem

A *cap* of spherical radius α on a unit d-sphere S is the set of points within spherical distance α from a given point on the sphere. Let $\mathcal{F}$ be a finite set of caps lying on S. We prove that if no hyperplane through the center of S divides $\mathcal{F}$ into two non-empty subsets without intersecting any cap in $\mathcal{F}$, then there is a cap of radius equal to the sum of radii of all caps in $\mathcal{F}$ covering all caps of $\mathcal{F}$ provided that the sum of radii is less $\pi/2$.

YAIR SHENFELD, Massachusetts Institute of Technology

[Wednesday May 26, 12:20]

Extremal structures of log-concave sequences via convex geometry

Many sequences arising naturally in combinatorics are known, or conjectured to be, concave after taking their logarithm. Suppose that such a sequence has a flat part, meaning that one term is equal to the average of its neighbors. What does this imply for the structure of the combinatorial objects at hand? Our recent resolution of the conjectures about the extremal structures of the Alexandrov-Fenchel inequalities in convex geometry allows us to tackle such questions. No background in convex geometry is assumed. Joint work with Ramon van Handel.

Back to Table of Contents

COSMIN POHOATA, Yale University

[Wednesday May 26, 12:50]

On the Zarankiewicz problem for graphs with bounded VC-dimension

The problem of Zarankiewicz asks for the maximum number of edges in a bipartite graph on n vertices which does not contain the complete bipartite graph $K_{k,k}$ as a subgraph. In this talk, we will present some new phenomena related to an important variant of this problem, which is the analogous question in bipartite graphs with VC-dimension at most d, where d is a fixed integer such that $k \geq d \geq 2$. Several connections with incidence geometry will also be discussed. Joint work with Oliver Janzer.

JOSH ZAHL, University of British Columbia

[Wednesday May 26, 13:20]

Sphere tangencies, line incidences, and Lie's line-sphere correspondence

In this talk I will discuss a connection between two problems in combinatorial geometry: bounding the maximum possible number of tangencies determined by a set of spheres in three dimensions, and bounding the maximum possible number of intersections determined by a set of lines in three dimensions. The connection between these two problems is given by Lie's line-sphere correspondence.

Org: Natasha Morrison (University of Victoria)

Abstracts

WOJCIECH SAMOTIJ, Tel Aviv University

[Wednesday May 26, 11:20]

Sharp thresholds for Ramsey properties

Given graphs G and H and an integer $r \geq 2$, write $G \longrightarrow (H)_r$ if every r-colouring of the edges of G contains a monochromatic copy of H. Ramsey's theorem states that, when n is sufficiently large, $G \longrightarrow (H)_r$ is a nontrivial, monotone property of subgraphs of K_n. The celebrated work of Rödl and Ruciński located the threshold for this property in the random graph $G_{n,p}$ for all H and r. We prove that this threshold is sharp when H is a clique or a cycle.

Joint work with Ehud Friedgut, Eden Kuperwasser, and Mathias Schacht.

SHOHAM LETZTER, University College London

[Wednesday May 26, 11:50]

Chi-boundedness of graphs with no cycle with exactly k chords

A family of graph $\mathcal{H}$ is called χ-bounded if there is a function f such that for every graph $H \in \mathcal{H}$, the following holds: $\chi(H) \leq f(\omega(H))$, where $\chi(H)$ is the chromatic number of H and $\omega(H)$ is the clique number of H.

We show that the family of graphs with no cycle with exactly k chords is χ-bounded, for every sufficiently large k.

This is joint work with Joonkyung Lee and Alexey Pokrovskiy.

KATHERINE STADEN, University of Oxford

[Wednesday May 26, 12:20]

Ringel's tree packing conjecture

The graph decomposition (or packing) problem asks when the edge set of a host graph can be decomposed into copies of a given guest graph. I will present the following theorem on tree decomposition (joint work with Peter Keevash): given any tree T with r edges, any dense quasirandom graph G with n vertices and rn edges can be decomposed into n copies of T. The special case when G is the complete graph is Ringel's tree packing conjecture from 1963. An independent proof of the original conjecture was also obtained by Montgomery, Pokrovskiy and Sudakov.

Back to Table of Contents

ROB MORRIS, Instituto de Matemática Pura e Aplicada

[Wednesday May 26, 12:50]

Flat Littlewood Polynomials Exist

A polynomial $P(z) = \sum_{k=0}^{n} \varepsilon_k z^k$ is a Littlewood polynomial if $\varepsilon_0, \ldots, \varepsilon_n \in \{-1, 1\}$. We will describe a proof that, for every $n \geqslant 2$, there exist 'flat' Littlewood polynomials of degree n, that is, with

$$\delta\sqrt{n} \leqslant |P(z)| \leqslant \Delta\sqrt{n}$$

for all $z \in \mathbb{C}$ with $|z| = 1$, for some absolute constants $\Delta > \delta > 0$. This answers a question of Erdos, and confirms a conjecture of Littlewood. The proof is entirely combinatorial, and uses probabilistic ideas from discrepancy theory.

Joint work with Paul Balister, Béla Bollobás, Julian Sahasrabudhe and Marius Tiba.

MARCELO CAMPOS, Instituto de Matemática Pura e Aplicada

[Wednesday May 26, 13:20]

Singularity of random symmetric matrices revisited

Let M_n be drawn uniformly from all ± 1 symmetric $n \times n$ matrices. I'll describe recent work where we show that the probability that M_n is singular is at most $\exp(-\Omega(\sqrt{n \log n}))$. This represents a natural barrier in recent approaches to this problem and improves the best-known previous bound by Campos, Mattos, Morris and Morrison of $\exp(-\Omega(\sqrt{n}))$ on the singularity probability. In particular I'll show a new Inverse Littlewood-Offord type theorem, which is simpler and stronger in some ways than previous theorems of this type.

This is joint work with Matthew Jenssen, Marcus Michelen, Julian Sahasrabudhe.

Back to Table of Contents

Org: Gary MacGillivray (University of Victoria)

Abstracts

XUDING ZHU, Zhejiang Normal University

[Wednesday May 26, 11:20]

On Hedetniemi's Conjecture

Hedetniemi conjectured that if none of G and H is c-colourable, then $G \times H$ is not c-colourable. This conjecture remained open for more than half century, until Shitov proved in 2019 that it fails for huge c. Shortly after, this author found smaller counterexamples, showed that Hedetniemi's conjecture fails for $c \geq 125$, and then by Tardif to $c \geq 13$, and then by Wrochna to $c \geq 5$. In the other direction, El-Zahar and Sauer showed that Hedetniemi's conjecture holds for $c \leq 3$. I shall sketch ideas, explain the similarities and differences in these proofs.

SHENWEI HUANG, Nankai University

[Wednesday May 26, 11:50]

k-critical graphs in $P5$-free graphs

A graph G is k-vertex-critical if G has chromatic number k but every proper induced subgraph of G has chromatic number less than k. We will talk about the finiteness of k-vertex-critical graphs in subclasses of P_5-free graphs. Our main result is a complete classification of the finiteness of k-vertex-critical graphs in the class of (P_5, H)-free graphs for all graphs H on 4 vertices. To obtain the complete dichotomy, we prove the finiteness for four new graphs H using various techniques – such as Ramsey-type arguments and the dual of Dilworth's Theorem – that may be of independent interest.

JAROSLAV NEŠETŘIL, Charles University

[Wednesday May 26, 12:20]

In praise of homomorphisms

Related to a recent survey with P. Hell (Comp. Sci. Review 2021) we highlight some aspects of development of this exciting area of mathematics and theoretical computer science.

KATHIE CAMERON, Wilfred Laurier University

[Wednesday May 26, 12:50]

A Parity Theorem About Trees with Specified Degrees

Thomassen and I proved that the number of cycles containing a specified edge and all the odd-degree vertices is odd if and only if graph G is eulerian. Where all vertices have even degree this is Toida's Theorem and where all vertices have odd degree it is Thomason's generalization of Smith's Theorem. Berman extended Thomason's Theorem to trees, proving that if T is a spanning tree of G where all degrees in G-E(T) are even, there is an even number of spanning trees with the same degree as T at each vertex. I give a common generalization of these results.

Back to Table of Contents

ARASH RAFIEY, Indiana State University

[Wednesday May 26, 13:20]

2-SAT and Transitivity Clauses

We show that every instance of 3-SAT is polynomial-time equivalent to an instance of 2-SAT together with transitivity clauses, 2-SAT-Trans. More precisely, every 3-SAT instance is polynomially equivalent to an instance with variables $X_{i,j}$, $i \neq j \in [1, n]$ $(X_{i,j} \equiv \neg X_{j,i})$ and all the clauses of form $(X_{i,j} \vee X_{j,k} \vee X_{k,i}) \wedge (X_{j,i} \vee X_{k,j} \vee X_{i,k})$ together with some two variables clauses. We show several graph vertex ordering problems are instances of 2-SAT-Trans. Our goal is to specify the 2-SAT-Trans instances that are polynomial.

Based on joint works with Pavol Hell and co-authors.

Org: Zdeněk Dvořák (Charles University)

Abstracts

ZDENĚK DVOŘÁK, Charles University

[Wednesday May 26, 11:20]

Sparsity: Concepts and applications

I will give a basic overview of the hierarchy of sparsity notions and the relationships between them, demonstrate their importance in several interesting applications, and set up the stage for the other talks in this minisymposium.

FELIX REIDL, Birkbeck University of London

[Wednesday May 26, 11:50]

Algorithmic aspects I

One of the beautiful aspects of the theory of sparse classes are the various notions of sparseness that turn out to be intrinsically connected. From the algorithmic side, this provides us with a nice toolkit to design exact, parameterized and approximation algorithms. In this talk we will feature a few interesting problems and see how the toolkit can be applied.

MICHAŁ PILIPCZUK, University of Warsaw

[Wednesday May 26, 12:20]

Algorithmic aspects II

During the talk we will show how to make use of forbidden structures in sparse graphs, such as half-graphs in their powers, to design efficient parameterized algorithms for various problems. This topic will also serve as an excuse to survey some on-going work on constructing a theory for classes of well-structured dense graphs.

PATRICE OSSONA DE MENDEZ, CNRS, École des Hautes Études en Sciences Sociales

[Wednesday May 26, 12:50]

A model theoretical approach to sparsity

The notion of sparse graphs, although vague, usually witnesses a qualitative leap in structural properties. It appears that this structural differentiation agrees with the main dividing lines of model theory: stability and dependence. We survey some mutual enrichments of structural graph theory and model theory and show how model theory provides interesting tools to handle sparse graphs and suggests intriguing problems, whose significance encompasses both graph theory, theoretical computer science, and model theory.

SEBASTIAN SIEBERTZ, University of Bremen

[Wednesday May 26, 13:20]

Characterizing sparsity by games.

The two key notions of uniform sparseness, bounded expansion and nowhere denseness, admit many equivalent characterizations. In this talk, I will present very intuitive game characterizations of both concepts.

Back to Table of Contents

Org: Thaís Bardini Idalino (Universidade Federal de Santa Catarina, Brazil), **Jonathan Jedwab** (Simon Fraser University) and **Shuxing Li** (Simon Fraser University)

Designs and codes are closely intertwined studies that share many common discrete structures. This minisymposium explores algebraic and combinatorial approaches to the construction, analysis, and classification of designs and codes, with particular emphasis on these common discrete structures.

Abstracts

MARCO BURATTI, University of Perugia, Italy

[Wednesday May 26, 11:20]

Old and new results on elementary abelian 2-designs

A 2-design is *elementary abelian* if it admits an elementary abelian group of automorphisms acting sharply transitively on its points.

In this talk I will briefly survey the main results on this topic and I will present some new infinite families of elementary abelian 2-(q^n, kq, λ) designs in which every block is a union of k parallel lines of $\mathrm{AG}(n, q)$, the n-dimensional affine geometry over the field of order q.

NIKOLAY KALEYSKI, University of Bergen, Norway

[Wednesday May 26, 11:50]

Bounding the Hamming distance between APN functions

Almost perfect nonlinear (APN) functions are defined as those functions that provide the best possible resistance to differential cryptanalysis. Their significance reaches far beyond the practical needs of cryptography: APN functions have a natural combinatorial definition, and thus correspond to optimal objects in many diverse areas of study (design theory, coding theory, sequence design, algebra, affine geometry, etc.) APN functions have very little structure by design and are difficult to study. We show how a lower bound on the distance between APN functions can be derived, and explore some of its practical and theoretical applications.

EIMEAR BYRNE, University College Dublin, Ireland

[Wednesday May 26, 12:20]

New subspace designs from q-matroids

A perfect matroid design (PMD) is a matroid whose flats of the same rank all have the same size. In this talk we introduce the q-analogue of a PMD. A subspace design is a collection B of k-dimensional spaces such that every t-dimensional subspace is contained in the same number λ of members of B. For $\lambda = 1$, the design is called a q-Steiner system. Currently, the only known q-Steiner system parameters that have been realised is $S(2, 3, 13; 2)$. We show that q-Steiner systems are examples of q-PMD's and we use this q-matroid structure to construct subspace designs from q-Steiner systems.

Back to Table of Contents

GOHAR KYUREGHYAN, University of Rostock, Germany

[Wednesday May 26, 12:50]

Image sets of APN maps

Almost perfect nonlinear (APN) maps of finite fields yield constructions for optimal objects in cryptology, coding theory, combinatorics. In this talk we study the size of the image set and the preimage distribution of an APN map. The talk is based on a joint work with Björn Kriepke and Lukas Kölsch.

ALEX POTT, Otto-von-Guericke University, Germany

[Wednesday May 26, 13:20]

Designs and bent functions

The connection between bent functions and difference sets (which give rise to designs) is well known. It is not so well known that the classical Boolean as well as vectorial bent functions can be also used to construct incidence structures using the concept of vanishing flats, as it has been introduced recently by S. Li, W. Meidl, A. Polujan, A. Pott, C. Riera and P. Stănică.

The results in this talk are based on W. Meidl, A. Polujan, A. Pott, *Linear codes and incidence structures of bent functions and their generalizations*, arXiv:2012.06866v1.

Org: Yifan Jing (University of Illinois at Urbana-Champaign) and **Chieu-Minh Tran** (University of Notre Dame)

Arithmetic Combinatorics is a rapidly growing discipline, with interactions with many other areas of mathematics, including ergodic theory, harmonic analysis, number theory, model theory, etc.
In this mini-symposium, we aim to bring researchers in arithmetic combinatorics in order to present recent developments in this field, exchange research ideas, and initiate new collaborations.

Abstracts

WEIKUN HE, Korea Institute for Advanced Study

[Wednesday May 26, 11:20]

Sum-product estimates in semisimple algebras and random walks on the torus

I will present some results in the spirit of Bourgain's discretized sum-product theorem, but for general semisimple algebras over the real numbers. Then I will highlight an application to ergodic theory. More precisely, I will explain how these sum-product estimates are used in proving new results on the equidistribution of linear random walks on the torus. This talk is based on joint works with Nicolas de Saxcé.

SIMON MACHADO, University of Cambridge

[Wednesday May 26, 11:50]

Approximate Subgroups, Meyer Sets and Arithmeticity

Approximate lattices are discrete subsets of locally compact groups that are aperiodic but nonetheless exhibit long range order. In abelian groups, these subsets correspond to the so-called quasi-crystals and were given a precise structure theory by Meyer: he showed that they are projections of arithmetic subsets in higher dimension. We will discuss how tools originating from ergodic theory, aperiodic order and the structure of finite approximate subgroups enable us to generalise at once Meyer's theorem and Margulis' arithmeticity. In particular we show that approximate lattices in $SL_n(K)$, $n \geq 3$ consist of matrices with coefficients in the set of Pisot numbers.

ARTURO RODRIGUEZ FANLO, University of Oxford

[Wednesday May 26, 12:20]

On metric approximate subgroups

In 2011, using model theory, Hrushovski found a connexion between finite approximate subgroups and Lie groups. This result, known as the Lie model Theorem, was the starting point used to finally give a complete classification of finite approximate subgroups by Breuillard, Green and Tao. In this talk we will see a generalization of the Lie model Theorem to metric approximate subgroups, where small thickenings are also allowed.

Back to Table of Contents

GABRIEL CONANT, University of Cambridge

[Wednesday May 26, 12:50]

Quantitative stable arithmetic regularity in arbitrary finite groups

In 2018, Terry and Wolf showed that any stable subset of a finite abelian group can be efficiently approximated by cosets of a subgroup whose index is bounded exponentially in the approximation and stability constants. At the same time, in joint work with Pillay and Terry, we proved a version of this for arbitrary finite groups using model theoretic techniques, with stronger qualitative features, but no quantitative bounds. Here I will discuss a new effective proof of our result, which yields quantitative bounds for arbitrary finite groups, and improves the bound in Terry & Wolf's result from exponential to polynomial.

CHIEU-MINH TRAN, University of Notre Dame

[Wednesday May 26, 13:20]

A nonabelian Brunn-Minkowski inequality

Henstock and Macbeath asked in 1953 whether the Brunn-Minkowski inequality can be generalized to nonabelian locally compact groups; questions in the same line were also asked by Hrushovski, McCrudden, and Tao. We obtain here such an inequality and prove that it is sharp for helix-free locally compact groups, which includes real linear algebraic groups, Nash groups, semisimple Lie groups with finite center, solvable Lie groups, etc. As an application, we obtain a characterization of sets with nearly minimal measure expansion in noncompact locally compact groups, answering another question by Tao.

Org: Nino Bašić (University of Primorska, Slovenia) and **Elizabeth Hartung** (Massachusetts College of Liberal Arts, USA)

This minisymposium in chemical graph theory explores various applications of graph theory to chemistry. A molecule can be described as a graph, where vertices represent atoms and edges represent chemical bonds: benzenoids and fullerenes are two examples of such graph classes. Properties of those graphs, such as perfect matchings and graph spectra, can be used to model characteristics of molecules, including stability, reactivity, and electronic structure. Other related topics in chemical graph theory include enumeration of graphs classes and algorithms for their enumeration. Graphs are also important for biosciences, such as phylogenetics where they are used to study phylogenetic trees and related structures, and synthetic biology where graphs proved to be useful for modeling self-assembly of DNA and protein nanostructures.

Abstracts

TOMAŽ PISANSKI, University of Ljubljana, Slovenia

[Wednesday May 26, 11:20]

Flat benzenoid complexes

Benzenoids form an important family of chemical graphs. Several other families, such as coronenes, helicenes, tubulenes, etc. that generalize benzenoids play an important role in theoretical chemistry. This talk introduces flat benzenoid complexes as a language in which all these generalizations may be expressed. Roughly speaking a flat benzenoid complex is a structure that is locally benzenoid. We present a basic theory of flat benzenoid complexes. A special emphasis will be on catacondensed flat benzenoid complexes having the property that all vertices belong to the boundary of the complex. This is work in progress with Patrick Fowler and Nino Bašić.

TOMISLAV DOŠLIĆ, University of Zagreb, Croatia

[Wednesday May 26, 11:50]

Nice subgraphs of fullerene graphs with prescribed components

Let G be a graph with a perfect matching. A subgraph H of G is nice if $G - V(H)$ still has a perfect matching. In a chemical context, nice subgraphs of molecular graphs serve as mathematical models of addition patterns in the corresponding molecules such that the rest of the molecule still has a resonant structure. In this contribution we consider classical and generalized fullerene graphs and look for nice subgraphs with prescribed components such as, e.g., stars and odd cycles. We also report some computational results for small fullerenes and list some open problems.

DAMIR VUKIČEVIĆ, University of Split, Croatia

[Wednesday May 26, 12:20]

Vukicevic, Boskovic: Adriatic graphs - mathematical properties and applications to correct NIST database

Let F be a family of graphs. Adriatic graph A(F) is a graph which vertices are ordered pairs of graphs in F that have the same number of vertices. Two vertices (G_1, G_2) and (H_1, H_2) are adjacent if: there is a non-pendant vertex v_i in graph G_i which all neighbors except one are leaves, i =1,2; v_1 and v_2 have the same degrees; and graph obtained by replacing one pendant vertex of v_i by path of length two is isomorphic to H_i, i=1,2. Mathematical properties of these graphs and their application in chemistry will be discussed.

Back to Table of Contents

LAVANYA SELVAGANESH, Indian Institute of Technology (BHU), India

[Wednesday May 26, 12:50]

Bounds Of The Symmetric Division Deg Index For Graphs With Cyclomatic Number At Most 2 And With A Perfect Matching

The Symmetric division deg (SDD) index is a well-established valuable index in the analysis of quantitative structure-property and structure-activity relationship for molecular graphs. Introduced by Vukicevic and Gasperov in 2010, the SDD index was shown to have the best correlation ability for predicting the total surface area of polychlorobiphenyls. In this talk, we will study the range of SDD-index for graphs with the cyclomatic number at most 2, that is, trees, unicyclic and bicyclic graphs. In particular, we compute the bounds for the SDD-index of these graphs, which admit a perfect matching and identify the graphs that attain these bounds.

NINO BAŠIĆ, University of Primorska, Slovenia

[Wednesday May 26, 13:20]

Pentagonal Clusters in Fullerenes

IPR-fullerenes form an important and well-studied family of fullerenes. In 2017, the Pentagonal Incidence Partition (PIP) was introduced which generalises this concept. All possible partitions of the number 12 were characterised, for which a fullerene with a prescribed PIP exists. In this sense, IPR-fullerenes can be described as fullerenes F with $\mathrm{PIP}(F) = (1, 1, \ldots, 1)$. We further generalise this notion and introduce the Pentagonal Patch Partition (PPP). We show which PPPs are admissible.

Back to Table of Contents

Org: Shonda Dueck (University of Winnipeg)

Motivated by the problem of efficiently locating a moving point or intruder in a network, the concept of the metric dimension of a graph was first introduced by Slater, and independently by Harary and Melter, in the mid 1970's. This graph parameter has applications in network discovery and verification, combinatorial optimization, chemistry, and many other areas. The problem of determining the metric dimension of a graph is NP hard, and so researchers focus on bounding this parameter in terms of its diameter, order and size, and on determining the metric dimension of different classes of graphs. Several interesting and useful variants of the metric dimension have also been introduced over the years, such as the partition dimension, the strong dimension, the edge dimension, the threshold dimension, and the threshold strong dimension of a graph. In this minisymposium, we present several recent developments in research on the metric dimension of graphs.

Abstracts

FLORENT FOUCAUD, University Clermont Auvergne, France

[Wednesday May 26, 11:20]

Bounds on the order of a graph of given metric dimension and diameter: studies for standard graph classes

It is easily seen that any graph of metric dimension k and diameter D has at most $D^k + k$ vertices. This is almost never reached for general k and D; a tight bound (still exponential) was derived by Hernando, Mora, Pelayo, Seara and Wood in 2011. However, for many graph classes, a polynomial bound holds. We discuss such bounds for trees, interval graphs, permutation graphs, planar graphs, etc. One of the tools that is helpful here is the notion of distance-V-C dimension. Joint work with Laurent Beaudou, Peter Dankelmann, Michael Henning, Arnaud Mary, George Mertzios, Reza Naserasr, Aline Parreau, Petru Valicov.

ISMAEL GONZALEZ YERO, Universidad de Cadiz, Spain

[Wednesday May 26, 11:50]

Comparing the metric and edge metric dimensions of graphs

Given a connected graph G, the cardinality of a smallest set of vertices that uniquely identifies all the (vertices or edges, resp.) of G, through a vector of distances to such set of vertices, is the (metric or edge metric, resp.) dimension of G. We shall present in this talk some comparisons between metric and edge metric dimension of graphs. Specifically, that for every $r, t \geq 2$, with $r \neq t$, there is n_0, such that for every $n \geq n_0$ there exists a graph G of order n with metric dimension r and edge metric dimension t.

TERO LAIHONEN, Turku University, Finland

[Wednesday May 26, 12:20]

On Vertices Belonging to Every Metric Basis

A set $S \subseteq V(G)$ is a resolving set in a graph G if for any pair $u, v \in V(G)$ there exists $s \in S$ such that $d(u,s) \neq d(v,s)$. A metric basis is a resolving set of the smallest possible cardinality. It is known that there are graphs where some vertices must belong to every metric basis. We call these vertices *basis forced vertices*. In this talk, we give, for example, bounds on the size of a graph with k basis forced vertices.

This is a joint work with Anni Hakanen, Ville Junnila and Ismael Yero.

Back to Table of Contents

ELIZABETH MARITZ, University of the Free State, South Africa

[Wednesday May 26, 12:50]

On the partition dimension of circulant graphs

Let $\Pi = \{S_1, S_2, \ldots, S_k\}$ be an ordered partition of the vertex set $V(G)$ of a graph G. The *partition representation* of a vertex $v \in V(G)$ with respect to Π is the k-tuple $r(v|\Pi) = (d(v, S_1), d(v, S_2), \ldots, d(v, S_k))$. If every pair of distinct vertices have distinct partition representations with respect to Π, then Π is a *resolving partition* for G. The cardinality of a smallest resolving partition of G is called the *partition dimension* of G. We present exact values and bounds on the partition dimension for undirected and directed circulant graphs.

DOROTA KUZIAK, Universidad de Cadiz, Spain

[Wednesday May 26, 13:20]

The strong metric dimension of a graph

A vertex w *strongly resolves* a pair u, v of vertices of a connected graph G if there exists some shortest $w - u$ path containing v or some shortest $w - v$ path containing u. A set S of vertices is a *strong metric generator* for G if every pair of vertices of G is strongly resolved by some vertex of S. The smallest cardinality of a strong metric generator for G is the *strong metric dimension* of G. We shall present exact values or sharp bounds for the strong metric dimension of cactus graphs and some product graphs.

Abstracts

CAROL T. ZAMFIRESCU, Ghent University, Belgium

[Wednesday May 26, 11:20]

K_2-hamiltonian graphs

Motivated by a conjecture of Grünbaum and a problem of Katona, Kostochka, Pach, and Stechkin, both dealing with non-hamiltonian n-vertex graphs and their $(n-2)$-cycles, we investigate K_2-*hamiltonian* graphs, i.e. graphs in which the removal of any pair of adjacent vertices yields a hamiltonian graph. In the talk we shall present infinitely many cubic non-hamiltonian K_2-hamiltonian graphs, both of the 3-edge-colourable and the non-3-edge-colourable variety. In fact, cubic K_2-hamiltonian graphs with chromatic index 4 (such as Petersen's graph) are a subset of the critical snarks. We also describe an operation conserving K_2-hamiltonicity which yields an infinite family of non-hamiltonian K_2-hamiltonian graphs in which, asymptotically, a quarter of vertices has the property that removing such a vertex yields a non-hamiltonian graph, and extend a celebrated result of Tutte by showing that every planar K_2-hamiltonian graph with minimum degree at least 4 is hamiltonian.

JAN GOEDGEBEUR, Ghent University

[Wednesday May 26, 11:50]

Graphs with few hamiltonian cycles

We will present a new algorithm for the exhaustive generation of all non-isomorphic graphs with a given number $k \geq 0$ of hamiltonian cycles, which is especially efficient for small values of k. Our main findings, combining applications of this algorithm and existing algorithms with new theoretical results, revolve around graphs containing exactly one hamiltonian cycle – i.e. uniquely hamiltonian (UH) graphs – or exactly three hamiltonian cycles.

In particular, we proved equivalent formulations of the conjecture of Bondy and Jackson that every planar UH graph contains at least two vertices of degree 2, verify it up to order 16, and show that its toric analogue does not hold. We also strengthened a theorem of Entringer and Swart and made progress on conjectures of Sheehan and Cantoni, and answered a question of Chia and Thomassen.

This is joint work with Barbara Meersman and Carol T. Zamfirescu.

ALBERTO ESPUNY DÍAZ, Technische Universität Ilmenau

[Wednesday May 26, 12:20]

Hamiltonicity of randomly perturbed graphs

The study of randomly perturbed graphs has received a lot of attention in recent years. In this area, we consider the union of a dense deterministic graph H (usually with some minimum degree condition) and a random graph G, and the main goal is to improve threshold results for random graphs by considering the union with H: there are many results showing that, in order for $H \cup G_{n,p}$ to satisfy a given property $\mathcal{P}$, the minimum p which is required is substantially smaller than that required for $G_{n,p}$ itself.

In this talk, I will introduce the model of randomly perturbed graphs and some of the results that have been obtained so far, and then I will present some new results about Hamiltonicity and pancyclicity when we let G be a random regular graph or a random geometric graph. Parts of this are joint work with António Girão.

Back to Table of Contents

RADEK HUŠEK, Charles University, Czech Republic

[Wednesday May 26, 12:50]

Counting Circuit Double Covers

Several recent results and conjectures study counting versions of classical existence statements. We ask the same question for cycle double covers of cubic graphs. We show that counting cycle double covers usually allows “cheating” by splitting a cycle consisting of more circuits into many cycles, and for this reason we try to count circuit double covers instead. In 2017 we showed that bridgeless cubic planar graphs has $2^{\Omega(\sqrt{n})}$ circuit double covers.

Now we present an exponential bound: Every bridgeless cubic planar graph with n vertices has at least $(5/2)^{n/4-1/2}$ circuit double covers. The method we used to obtain this bound motivates a general framework for counting objects on graphs using linear algebra which might be of independent interest. We also conjecture that every bridgeless cubic graph has at least $2^{n/2-1}$ circuit double covers.

CRAIG LARSON, Virginia Commonwealth University

[Wednesday May 26, 13:20]

Deming Decompositions and Egervary Graphs

König-Egerváry (KE) graphs are a generalization of bipartite graphs. Here we discuss Egerváry graphs, which are a generalization of KE graphs and maintain certain attractive properties. A graph is Egerváry if it cannot covered by a matching and a positive even number of odd cycles.

We have extended Deming’s KE-recognition algorithm to produce a decomposition of any graph with a perfect matching into subgraphs which are either almost KE (and where $\alpha = \nu - 1$) and where the the remaining subgraph is KE (and where $\alpha = \nu$). Each of the subgraphs has a perfect matching. We apply this Deming Decomposition to the investigation of the structure of Egerváry graphs.

This is joint work with Jack Edmonds and Mark Kayll.

Abstracts

ALANE DE LIMA, Federal University of Paraná (UFPR)

[Wednesday May 26, 11:20]

Sample Complexity in Graph Problems

We present the use of sample complexity tools in two randomized algorithms for graph problems. We first show a $\tilde{O}(m)$ algorithm for a directed weighted graph G that, for $0 < \epsilon, \delta < 1$, it estimates the percolation centrality of every vertex of G within ϵ of the original value with probability at least $1 - \delta$. The second problem we deal with is the all-pairs shortest paths problem (APSP) for undirected graphs with non-negative real weights. We propose an algorithm that computes the exact shortest path SP between a pair of vertices depending on a certain measure of "importance" of SP, called shortest path centrality. That is, for $0 < \epsilon, \delta < 1$, SP is computed with probability at least $1 - \delta$ whenever its centrality is at least ϵ. The algorithm has expected running time $O(\log \mathrm{Diam}_V(G) \cdot \max(m + n \log n, \mathrm{Diam}_V(G)^2))$, where $\mathrm{Diam}_V(G)$ is the vertex-diameter of G.

SARAH NOURI, RECITS laboratory, Faculty of Mathematics, USTHB University

[Wednesday May 26, 11:50]

Scheduling on identical machines with conflict graphs

A k-equitable coloring of a graph G is a proper coloring of G with k colors such that the sizes of any two different classes of colors differ by at most one. We studied the complexity of the 2 and 3-equitable coloring of bipartite graph, and we considered a scheduling problem of uninterruptible jobs on identical machines, where some conflict jobs (represented by a weighted conflict graph) cannot be executed on the same machine, as an application in the case of weighted graph. For this scheduling problem, the vertices of the graph represent jobs and two vertices are adjacent if and only if corresponding jobs are in conflict (the weight on the vertex represents the processing time of the correspondent job). We want to schedule jobs while minimizing the large difference between the scheduling lengths of the machines noted by ϵ_{max}.

ABDENNOUR AZERINE, Université des Sciences et de la Technologie Houari Boumedienne, Alger, Algérie

[Wednesday May 26, 12:20]

Two-machine no-wait flow shop with two agents and makespan criteria

The two-agent flow shop scheduling problem with the no-wait constraint is investigated, where two users compete to process their job sets on two shared machines in a flow shop environment. The makespan is considered as an objective to be minimized for both agents. Due to the no-wait constraint, the processing of each job cannot be interrupted once it is started, i.e. no waiting is allowed during the processing of a job between the first and the second machine. We prove that this issue is strongly NP-hard. Furthermore, we propose an exact algorithm to solve instances with up to 40 jobs.

Back to Table of Contents

NAZIM SAMI, RECITS laboratory, faculty of Mathematics, Ushtb University

[Wednesday May 26, 12:50]

New algorithms for the two-machine chain-reentrant shop problem with the no-wait constraint

In this work, we tackle the flow shop scheduling problem with chain-reentrance and no-wait constraints, while minimizing the overall execution time (makespan). In this problem, a set of n jobs is to be processed on two machines, each job should start its execution on the first machine (M_1), then goes to the second machine (M_2) and finally returns back to the first machine. This configuration can be encountered in several manufacturing processes such as automobile assembly, integrated circuit (IC) manufacturing and TFT-LCD panel manufacturing. We propose two new heuristics and two new improved lower bounds, a comparison between the numerical experiments is also provided.

Back to Table of Contents

Org: László Végh (London School of Economics)

Abstracts

VERA TRAUB, ETH Zurich

[Wednesday May 26, 15:30]

Improving the Approximation Ratio for Capacitated Vehicle Routing

We devise a new approximation algorithm for capacitated vehicle routing. Our algorithm yields a better approximation ratio for general capacitated vehicle routing as well as for the unit-demand case and the splittable variant. Our results hold in arbitrary metric spaces. This is the first improvement on the classical tour partitioning algorithm by Haimovich and Rinnooy Kan [1985] and Altinkemer and Gavish [1987].

This is joint work with Jannis Blauth and Jens Vygen.

ZHUAN KHYE KOH, London School of Economics

[Wednesday May 26, 16:00]

An Accelerated Newton-Dinkelbach Method and its Application to Two Variables Per Inequality Systems

In this talk, I will present an accelerated, or 'look-ahead' version of the Newton-Dinkelbach method, a well-known technique for solving fractional and parametric optimization problems. This acceleration halves the Bregman divergence between the current iterate and the optimal solution within every two iterations. Using the Bregman divergence as a potential in conjunction with combinatorial arguments, we obtain a strongly polynomial label-correcting algorithm for solving linear feasibility systems with two variables per inequality. This extends and strengthens a previous result by Madani (2002).

Based on joint work with Daniel Dadush, Bento Natura and László Végh.

SHARAT IBRAHIMPUR, University of Waterloo

[Wednesday May 26, 16:30]

Approximation Algorithms for Stochastic Minimum Norm Combinatorial Optimization

In this work, we introduce and study stochastic minimum-norm optimization. We have an underlying combinatorial optimization problem where the costs involved are random variables with given distributions; each feasible solution induces a random multidimensional cost vector. We seek a solution that minimizes the expected norm of the induced cost vector, for a given monotone, symmetric norm. We give a general framework for devising approximation algorithms for stochastic minimum-norm optimization, using which we obtain approximation algorithms for the stochastic minimum-norm versions of the load balancing and spanning tree problems.

Based on joint work with Chaitanya Swamy.

Back to Table of Contents

NATHAN KLEIN, University of Washington

[Wednesday May 26, 17:00]

Approximating the minimum k-edge connected multi-subgraph problem

Here we are given a weighted graph and wish to find a minimum cost k-edge connected spanning subgraph. Our subgraph may use the same edge multiple times. While for unweighted graphs a $1+O(1/k)$ approximation is known, the weighted case only has a 3/2 approximation from the 80s. We show a simple $1+o(1)$ approximation as k goes to infinity, demonstrating that the problem gets easier as k grows. The entire (elementary) analysis will be explained in this talk and serves as a gentle introduction to Strongly Rayleigh distributions.

Based on joint work with Anna Karlin, Shayan Oveis Gharan, and Xinzhi Zhang.

SAMI DAVIES, University of Washington

[Wednesday May 26, 17:30]

Scheduling with Communication Delays via LP Hierarchies and Clustering

We study scheduling with precedence constraints and communication delays. Here, if two dependent jobs are scheduled on different machines, then c time units must pass between their executions. Previously, the best known approximation ratio was $O(c)$, though an open problem in the top-10 list by Schuurman and Woeginger asks whether there exists a constant-factor approximation algorithm. We give a polynomial-time $O(\log c \cdot \log m)$-approximation algorithm when given m identical machines and delay c for minimizing makespan. Our approach uses a Sherali-Adams lift of an LP relaxation and a clustering of the semimetric space induced by the lift.

Back to Table of Contents

Org: Pengyu Liu (Simon Fraser University)

Abstracts

BAPTISTE ELIE, MIVGEC, Université Montpellier

[Wednesday May 26, 15:30]

The source of individual heterogeneity shapes infectious disease outbreaks

Studies show that the biological sources of heterogeneity affects epidemic spread, but they do so without controlling for the overall heterogeneity in the number of secondary cases caused by an infection. Here, we control for this important bias to explore the role of individual variation in infection duration and transmission rate on parasite emergence and spread. Our results show that using realistic distributions for infection duration is necessary to accurately capture the effect of individual heterogeneity on epidemiological dynamics, which has implications for the monitoring and control of infectious diseases, as well as data collection.

XINGRU CHEN, Dartmouth College

[Wednesday May 26, 16:00]

Effectiveness of Massive Travel Restrictions on Mitigating Outbreaks of COVID-19 in China

In the early stage of an outbreak of COVID-19 started in the epicenter, Wuhan, Hubei Province, the Chinese government imposed by far the largest scale of travel restrictions nationwide, amid the busiest period for domestic travels during the Lunar New Year. Such massive restrictions have caused a dramatic reduction in travel volume and helped curb the imported cases to other provinces. The control measures could slow down the onset of epidemic outbreaks and weaken the impact of the disease. We are interested in estimating the effectiveness of massive travel restrictions on the mitigation of disease impact using a data-driven approach.

WASIUR KHUDABUKHSH, Ohio State University

[Wednesday May 26, 16:30]

Chemical reaction networks with covariates

In many biological systems, chemical reactions or changes in a physical state are assumed to occur instantaneously. For describing the dynamics, Markov models that require exponentially distributed inter-event times have been used widely. However, some biophysical processes are known to render the usual exponential assumption untenable. We relax this assumption by incorporating age-dependent random time delays into the system dynamics. We do so by constructing a measure-valued Markov process whose large-volume limiting density can be approximated by Partial Differential Equations (PDEs). We show how the limiting PDE system can be used for the purpose of devising efficient simulation algorithms.

Back to Table of Contents

JOEL MILLER, La Trobe University

[Wednesday May 26, 17:00]

Simulating epidemic spread on contact networks

Simulation of disease spread in contact networks is more challenging than in well-mixed populations because the simulation needs to track more than just how many individuals have each infection status, but also, which specific individuals have each infection status. So standard simulation approaches may be significantly slowed by the extra effort required to identify which individual is changing status each time an event occurs. In this talk I will discuss algorithms which allow us to efficiently simulate infection spread in (static) contact networks, and offer an introduction to the Python Epidemics on Networks (EoN) package.

Org: Gena Hahn (Université de Montréal) and **Gary MacGillivray** (University of Victoria)

Abstracts

RICHARD BREWSTER, Thompson Rivers University

[Wednesday May 26, 15:30]

Characterizing Circular Colouring Mixing for $p/q < 4$

Given two graph homomorphisms $f, g : G \to H$, f *reconfigures* to g if g can be obtained from f by successively changing the image of one vertex at a time where all intermediate maps are homomorphisms. Such a sequence is a path in the homomorphism graph $\mathrm{Col}(G, H)$. If $\mathrm{Col}(G, H)$ is connected, then G is *H-mixing*. We study mixing when H is a circular clique $G_{p,q}$, characterizing $G_{p,q}$-mixing in terms of the *wind* of cycles in G. It is co-NP-complete to determine if G is $C_{k,2k+1}$-mixing, but polynomial time solvable when restricted to planar graphs.

Joint with Benjamin Moore.

DAVID KIRKPATRICK, UBC

[Wednesday May 26, 16:00]

Forbidden Induced Subgraphs for k-Nested Interval Graphs

An interval I is properly nested in interval I' if both endpoints of I lie in the interior of I'. An interval representation $\mathcal{R}$ of a given interval graph G has nesting depth at most d if there is no sequence of $d+1$ properly nested intervals in $\mathcal{R}$. We denote by k-NestedINT the class of all interval graphs that admit interval representations with nesting depth at most k.

The graphs in 1-NestedINT are known as proper interval graphs. Roberts proved that proper interval graphs are precisely those interval graphs that do not contain a claw ($K_{1,3}$). Combined with the forbidden induced subgraph characterization of general interval graphs, due to Lekkerkerker and Boland, this provides a succinct description of the (infinitely many) minimal forbidden subgraphs that characterize 1-NestedINT.

We develop a similar description that characterizes k-NestedINT, for $k \geq 1$. An explicit description is provided for the case $k = 2$, and for fixed $k > 2$ an algorithm is described that produces a characterization inductively. This is related to a previous algorithm by Klavik, Otachi, and Sejnoha, but in addition provides a combinatorial characterization.

(Based on joint work with P. Hell, P. Klavik, and Y. Otachi.)

JING HUANG, University of Victoria

[Wednesday May 26, 16:30]

Obstructions for local tournament orientation completions

The orientation completion problem for a class of oriented graphs asks whether a partially oriented graph can be completed to an oriented graph in the class. Orientation completion problems have been studied recently for several classes of oriented graphs, yielding both polynomial time solutions as well as NP-completeness results.

Using a structure theorem on local tournaments we obtain the full list of minimal partially oriented graphs that cannot be completed to local tournaments. The result may be viewed as an extension of the well-known forbidden subgraph characterization of proper circular-arc graphs obtained by Tucker. This is joint work with Hsu.

Back to Table of Contents

CESAR HERNANDEZ-CRUZ, Universidad Nacional Autónoma de México

[Wednesday May 26, 17:00]

Strongly Chordal Digraphs

Defining a digraph analogue for a given family of graphs is usually a difficult task; typically there are different ways of doing it, and each one has advantages and disadvantages. In this work we propose what we think is a natural digraph analogue to strongly chordal digraphs, and provide evidence to support this claim.

Our definition considers a general setting where a digraph may have loops at some vertices, which has been useful when defining directed analogues of other graph families (Pavol Hell will discuss some examples in another session).

Joint work with Pavol Hell, Jing Huang and Jephian Lin.

GARY MACGILLIVRAY, University of Victoria

[Wednesday May 26, 17:30]

Frugal homomorphisms

For a given positive integer k, a homomorphism from a graph G to a graph H is k-frugal if, for every $x \in V(G)$, no $y \in V(H)$ is the image of more than k neighbours of x. Injective homomorphisms are the same as 1-frugal homomorphisms. We present a dichotomy theorem for k-frugal homomorphisms for all $k \geq 2$. This is joint work with Stefan Bard.

Org: **Stijn Cambie** (Radboud University Nijmegen, the Netherlands)

Continuing the sessions held last year, we want to get together with enthusiasts working on different average graph parameters. From the minisymposium in 2019 arised some papers, so we are hopeful for this year as well. During the talks, the state of the art and intriguing open problems in the field will be shared.
Starting with the oldest and most well-known average graph parameter, the Wiener index (which dates back to 1947) or equivalently the average distance of a graph. But there will also be talks on the average connectivity, order and size of certain substructures of graphs such as independent sets, dominating sets and subtrees.

Abstracts

PETER DANKELMANN, University of Johannesburg

[Wednesday May 26, 15:30]

On the Wiener Index of Graphs with Large Maximum Degree

The Wiener index $W(G)$ of a connected graph G is defined as the sum of the distances between all unordered pairs of vertices of G.

Best possible upper bounds on the Wiener index in terms of order and either minimum degree or maximum degree were given by Kouider and Winkler, and Plesnik, respectively. In this talk we combine these bounds. Among others, we prove the best possible bound

$$W(G) \leq \binom{n-\Delta+\delta}{2}\frac{n+2\Delta}{\delta+1}+O(n^2),$$

for graphs of order n, minimum degree δ and maximum degree Δ.

Joint work with Alex Alochukwu.

RISTE SKREKOVSKI, University of Ljubljana

[Wednesday May 26, 16:00]

Some problems and results on some graph parameters

In the talk I will survey some open problems and results on Wiener index and several other related graph parameters.

EVA CZABARKA, University of South Carolina

[Wednesday May 26, 16:30]

Minimum Wiener index of planar triangulations and quadrangulations

The Wiener index of a graph is the sum of distances between all unordered pairs of vertices (or $\binom{n}{2}$ times the average distance, where n is the order of the graph). We will determine the minimum Wiener index of n-vertex of c-connected planar triangulations and quadrangulations for all possible values of c, and find the structure of the extremal graphs for 5-connected triangulations and 3 connected quadrangulations.

FADEKEMI JANET OSAYE, Auburn University

[Wednesday May 26, 17:00]

The average eccentricity of a graph with prescribed girth

Let G be a connected graph of order n. The eccentricity $e(v)$ of a vertex v is the distance from v to a vertex farthest from v. The average eccentricity of G is the mean of all eccentricities in G. We give upper bounds on the average eccentricity of G in terms of n, minimum degree δ, and girth g. In addition, we proved that if for given g and δ, there exists a Moore graph, then the bounds are asymptotically sharp. Moreover, we showed that the bounds can be further improved if G has a large degree.

LUCAS MOL, The University of Winnipeg

[Wednesday May 26, 17:30]

The mean subtree order of graphs under edge addition

A *subtree* of a graph G is a subgraph of G that is a tree. The *mean subtree order* of G is the average order of the subtrees of G. We conjecture that every non-complete graph G contains a pair of nonadjacent vertices u and v such that adding the edge between u and v increases the mean subtree order, and we prove this conjecture in the case that G is a tree. We discuss several related open problems and conjectures. This is joint work with Ben Cameron (University of Guelph).

Org: Iain Beaton (Dalhousie University) and **Ben Cameron** (University of Guelph)

For a variety of combinatorial problems, such as network reliability and graph colourings, the models turn out to be graph polynomials. On the other hand, the investigation of various subgraph properties leads one to explore the associated combinatorial sequences by formulating generating polynomials. In all cases, polynomials carry useful information about the underlying combinatorics, and one can draw on classical areas of mathematics, such as analysis and algebra, in the investigations. Combinatorial properties such as unimodality and log-concavity of various graphical sequences can surprisingly be extracted from the location of the roots of such polynomials. In this two part minisymposium, we aim to draw on the research of people working on a variety of graph polynomials to share techniques and methods to help advance the study of each polynomial.

Abstracts

IAIN BEATON, Dalhousie University

[Wednesday May 26, 15:30]

On the Unimodality of Domination Polynomials

A polynomial is said to be unimodal if its coefficients are non-decreasing and then non-increasing. The domination polynomial of a graph G is the generating function of the number of domination sets of each cardinality in G, and its coefficients have been conjectured to be unimodal. In talk paper we will show the domination polynomial of paths and cycles are unimodal, and that the domination polynomial of almost every graph is unimodal with mode $\lceil \frac{n}{2} \rceil$. This joint work with Jason Brown.

DANIELLE COX, Mount Saint Vincent University

[Wednesday May 26, 16:00]

Chromatic Polynomials of 2-Edge-Coloured Graphs

In this talk we extend the definition of chromatic polynomial to 2-edge-coloured graphs. We will provide results regarding the computation of the polynomial as well as discuss the location of roots. This is joint work with Chris Duffy (University of Saskatchewan) and Iain Beaton (Dalhousie University).

SAMANTHA DAHLBERG, Arizona State University

[Wednesday May 26, 16:30]

Chromatic symmetric functions and e-positivity

Richard Stanley introduced the chromatic symmetric function X_G of a simple graph G, an algebraic encoding of all possible proper colorings with colors $\{1, 2, 3, \dots\}$. These formal power series are symmetric functions that generalize the chromatic polynomial. In this talk we discuss the algebraic property of e-positivity, when X_G can be written as a non-negative sum of elementary symmetric functions. We will also discuss what is known about e-positivity, and additionally we will resolve Stanley's e-Positivity of Claw-Contractible-Free Graphs. This is joint work with Angele Foley and Stephanie van Willigenburg.

DAVID GALVIN, University of Notre Dame

[Wednesday May 26, 17:00]

The independence polynomial of the random tree

The independence polynomial of a graph is not in general well-behaved — Alavi et al. showed, for example, that its coefficient sequence can exhibit arbitrary patterns of rises and falls. For some restricted families, things are much nicer — Hamidoune, for example, showed that for claw-free graphs the coefficient sequence is log-concave.

Open since 1987 is the question (due to Alavi et al.) of whether trees and forests have independence polynomials with log-concave coefficient sequences. I'll report on some recent work around this problem, joint with Abdul Basit, where we focus on the independence polynomial of the random tree.

JÁNOS MAKOWSKY, Technion - Israel Institute of Technology

[Wednesday May 26, 17:30]

Graph polynomials unimodular for almost all graphs.

Inspired by a recent result of I. Beaton and J. Brown (2020), which states that for almost all graphs the domination polynomial $D(G;x)$ has a unimodal sequence of coefficients, we study the same unimodality result for graph polynomials which are generating functions of a graph property $\mathcal{C}$ or a property of graphs with an additional relation $\mathcal{P}$.

THEOREM: Let $\mathcal{C}$ be the complement of a hereditary graph property, and let $P_{\mathcal{C}}(G;X) = \sum_{A \subseteq V(G): G[A] \in \mathcal{C}} X^{|A|}$. Then the coefficients of $P_{\mathcal{C}}(G;X)$ are unimodal for almost all graphs G.

Joint work with Vsevolod Rakita. https://arxiv.org/pdf/2102.00268.pdf

Org: Karoly Bezdek (University of Calgary, Canada) and **Oleg Musin** (The University of Texas Rio Grande Valley, USA)

Sphere packings have been studied from the birth of geometry. The minisymposium will focus on selected latest developments about densest packings of spheres and extremal properties of contact graphs of sphere packings. Particular emphases are given for estimating kissing numbers and contact numbers of congruent sphere packings in Euclidean as well as non-Euclidean spaces. The methods to be discussed use techniques from combinatorial geometry, convex geometry; geometry of numbers; Voronoi tilings; geometric rigidity; coding theory; linear programming as well as semidefinite programming. Together with the latest results we hope to discuss some open problems that appear to be within reach and have the potential to progress the interplay between analysis, geometry, and combinatorics. Part I will have 5 talks each being centered around kissing numbers. Part II will consist of 5 talks investigating densest sphere packings and contact graphs of sphere packings.

Abstracts

SERGE VLADUT, Aix-Marseille University, France

[Wednesday May 26, 15:30]

Lattices with exponentially large kissing numbers

The quality of a lattice $L \subset R^n$, considered as a sphere packing can be measured by its density and/or its kissing number. For $n \to \infty$ the classical Minkowski theorem implies the existence of lattice families with density behaving as $O(2^{-n})$. However, that classical method does not permit to construct lattices with exponentially large (in n) kissing numbers, and their existence was not known until very recently. I will explain how to construct such lattice families using rather roundabout way through coding theory and algebraic geometry.

ALEXANDER KOLPAKOV, University of Neuchatel, Neuchatel, Switzerland

[Wednesday May 26, 16:00]

Kissing number in non-Euclidean spaces of constant sectional curvature

We obtain upper and lower bounds on the kissing number of congruent radius $r > 0$ spheres in hyperbolic $\mathbb{H}^n$ and spherical $\mathbb{S}^n$ spaces, for $n \geq 2$, and show that $\kappa_H(n,r) \sim (n-1) \cdot d_{n-1} \cdot B(\frac{n-1}{2}, \frac{1}{2}) \cdot e^{(n-1)r}$ for large n. Here d_n is the sphere packing density in $\mathbb{R}^n$, and B is the beta-function. We also produce numeric bounds by using semidefinite programs and spherical codes. A similar approach locates the values of $\kappa_S(n,r)$, for $n = 3,\ 4$, over subintervals in $[0,\pi]$ with relatively high accuracy. Joint work with Maria Dostert (KTH Stockholm, Sweden).

MARIA DOSTERT, Royal Institute of Technology (KTH), Stockholm, Sweden

[Wednesday May 26, 16:30]

Kissing number of the hemisphere in dimension 8

The kissing number of spherical caps asks for the maximal number of pairwise non-overlapping unit spheres that can simultaneously touch a central spherical cap in n-dimensional Euclidean space. Bachoc and Vallentin proved using semidefinite optimization that the kissing number of the hemisphere in dimension 8 is 183. In this talk I will explain our rounding procedure to determine an exact rational solution of the semidefinite program from an approximate solution in floating point given by the solver. Furthermore, I will show that the lattice E8 is the unique solution for the kissing number problem on the hemisphere in dimension 8.

Back to Table of Contents

ALEXEY GLAZYRIN, The University of Texas Rio Grande Valley, USA

[Wednesday May 26, 17:00]

Linear programming bounds revisited

This talk will be devoted to linear programming methods for sphere packing bounds. I will describe a new approach to classic bounds and, at the end, present a new short solution of the kissing number problem in dimension three.

OLEG MUSIN, The University of Texas Rio Grande Valley, USA

[Wednesday May 26, 17:30]

The SDP bound for spherical codes using their distance distribution

In this talk we present a new extension of known semidefinite and linear programming upper bounds for spherical codes and consider a version of this bound for distance graphs. We apply the main result for the distance distribution of a spherical code and discuss reasonable approaches for solutions of two long standing open problems: the uniqueness of maximum kissing arrangements in 4 dimensions and the 24-cell conjecture.

Abstracts

ALEXANDER CLOW, St. Francis Xavier University

[Wednesday May 26, 15:30]

From Poset Games to Partially Ordered Games

Combinatorial games are 2 player games of no chance and perfect information. Under the normal play condition the player to have no move on their turn loses and a game is impartial if for every position both players have the same set of moves. In their paper *Advances in Finding Ideal Play on Poset Games* Clow and Finbow showed that poset games (a class of impartial combinatorial games) under normal play can be reduced to much simpler poset games in such a way that the score of the game (nimber) and optimal moves are preserved. This talk generalizes these results to all normal play games. In doing so both the notions of ordinal sums (whose partial order is a total order of cardinality 2) and disjoint sums of games are generalized. Furthermore the Colon Principle, which deals with ordinal sums of games is generalized.

MOZHGAN FARAHANI, Memorial University of Newfoundland

[Wednesday May 26, 16:00]

The deduction game to capture robbers

We study a variation of the game of cops and robbers on graphs in which the cops must capture an invisible robber in one move. Cops know each others' initial locations, but they can only communicate if they are on the same vertex. Thus, the challenge for the cops is to deduce the other cops' movement and move accordingly in order to capture the robbers and guarantee a win. We call this game the deduction game to capture robbers. In this talk, we introduce the deduction number as the minimum number of cops needed to capture all robbers and discuss the deduction number for some classes of graphs.

RYAN HAYWARD, University of Alberta

[Wednesday May 26, 16:30]

Let's Play Hex: Some Open Problems

For the regular nxn Hex board, what are some winning first moves? What about for the misere version of this game, Reverse Hex? Is the world's strongest Hexbot stronger than the world's strongest Hex human? What happens when a deterministic Hex player plays a random Hex player on a board whose shape (more rows than columns) favours the random player? What's a best strategy for Dark Hex (also known as Kriegspiel Hex, where you don't see your opponent's moves) on the 4x4 board? I will discuss these open problems.

Back to Table of Contents

MASOOD MASJOODY, Simon Fraser University

[Wednesday May 26, 17:00]

Confining the Robber on Cographs

In this talk, the notions of *trapping* and *confining* the robber on a graph, and the corresponding cop numbers are introduced. The latter two are easily seen to be lower bounds for the (regular) cop number of a graph. We present some structurally necessary conditions for graphs G not containing the path on k vertices (P_k-free graphs) so that $k-3$ cops do not have a strategy to capture or confine the robber on G. We show that for planar cographs and planar P_5-free graphs the confining cop number is at most one and two, respectively, and that the number of vertices of connected cographs having a confining cop number ≥ 2 has a tight lower-bound of eight. We conclude by posing two conjectures concerning the confining cop number of P_5-free graphs and the smallest planar graph of confining cop number of three.

JÉRÉMIE TURCOTTE, McGill University

[Wednesday May 26, 17:30]

Finding the smallest 4-cop-win graph(s)

We study extremal graphs for the game of Cops and Robbers. It is well known that the smallest connected graph on which 3 cops are needed to capture the robber is the Petersen graph. Using both formal and computational methods, we determine the minimum order of connected 4-cop-win graphs, which confirms a conjecture of Andreae (1986), and later of Baird et al. (2014), and work towards the uniqueness of such graphs. Joint work with Samuel Yvon.

Abstracts

MÁRIA ŠURIMOVÁ, Pavol Jozef Šafárik University

[Wednesday May 26, 15:30]

Adynamic coloring of graphs

Let G be a graph having at least one vertex with independent neighborhood. A proper vertex coloring of G such that there exists at least one vertex of degree at least 2 whose all neighbors have the same color is called an *adynamic coloring*. We explore basic properties of adynamic coloring and its relations to proper and dynamic colorings. We also establish a number of results for planar graphs; in particular, we extend the Four Color Theorem and Grötzsch's Theorem to adynamic coloring. Also, we prove that triangle-free graphs with maximum degree 3 are adynamically 3-colorable; we also present an example showing that, in general, 3-colorable triangle-free graphs of higher maximum degree are not adynamically 3-colorable.

JOHN GIMBEL, University of Alaska Fairbanks

[Wednesday May 26, 16:00]

On Graphs with Proper Connection Number Two

A path is properly colored if the edges are assigned colors so that no adjacent edges are given the same color. We say that a graph has a proper connection number of two if the edges can be 2-colored so that between each pair of distinct vertices there exists a path that is properly colored. We present several results on graphs with a proper connection number two. These include the fact that any regular Type 1 graph has such a connection number. Joint work with Leah Berman, Glenn Chappell, Jill Faudree, Chris Hartman and Gordon Williams.

ZUZANA ŠÁROŠIOVÁ, Pavol Jozef Šafárik University in Košice, Slovakia

[Wednesday May 26, 16:30]

Algorithms for finding the interval chromatic number of trees

A vertex k-coloring is an *open interval k-coloring* if for every vertex v the set of colors used on the neighbors of v forms an interval of integers. Similarly, vertex k-coloring is a *closed interval k-coloring* if for every vertex v the set of colors used on $N[v]$ forms an interval of integers. The largest k for which there exists an open (closed) interval k-coloring of G is called *open (closed) interval chromatic number* of G, we will denote it as $\chi_{io}(G)$ ($\chi_{ic}(G)$).

There was a lot of attention given to the edge version of such a coloring (the existence of interval edge coloring of given graph and the value of the corresponding chromatic index), but the vertex interval coloring was (as far as we know) not investigated. In the talk we present some results and algorithms for finding the precise value of χ_{io} and χ_{ic} for trees.

KYLE MACKEIGAN, Dalhousie University

[Wednesday May 26, 17:00]

Orthogonal Colourings of Random Geometric Graphs

Two colourings of a graph are orthogonal if they have the property that when two vertices receive the same colour in one colouring, then those vertices must receive distinct colours in the other colouring. In this talk, orthogonal colourings of random geometric graphs are discussed. It is shown that sparse random geometric graphs have optimal orthogonal colourings. Then, an upper bound on the orthogonal chromatic number for dense random geometric graphs is obtained.

Back to Table of Contents

Abstracts

RACHEL DOMAGALSKI, Michigan State University

[Wednesday May 26, 15:30]

Pattern Avoidance in Circular Permutations

A circular permutation avoids a given pattern if it does not contain a subsequence equivalent to that pattern. We find the number of circular permutations that avoid all different pairs and triples of length 4 patterns. This is joint work with Dr. Bruce Sagan, Jinting Liang, Quinn Minnich, Jamie Schmidt, and Alexander Sietsema.

JINTING LIANG, Michigan State University

[Wednesday May 26, 16:00]

Generating functions over avoidance sets of circular permutations

Motivated by the study of enumeration of circular permutations avoiding a given pattern, we study and obtain an explicit formula for the generating function of circular descents, cdes, over the set of circular permutations avoiding a single four letter pattern. This is joint work with Dr. Bruce Sagan, Rachel Domagalski, Quinn Minnich, Jamie Schmidt and Alexander Sietsema.

GABRIEL LOOS, Georgia Southern University

[Wednesday May 26, 16:30]

Combinatorics of Cyclic Compositions

Integer compositions are ordered sequences of positive integers that sum up to a given integer. We use generating functions to study cyclic versions of compositions, colored compositions under various constraints. First, a general construction of the generating functions for cyclic compositions (or their parts) is established. With this generating function we look to find and justify patterns from the number of cyclic compositions or number of parts in the cyclic compositions.

BRUCE SAGAN, Michigan State University

[Wednesday May 26, 17:00]

On a rank-unimodality conjecture of Morier-Genoud and Ovsienko

Let $\alpha = (a, b, \ldots)$ be a composition. Consider the associated fence poset $F(\alpha)$ whose covering relations are

$$x_1 \lhd x_2 \lhd \ldots \lhd x_{a+1} \rhd x_{a+2} \rhd \ldots \rhd x_{a+b+1} \lhd x_{a+b+2} \lhd \ldots .$$

We study the distributive lattice $L(\alpha)$ of all lower order ideals of $F(\alpha)$. These lattices are important in cluster algebras and in constructing q-analogues. In particular, we make progress on a recent conjecture of Morier-Genoud and Ovsienko that $L(\alpha)$ is rank unimodal. We show that if one of the parts of α is greater than the sum of the others, then the conjecture is true. We conjecture that $L(\alpha)$ enjoys the stronger properties of having a nested chain decomposition. We verify that these properties hold for compositions with at most three parts generalizing work of Claussen and simplifying a construction of Gansner. This is joint work with Thomas McConville and Clifford Smyth.

Back to Table of Contents

HUA WANG, Georgia Southern University

[Wednesday May 26, 17:30]

Counting colored compositions and tilings

A composition of a given positive integer n is an ordered sequence of positive integers with sum n. In n-color compositions a part k has one of k possible colors. Using spotted tiling to represent such colored compositions we consider those with restrictions on colors. With general results on the enumeration of color restricted n-color compositions in terms of allowed or prohibited colors, we introduce many particular combinatorial observations related to various integer sequences and identities. This is joint work with Brian Hopkins.

Back to Table of Contents

Abstracts

LOGAN CREW, University of Waterloo

[Wednesday May 26, 15:30]

Identities of the Chromatic and Tutte Symmetric Functions

For a graph G, its Tutte symmetric function XB_G generalizes both the Tutte polynomial T_G and the chromatic symmetric function X_G. We may consider XB as a map from the t-extended Hopf algebra $\mathbb{G}[t]$ of labelled graphs to symmetric functions.

In this talk, I show that the kernel of XB is generated by vertex-relabellings and a finite set of modular relations, in the same style as a recent analogous result by Penaguiao for the chromatic symmetric function X. Additionally, I give a structural characterization of all local modular relations of the chromatic and Tutte symmetric functions, and prove that there is no single local modification that preserves either function on simple graphs.

This is joint work with Sophie Spirkl.

HOSSEIN TEIMOORI FAAL, Allameh Tabataba'i University, Tehran, Iran

[Wednesday May 26, 16:00]

The Generalized Face Handshaking Lemma and Higher Derivatives of Face Polynomials

A face polynomial of a simplicial complex $\mathcal{K}$ denoted by $f(\mathcal{K},x)$ is defined as the generating function of the number of k -faces in $\mathcal{K}$. In this talk, we define the value of a face σ denoted by $val_{\mathcal{K}}(\sigma)$ as the number of vertices of the link of σ .

A generalization of handshaking lemma for complexes is the following identity:

$$\sum_{\sigma:\ \sigma\ is\ a\ k-face} val_{\mathcal{K}}(\sigma) = \binom{k+1}{1} f_k(\mathcal{K}), \quad (k \geq 1).$$

This identitiy implies the well-known combinatorial interpretation of the first derivative of face polynomials.
Our main goal here is to give a generalization of the combinatorial interpretation of the first derivative of face polynomials to higher-order derivatives. We also present some interesting research questions related to face polynomials and their higher derivatives.

FOSTER TOM, UC Berkeley

[Wednesday May 26, 16:30]

A combinatorial Schur expansion of triangle-free horizontal-strip LLT polynomials

In recent years, Alexandersson and others proved combinatorial formulas for the Schur function expansion of the horizontal-strip LLT polynomial $G_\lambda(x;q)$ in some special cases. We associate a weighted graph Π to λ and we use it to express a linear relation among LLT polynomials. We apply this relation to prove an explicit combinatorial Schur-positive expansion of $G_\lambda(x;q)$ whenever Π is triangle-free. We also prove that the largest power of q in the LLT polynomial is the total edge weight of our graph.

Back to Table of Contents

LAURENCE WIJAYA, Institut Teknologi Bandung

[Wednesday May 26, 17:00]

A Relationship Between Cayley-Dickson Process and The Generalized Study Determinant

Study determinant is known as one of replacements for the determinant of matrices with entries in a noncommutative ring. In this work, a generalization of Study determinant is given and show its relationship with the Cayley-Dickson process. Some properties of a non-associative ring obtained by the Cayley- Dickson process with a not necessarily commutative, but associative ring as the initial ring also will be given.

AJAY KUMAR, Indian Institute of Technology (BHU), Varanasi, India

[Wednesday May 26, 17:30]

Vertex connectivity of superpower graphs of dicyclic groups T_{4n}

For a finite group G, the superpower graph $S(G)$ of G is an undirected simple graph with vertex set G and two vertices in G are adjacent in $S(G)$ if and only if the order of one divides the order of the other in the group G. Aim of this talk is to provide the tight bounds for the vertex connectivity $\kappa(S(T_{4n}))$ of superpower graph $S(T_{4n})$ of dicyclic group T_{4n}.

Org: Pengyu Liu (Simon Fraser University)

Abstracts

JIANRONG YANG, Sun Yat-sen University

[Thursday May 27, 11:20]

Developmental cell lineage trees, and the quantitative comparisons between them

The developmental process of multicellular organisms can be summarized as the cell lineage tree (CLT). Technological breakthroughs have facilitated determination of more CLTs, but complete comprehension of the data remains difficult without a quantitative framework for CLT comparison. I will briefly introduce some CLT data, and present "DELTA", a novel algorithm that quantitatively compares CLTs. Application of DELTA to the worm CLTs allowed inference of transcriptomic resemblance, identifying cell fate transformations, predicting functional relationships between mutants, and finding evolutionary correspondence between cell types of different species. Quantitative comparison between CLTs can likely help answer many questions surrounding the developmental process.

CHRISTOPH WEITKAMP, Universität Göttingen

[Thursday May 27, 11:50]

GROMOV-WASSERSTEIN BASED PHYLOGENETIC TREE SHAPE COMPARISON

The shapes of phylogenetic trees carry important information about short and long-term evolutionary processes. In this talk, we propose to model the shapes considered as dissimilarity measure spaces and to compare them based on the Gromov-Wasserstein distance. We quantify their similarity on the basis of a dissimilarity-preserving soft assignment of the elements of the respective spaces. To reduce the computational complexity, we introduce several computationally efficient surrogates and illustrate in various examples that these represent powerful tools for the comparison of phylogenetic tree shapes. We compare our methods to the Colijn-Plazotta metric and illustrate the fundamental differences between these approaches.

LOUXIN ZHANG, National University of Singapore

[Thursday May 27, 12:20]

The Bourque Distances for Mutation Trees of Cancers

Mutation trees are rooted trees in which nodes are of arbitrary degree are labeled with a mutation set. These trees are used in computational oncology to represent the mutational history of tumours. Classical tree metrics are of limited use for the comparison of mutation trees. One reason is that mutation trees inferred with different methods or for different patients often contain different sets of mutation labels. We generalize the Robinson-Foulds distance into a set of distance metrics called Bourque distances for comparing mutation trees.

Back to Table of Contents

JULIA PALACIOS, Stanford University

[Thursday May 27, 12:50]

Distance-based summaries and modeling of evolutionary trees

Ranked tree shapes are used to model evolutionary relationships for evolutionary biology and phylodynamics. Bayesian methods explore the posterior distribution of trees, however assessing uncertainty and summarizing distributions remains challenging. Similarly, in many instances, one seeks to summarize samples of trees obtained from different samples and environments, and wishes to assess stability and generalizability of these summaries. Here, we exploit recently proposed distance of unlabeled evolutionary trees and provide a combinatorial optimization algorithm for estimating Fréchet means and variances. We show the applicability of our summary statistics for studying popular tree distributions and for studying the evolution of viruses.

Back to Table of Contents

Org: Thomas Dreyfus (CNRS, Université de Strasbourg) and **Andrew Elvey Price** (CNRS, Université de Tours)

Abstracts

LUCIA DI VIZIO, CNRS, Université de Versailles-St Quentin

[Thursday May 27, 11:20]

Differential transcendence for the Bell numbers and their relatives

Martin Klazar proved in 2003 that the ordinary generating function of the Bell numbers is differentially transcendental over the germs of meromorphic functions at 0. We show that this result is an instance of a general phenomenon: on one hand we prove a general result, in a compact way, using difference Galois theory; on the other hand, we obtain as a consequence the differential transcendence of the generating functions of many other combinatorial sequences, including Bernoulli, Euler and Genocchi numbers. These results bring concrete evidence in support to the Pak-Yeliussizov conjecture. This is joint work with A. Bostan and K. Raschel.

HELEN JENNE, Université de Tours and Université d'Orléans

[Thursday May 27, 11:50]

Three-dimensional lattice walks confined to an octant: non-rationality of the second critical exponent

We discuss the following: is there a walk model (a step set and cone $C \in \mathbb{R}^d$) so the sequence $e(P,Q;n)$ of length n walks in C from P to Q admits asymptotics

$$e(P,Q;n) = \rho^n(K_1 n^{\alpha_1} + K_2 n^{\alpha_2} + \cdots)$$

with $\alpha_1 \in \mathbb{Q}$ and $\alpha_2 \notin \mathbb{Q}$? Indeed, there is a strong relationship between D-finiteness of the generating function $e(P,Q;n) = \sum_{n\geq 0} e(P,Q;n)t^n \in \mathbb{Q}[[t]]$ and the asymptotic behavior of its coefficients, and recent works study the rationality of α_1.
In the three-dimensional case, we answer the analogous question in the continuous setting by proving there is a cone such that the heat kernel has the desired property. (Joint work with Luc Hillairet and Kilian Raschel.)

MICHAEL SINGER, North Carolina State University

[Thursday May 27, 12:20]

Differentially Algebraic Generating Series for Walks in the Quarter Plane

I will present a refinement of necessary and sufficient conditions for the generating series of a weighted model of a quarter plane walk to be differentially algebraic. In addition, I will discuss algorithms based on the theory of Mordell-Weil lattices that, for each weighted model, yield polynomial conditions on the weights determining this property of the associated generating series. This is joint work with C. Hardouin and appears in arXiv:2010.00963

Back to Table of Contents

MICHAEL WALLNER, TU Wien

[Thursday May 27, 12:50]

More Models of Walks Avoiding a Quadrant

We continue the enumeration of plane lattice paths avoiding the negative quadrant initiated in [Bousquet-Mélou, 2016] and solve a new case, the king walks with all 8 nearest neighbour steps. As in the two cases solved in [Bousquet-Mélou, 2016], the associated generating function differs from a simple, explicit D-finite series (related to the enumeration of walks confined to the first quadrant) by an algebraic one. The principle of the approach is the same as in [Bousquet-Mélou, 2016], but challenging theoretical and computational difficulties arise as we now handle algebraic series of larger degree. This is joint work with Mireille Bousquet-Mélou.

Org: Alyssa Sankey (University of New Brunswick)

Coherent configurations are sets of association schemes, linked by additional relations. They arise naturally in relation to the graph isomorphism problem and to finite permutation groups, which provide numerous examples of Schurian cc's – those in which the orbits, under the action of the group on ordered pairs, form the relations. The fruitful and interesting interplay between graphs, designs, finite geometries and other combinatorial objects is apparent in many constructions of both Schurian and non-Schurian cc's. Some headway has been made in recent work employing computer experimentation to construct and enumerate small cc's. The cc's with very few vertices have been catalogued, yet the classification of cc's with few fibers has not been approached in a systematic way. This minisymposium highlights work towards that goal.

Abstracts

STEFAN GYURKI, Slovak University of Technology

[Thursday May 27, 11:20]

The Paulus-Rozenfeld-Thompson graph on 26 vertices

Strongly regular graphs (SRGs) correspond to homogeneous coherent configurations of rank 3. In finding the smallest feasible parameter set on which no vertex-transitive SRG appears was already interested N. Biggs, one of the fathers of the Algebraic graph theory. In fact, the smallest order, on which this happens, is 26, and the corresponding parameter set is (26,10,3,4). This parameter set is realized by 10 non-isomorphic graphs and the most symmetric among them is called the Paulus-Rozenfeld-Thompson graph T, having automorphism group of order 120 isomorphic to $A_5 \times C_2$, acting on the vertex set with two orbits of lengths 20 and 6.

The talk will provide a gentle introduction to a recently published comprehensive tutorial focusing on the graph T and putting it into the context of classical combinatorial objects.

(This work is joint with Mikhail Klin and Matan Ziv-Av.)

BOHDAN KIVVA, University of Chicago

[Thursday May 27, 11:50]

Robustness of the Johnson scheme under fusion and extension

We show that if a coherent configuration X on n vertices or its fission contains a Johnson scheme $J(s,d)$ as a subconfiguration on $(1-c)n$ vertices for a sufficiently small constant $c > 0$ and $s > 100d^4$, then X itself is a Johnson scheme.

Our result simplifies the conclusion of the Split-or-Johnson lemma, which is one of the key ingredients of Babai's quasipolynomial-time algorithm for the Graph Isomorphism problem.

Additionally, the result can be seen as a strengthening of a 1972 theorem of Klin and Kaluzhnin that corresponds to the case of $c = 0$.

Based on a joint work with László Babai.

Back to Table of Contents

MIKHAIL MUZYCHUK, Ben-Gurion University of the Negev

[Thursday May 27, 12:20]

On Jordan schemes

In 2003 Peter Cameron introduced the concept of a *Jordan scheme* and asked whether there exist Jordan schemes which are not symmetrisations of coherent configurations (*proper* Jordan schemes). In my talk I'll present several constructions of infinite series of proper Jordan schemes and present first developments in the theory of Jordan schemes - a new class of algebraic-combinatorial objects. This is a joint work with M. Klin and S. Reichard.

GRIGORY RYABOV, Novosibirsk State University

[Thursday May 27, 12:50]

Infinite family of nonschurian separable association schemes

It is known that there exist infinite families of coherent configurations which are: (1) schurian and separable; (2) schurian and nonseparable; (3) nonschurian and nonseparable. The following question was asked, in fact, in [1].

Question. Whether there exists an infinite family of nonschurian separable coherent configurations?

We give an affirmative answer to this question. More precisely, we prove the following theorem.

Theorem. For every prime $p \geq 5$, there exists a nonschurian association scheme of degree $4p^2$ which is separable.

References

[1] *G. Chen, I. Ponomarenko*, Coherent configurations, Central China Normal University Press, Wuhan (2019).

Back to Table of Contents

Org: Sebastian Cioaba (University of Delaware) and **Michael Tait** (Villanova University)

Spectral methods have become ubiquitous in graph theory for several reasons including efficiently giving bounds on hard to compute graph parameters (e.g. the Hoffman-ratio bound), quantifying edge distribution and pseudo-randomness (e.g. the expander-mixing lemma and Cheeger-type inequalities), and giving well-performing graph algorithms (e.g. spectral partitioning and max-cut approximations). We propose a minisymposiumon "Spectral graph theory" focused on recent developments in the field. We propose a 2 part minisymposium with the following confirmed speakers:
Aida Abiad, Krystal Guo, Ferdinand Ihringer, Jephian Lin, Nathan Lindzey, Theo McKenzie, Siddanth Mohanty, Sjanne Zeijlemaker

Abstracts

FERDINAND IHRINGER, Ghent University

[Thursday May 27, 11:20]

Strongly regular graphs satisfying the 4-vertex condition

A graph satisfies the 3-vertex condition if and only if it is strongly regular. A graph of order v satisfies the v-vertex condition if and only if it is rank 3, so the most symmetric kind of strongly regular graph. We show that the family of strongly regular graphs $NO_n^\varepsilon(q)$, defined on the non-zero square points of a non-degenerate quadric with two points adjacent if they span a tangent, satisfies the 4-vertex condition. These graphs have rank $(q+3)/2$. We also discuss some other families of strongly regular graphs satisfying the 4-vertex condition.

Joint work with A. E. Brouwer.

JEPHIAN LIN, National Sun Yat-sen University

[Thursday May 27, 11:50]

The strong spectral property for graphs

A symmetric matrix A is said to have the strong spectral property if $X = O$ is the only symmetric matrix satisfying $A \circ X = O$, $I \circ X = O$, and $AX - XA = O$. Here the operation $\circ$ is the entrywise product. If a matrix has the strong spectral property, one may perturb the matrix slightly to create more nonzero entries without changing its spectrum. This behavior has been used widely for constructing matrices in the inverse eigenvalue problem of a graph. In this talk, we show that if the nonzero pattern of the matrix is described by certain graphs, then it always has the strong spectral property.

AIDA ABIAD, Eindhoven University of Technology

[Thursday May 27, 12:20]

Neumaier graphs with few eigenvalues

A Neumaier graph is a non-complete edge-regular graph containing a regular clique. In this talk we will discuss some recent progress on Neumaier graphs with few eigenvalues. This is joint work with B. De Bruyn, J. D'haeseleer and J.H. Koolen

Back to Table of Contents

KRYSTAL GUO, University of Amsterdam

[Thursday May 27, 12:50]

Entanglement of free Fermions on distance-regular graphs

Many physical processes evolving over time on an underlying graph have led to problems in spectral graph theory, including quantum walks. These problems provide new graph invariants and also new applications for theorems about the eigenspaces of graphs. In this talk, we will consider free Fermions on vertices of distance-regular graphs are considered. Using concepts from Terwilliger algebras, we study the entanglement Hamiltonian. This is based on joint work with Nicolas Crampé and Luc Vinet.

Org: Shonda Dueck (University of Winnipeg)

Motivated by the problem of efficiently locating a moving point or intruder in a network, the concept of the metric dimension of a graph was first introduced by Slater, and independently by Harary and Melter, in the mid 1970's. This graph parameter has applications in network discovery and verification, combinatorial optimization, chemistry, and many other areas. The problem of determining the metric dimension of a graph is NP hard, and so researchers focus on bounding this parameter in terms of its diameter, order and size, and on determining the metric dimension of different classes of graphs. Several interesting and useful variants of the metric dimension have also been introduced over the years, such as the partition dimension, the strong dimension, the edge dimension, the threshold dimension, and the threshold strong dimension of a graph. In this minisymposium, we present several recent developments in research on the metric dimension of graphs.

Abstracts

SHONDA DUECK, University of Winnipeg, Canada

[Thursday May 27, 11:20]

Logarithmic bounds on the threshold strong dimension of a graph

A set W of vertices of a connected graph G is a *strong resolving set* for G if, for every pair of vertices, one of the vertices in the pair lies on a shortest path from the other vertex to some vertex of W. The smallest cardinality of a strong resolving set of vertices of G is the *strong dimension* of G. The *threshold strong dimension* of G is the smallest strong dimension among all graphs having G as a spanning subgraph. We establish logarithmic bounds on the threshold strong dimension for graphs in general, and for trees.

BETH NOVICK, Clemson University, USA

[Thursday May 27, 11:50]

A geometric characterization of the threshold strong dimension of a graph

The *threshold strong dimension* of a graph G, denoted $\tau_S(G)$, is the smallest strong dimension among all graphs having G as a spanning subgraph. We give a geometric characterization of the threshold strong dimension. It expresses $\tau_S(G)$ in terms of the smallest number of paths (each of sufficiently large order) whose strong product admits a certain type of embedding of G. This characterization leads to several results. This is joint work with Nadia Benakli, Novi H. Bong, Shonda Dueck (Gosselin), Linda Eroh, and Ortrud Oellermann.

LINDA EROH, University of Wisconsin, Oshkosh Campus, USA

[Thursday May 27, 12:20]

The threshold strong dimension of trees

The cardinality of a smallest set that strongly resolves every pair of vertices in G is the *strong dimension* $\beta_s(G)$ of G. The *threshold strong dimension* $\tau_s(G)$ of G is the smallest strong dimension among all graphs having G as a spanning subgraph.

We show that trees with strong dimension 3 or 4 have threshold strong dimension 2. Oellermann et al observed $\tau(K_{1,6}) > 2$. Since $\beta_s(K_{1,6}) = 5$ and $\tau(K_{1,6}) \leq \tau_s(K_{1,6})$, the threshold strong dimension of trees with strong dimension 5 need not be 2. We observe there are trees of arbitrarily large dimension with threshold strong dimension 2.

Back to Table of Contents

RICHARD TILLQUIST, University of Colorado, USA

[Thursday May 27, 12:50]

A Bound on the Metric Dimension of Hamming Graphs and Applications in Machine Learning

Many powerful data analysis and data mining techniques require that data be embedded in Euclidean space. When faced with symbolic datasets, including biological sequence data produced by high-throughput sequencing assays, it is not always clear how to generate an effective embedding. In this talk, we discuss low-dimensional representations of symbolic information based on metric dimension. Specifically, we consider an upper bound on the metric dimension of Hamming graphs and how this bound can be used to map biological sequences of arbitrary length to real space.

Abstracts

ALEXANDER CLIFTON, Emory University

[Thursday May 27, 11:20]

An exponential bound for exponential diffsequences

A theorem of van der Waerden states that for any positive integer r, if you color $\mathbb{N}$ with r colors, then one color will contain arbitrarily long arithmetic progressions. It is natural to ask what other arithmetic structures are preserved when r-coloring $\mathbb{N}$ and to pose quantitative questions about these. We consider D-diffsequences, introduced by Landman and Robertson, which are increasing sequences $a_1 < a_2 < \cdots < a_k$ in which the consecutive differences $a_i - a_{i-1}$ all lie in some given set D. Here, we consider the case where D consists of all powers of 2 and define $f(k)$ to be the smallest n such that coloring $\{1, 2, \cdots, n\}$ with 2 colors guarantees the existence of a monochromatic D-diffsequence of length k. We establish that $f(k)$ grows exponentially and time permitting, we will discuss other choices of D which behave differently.

TORIN GREENWOOD, North Dakota State University

[Thursday May 27, 11:50]

Bounding monochromatic arithmetic progressions

We find a 2-coloring of the integers $\{1, 2, \ldots, n\}$ that minimizes the number of monochromatic arithmetic 3-progressions under certain restrictions. A monochromatic arithmetic progression is a set of equally-spaced integers that are all the same color. Previous work by Parrilo, Robertson, and Saracino conjectured an optimal coloring for large n that involves 12 colored blocks. Here, we prove that the conjectured coloring is optimal among symmetric colorings with 12 intervals. We leverage a connection to coloring the continuous interval $[0, 1]$ first identified by Butler, Costello, and Graham. The proof relies on identifying classes of colorings with permutations, and enumerating these permutations using mixed integer linear programming. Joint work with Jonathan Kariv and Noah Williams.

GLENN HURLBERT, Virginia Commonwealth University

[Thursday May 27, 12:20]

On intersecting families of independent sets in trees

The Erdős-Ko-Rado Theorem states that, for $r \leq n/2$, intersecting families of r-sets have size at most that of a star. A graph G is r-EKR if intersecting families of independent r-sets of G are maximized by a star. Holroyd and Talbot conjectured that every graph G is r-EKR for all $1 \leq r \leq \mu(G)/2$. We verified the conjecture for all chordal graphs with isolated vertices.

While investigating whether trees are r-EKR, we had conjectured that stars of trees are maximized at leaves. We proved this for $r \leq 4$, but Borg gave counterexamples for all $r \geq 5$. Here we prove that all trees with a unique split vertex satisfy the leaf conjecture, and we characterize their best leaves. It was recently shown that all trees whose split vertices have pendant edges satisfy the leaf conjecture. For such trees with exactly two split vertices, we also provide partial results on their best leaves.

Back to Table of Contents

STANISŁAW RADZISZOWSKI, Rochester Institute of Technology

[Thursday May 27, 12:50]

On Some Generalized Vertex Folkman Numbers

For graph G and integers $a_i \geq 2$, the expression $G \longrightarrow (a_1, \ldots, a_r)^v$ means that for any r-coloring of the vertices of G there exists a monochromatic a_i-clique for some color $i \in \{1, \cdots, r\}$. The vertex Folkman numbers are defined as $F_v(a_1, \ldots, a_r; H) = \min\{|V(G)| : G$ is H-free and $G \longrightarrow (a_1, \ldots, a_r)^v\}$, where H is a graph. Such numbers have been extensively studied for $H = K_s$ with $s > \max\{a_i\}_{1 \leq i \leq r}$.

Let J_k be the complete graph K_k missing one edge, $J_k = K_k - e$. In this work we focus on vertex Folkman numbers with $H = J_k$, in particular for $k = 4$ and $a_i \leq 3$. We prove that $F_v(3, 3, \cdots, 3; J_4)$ is well defined for any $r \geq 2$. The simplest but intriguing case is that of $F_v(3, 3; J_4)$, for which we establish the upper bound 135. The best known lower bound for this case is 25, which is implied by prior results.

Joint work Yu Jiang, David Narváez and Xiaodong Xu.

Back to Table of Contents

Abstracts

MICHAL STERN, Academic College of Tel-Aviv Yaffo

[Thursday May 27, 11:20]

Minimum removal or insertion list for Clustered Spanning Tree by Paths

Let $H = \langle V, \mathcal{S} \rangle$ be a hypergraph, where V is a set of vertices and $\mathcal{S}$ is a set of not necessarily disjoint clusters. The Clustered Spanning Tree by Paths problem aims to decide whether there exists a feasible solution tree, spanning all vertices of V, such that each cluster induces a path.

We introduce minimum cardinality removal or insertion list, which removes or inserts vertices from or into clusters, to gain feasibility. In addition, we decompose the intersection graph of H into smaller instances, for those cases where the intersection graph contains a cut node or a separating edge. We demonstrate how to compose a minimum cardinality feasible removal or insertion list for the given hypergraph from the smaller instances. This approach may reduce the size and intricacy of the instances.

Joint work with Nili Beck.

JAMES ROSS, University of New South Wales

[Thursday May 27, 11:50]

Sampling hypergraphs with given degrees

There are a variety of well-studied methods to approximately uniformly sample simple graphs with prescribed degree sequences, as well as for variations like bipartite graphs. In this talk, we will define and analyse an algorithm for sampling simple, uniform hypergraphs with a given degree sequence. This combines any black box function for sampling bipartite graphs, a standard correspondence from biadjacency matrices of bipartite graphs to the incidence matrices of hypergraphs, and rejection sampling, which guarantees that results are simple hypergraphs. We will show that sparse degree sequences, with length n and maximum degree $d_{\max}$ satisfying $d_{\max}^2 = o(n^{r-2})$ among other conditions, result in a polynomial expected running time, a small approximation error from the uniform distribution, and a small chance of failure when running the algorithm. This was a joint work with Martin Dyer, Catherine Greenhill, Pieter Kleer, and Leen Stougie.

SAM SPIRO, UC San Diego

[Thursday May 27, 12:20]

Cycle-free Subgraphs of Random Hypergraphs

Let $H_{n,p}^r$ denote the random r-uniform n-vertex hypergraph obtained by including each edge independently and with probability p. If $\mathcal{F}$ is a family of r-uniform hypergraphs, we let $ex(H_{n,p}^r, \mathcal{F})$ denote the size of a largest $\mathcal{F}$-free subgraph of $H_{n,p}^r$. In this talk we study this function when $\mathcal{F}$ is a family of hypergraph cycles, with a particular emphasis on the case when $\mathcal{F}$ is the set of all Berge cycles of length at most ℓ.

Back to Table of Contents

CHRISTIAN WINTER, Karlsruhe Institute of Technology, Karlsruhe, Germany

[Thursday May 27, 12:50]

Size-Ramsey Number of Tight Paths

The size-Ramsey number $\hat{R}^{(k)}(\mathcal{H})$ of a k-uniform hypergraph $\mathcal{H}$ is the minimum number of edges such that there is a k-uniform hypergraph $\mathcal{G}$ on this many edges with the property that each edge 2-coloring of $\mathcal{G}$ contains a monochromatic copy of $\mathcal{G}$.

For $k \geq 2$ and $n \in \mathbb{N}$, a k-uniform tight path on n vertices $\mathcal{P}_{n,k-1}^{(k)}$ is defined as a k-uniform hypergraph on n vertices for which there is an ordering of its vertices such that the edge set is precisely the set consisting of all k-element intervals of consecutive vertices in this ordering.

It is a subject of current research to find an upper bound on the size-Ramsey number of k-uniform tight paths that is linear in terms of n. In this talk we show a lower bound on this number, that is $\hat{R}^{(k)}(\mathcal{P}_{n,k-1}^{(k)}) = \Omega\big(\log(k)n\big)$.

Back to Table of Contents

Abstracts

NATALIE BEHAGUE, Ryerson University

[Thursday May 27, 11:20]

The Cerny Conjecture and Synchronizing Times for k-sets in Automata

An automaton consists of a finite set of states and a collection of functions from the set of states to itself. An automaton is *synchronizing* if there is a word (that is, a sequence of functions) that maps all states onto the same state. The Černý conjecture is a famous open problem on the length of the shortest such word. We consider the closely related question of determining the minimum length of a word mapping k states onto a single state.

For synchronizing automata, we have improved the upper bound on the minimum length of a word that sends some triple to a single state from $0.5n^2$ to $\approx 0.19n^2$. I will discuss this result and some related results, including a generalization of this approach this to an improved bound on the length of a synchronizing word for 4 states and 5 states.

This is joint work with Robert Johnson.

YING YING (FAY) YE, University of Victoria

[Thursday May 27, 11:50]

Chordality of locally semicomplete and weakly quasi-transitive digraphs

Chordal graphs are important in the structural and algorithmic graph theory. A digraph analogue of Chordal graphs was introduced by Haskin and Rose in 1973 but has not been studied until recently when a characterization of semicomplete chordal digraphs was found by Meister and Telle.

Locally semicomplete digraphs, quasi-transitive digraphs and extended semicomplete digraphs are the most popular generalizations of semicomplete digraphs. We extend the forbidden subdigraph characterization to Locally semicomplete chordal digraphs. We introduce weakly quasi-transitive digraphs, which contains qu- asitransitive digraphs, symmetric digraphs, and extended semicomplete digraphs, but is incomparable to locally semicomplete digraphs. We show that weakly quasi- transitive digraphs can be recursively constructed by substitutions from transitive oriented graphs, semicomplete digraphs, and symmetric digraphs. This recursive con- struction demonstrates the naturalness of the new digraph class. As a by-product, we prove that semicomplete chordal digraphs and weakly quasi-transitive chordal digraphs have the same forbidden subdigraphs.

SANTIAGO GUZMÁN PRO, Facultad de Ciencias, UNAM

[Thursday May 27, 12:20]

Hereditary properties and forbidden orientations

Several graph properties are characterized as the class of graphs that admit an orientation avoiding finitely many oriented structures. For instance, if F_k is the set of homomorphic images of the directed path on $k+1$-vertices, then a graph is k-colourable if and only if it admits an orientation with no induced oriented graph in F_k. There are two basic problems regarding this kind of characterizations: 1) given a finite set of oriented graphs, F, characterize the class of graphs that admit an F-free orientation, and 2) given a graph property, $\mathcal{P}$, determine if there a finite set of oriented graphs F such that a graph belongs to $\mathcal{P}$ if and only if it admits an F-free orientation. We begin by addressing the first problem when F is a set of oriented graphs on three vertices, and we conclude by exhibiting necessary conditions upon certain graph properties to admit such characterization.

KATARÍNA ČEKANOVÁ, Pavol Jozef Šafárik University, Košice, Slovakia

[Thursday May 27, 12:50]

Types of edges in embedded graphs with minimum degree 2

The weight $w(e)$ of an edge e is the degree-sum of its end-vertices. An edge $e = uv$ is of type (i, j) if $deg(u) \leq i$ and $deg(v) \leq j$. Kotzig proved that every 3-connected plane graph contains an edge of weight at most 13. Ivančo described bounds for weights of edges in the class of graphs embeddable on the orientable surfaces with higher genus. Jendroľ and Tuhársky investigated the weight of edges in the class of graphs embeddable on the nonorientable surfaces with higher genus. Later Jendroľ, Tuhársky and Voss described exact types of edges in large embedded maps with minimum degree 3.

In the talk we describe types of edges in connected embedded graphs with minimum degree at least 2, minimum face size at least 3 and sufficiently large number of vertices. We will also discuss the quality of our results.

Back to Table of Contents

Abstracts

MEHRDAD GHADIRI, Georgia Institute of Technology

[Thursday May 27, 11:20]

Socially Fair k-Means Clustering

We show that the popular k-means clustering algorithm (Lloyd's heuristic), used for a variety of scientific data, can result in outcomes that are unfavorable to subgroups of data (e.g., demographic groups). Such biased clusterings can have deleterious implications for human-centric applications such as resource allocation. We present a fair k-means objective and algorithm to choose cluster centers that provide equitable costs for different groups. The algorithm, Fair-Lloyd, is a modification of Lloyd's heuristic for k-means, inheriting its simplicity, efficiency, and stability. In comparison with standard Lloyd's, we find that on benchmark datasets, Fair-Lloyd exhibits unbiased performance by ensuring that all groups have equal costs in the output k-clustering, while incurring a negligible increase in running time, thus making it a viable fair option wherever k-means is currently used.

NICK HARVEY, Univeristy of British Columbia

[Thursday May 27, 11:50]

How to make predictions using two experts, forever

A fundamental task in learning theory is to make repeated predictions given advice from experts. A famous algorithm for this task is the multiplicative weight method. It was independently invented in many areas including game theory, computational geometry, online learning, discrete optimization, and information theory.

As an algorithm designer, I am compelled to ask: is the multiplicative weight method the optimal algorithm for this problem? It turns out that it is the optimal algorithm under two assumptions: (1) the number of "experts" is large, and (2) the duration of the task is known in advance. We consider the optimality question after removing both of these assumptions. For the setting with just two experts in which the duration is unknown, we find the optimal algorithm. It is provably better than the multiplicative weight method.

The algorithm is derived in an unusual way. We reformulate the problem so that time progresses continuously rather than discretely. After doing so, the optimal algorithm can be found via a partial differential equation, which we solve analytically. This PDE solution is then used as the algorithm in discrete time. One would expect this approach to incur some discretization error, but bizarrely the discretization error is negative!

Joint work with Chris Liaw, Sikander Randhawa and Ed Perkins.

RICHARD SANTIAGO, ETH Zürich

[Thursday May 27, 12:20]

Non-monotone weakly submodular function maximization subject to a cardinality constraint

Weak submodularity is a natural relaxation of the diminishing return property, which is equivalent to submodularity. Weak submodularity has been used to show that many (monotone) functions that arise in practice can be efficiently maximized with provable guarantees. In this talk we introduce a natural generalization of weak submodularity for non-monotone functions. We show that an efficient randomized greedy algorithm has provable approximation guarantees for maximizing these functions subject to a cardinality constraint.

BRUCE SHEPHERD, UBC

[Thursday May 27, 12:50]

Single Tree Cut Approximators and Disjoint Paths in Outerplanar Graphs

We show the existence of a tree which approximates all cut capacities in an outerplanar within a constant factor. We also show that this can be used to give a constant factor approximation to the maximum weight edge-disjoint path problem (MEDP). Such an algorithm for MEDP was previously only known for trees.

Abstracts

ROBERT HICKINGBOTHAM, Monash University

[Thursday May 27, 11:20]

Stack-number is not bounded by queue-number

Stacks and queues are fundamental data structures in computer science, but which is more powerful? In 1992, Heath, Leighton and Rosenberg formulated an approach to answer this question by introducing the graph parameters stack-number and queue-number to respectively measure the power of stacks and queues for representing graphs. Stacks would be considered more powerful than queues if every class of graphs with bounded queue-number has bounded stack-number and the converse does not hold (and vice versa). Despite extensive research on these parameters for various graph classes, this question has remained unsolved. In this talk, I will present a family of graphs that have queue-number at most 4 but unbounded stack-number. This demonstrates that stacks are not more powerful than queues in representing graphs. It remains open whether queues are more powerful than stacks. This talk is based on joint work with Vida Dujmović, David Eppstein, Pat Morin and David Wood.

CARL FEGHALI, Charles University

[Thursday May 27, 11:50]

Decomposing a triangle-free planar graph into a forest and a subcubic forest

We strengthen a result of Dross, Montassier and Pinlou (2017) that the vertex set of every triangle-free planar graph can be decomposed into a set that induces a forest and a set that induces a forest with maximum degree at most 5, showing that 5 can be replaced by 3. This is joint work with Robert Šámal.

TOMÁŠ KAISER, University of West Bohemia

[Thursday May 27, 12:20]

Edge-critical subgraphs of Schrijver graphs

For $k \geq 1$ and $n \geq 2k$, the Kneser graph $\mathrm{KG}(n,k)$ has all k-element subsets of an n-element set as its vertices, with edges joining disjoint subsets. Lovász (1978) proved that the chromatic number of $\mathrm{KG}(n,k)$ is $n-2k+2$. Schrijver (1978) described a subgraph of this graph, now called the Schrijver graph $\mathrm{SG}(n,k)$, with the same chromatic number and the property of being vertex-critical (which means that the chromatic number decreases if any vertex is deleted).

We take the next step in this direction and give an explicit combinatorial description of an edge-critical spanning subgraph of $\mathrm{SG}(n,k)$, for all values of n,k as above, with chromatic number $n-2k+2$. Here, a graph is edge-critical if the deletion of any edge decreases the chromatic number. Joint work with Matěj Stehlík.

Back to Table of Contents

ALEXANDRE BLANCHÉ, LaBRI, Université de Bordeaux

[Thursday May 27, 12:50]

Gallai's path decomposition conjecture for planar graphs

In 1968, Gallai conjectured that the edges of any connected graph with n vertices can be partitioned into $\lceil \frac{n}{2} \rceil$ paths. Although this conjecture has been tackled and partially solved over the years, such as for graphs of maximum degree 5 (Bonamy, Perrett, 2016), it is still open as of today. We prove that the conjecture is true for every planar graph. More precisely, we show that every connected planar graph except K_3 and K_5^- (K_5 minus one edge) can be decomposed into $\lfloor \frac{n}{2} \rfloor$ paths. (Joint work with Marthe Bonamy and Nicolas Bonichon)

Org: Tom Trotter (Georgia Institute of Technology)

Abstracts

PATRICE OSSONA DE MENDEZ, CNRS, École des Hautes Études en Sciences Sociales

[Thursday May 27, 15:30]

Small, sparse and ordered

An ordered graph is a simple graph with a linear order on the vertices. Ordered graphs have been particularly studied in extremal graph theory and in Ramsey theory. We show how the presence of a linear order allows to link, for a hereditary class of binary structures, the notions of "structural sparsity" (through the notion of twin-width), the notion of smallness, the model theoretic notion of dependence, and the parametrized complexity of first-order model checking.

GWENAËL JORET, Université Libre de Bruxelles

[Thursday May 27, 16:00]

The extension dimension and the linear extension polytope of a poset

The extension dimension of a poset P is the maximum dimension of a poset extending P. This talk focuses on posets with extension dimension 2. Our main result is a polyhedral characterization of these posets: They are exactly the posets P such that the linear extension polytope of P is equal to a natural relaxation of the polytope, consisting of the linear inequalities encoding the axioms for linear extensions. We also characterize these posets by a list of 78 forbidden induced subposets, and their comparability graphs by 2 forbidden subgraphs.

Joint work with Jean-Paul Doignon, Samuel Fiorini, and Selim Rexhep.

BARTŁOMIEJ BOSEK, Jagellonian University

[Thursday May 27, 16:30]

Dilworth's Theorem for Borel Posets

A famous theorem of Dilworth asserts that any finite poset of width k can be decomposed into k chains. We study the following problem: given a Borel poset P of finite width k, is it true that it can be decomposed into k Borel chains? We give a positive answer in a special case of Borel posets embeddable into the real line. We also prove a dual theorem for posets whose comparability graphs are locally countable. This is joint work with Jarosław Grytczuk and Zbigniew Lonc.

Back to Table of Contents

JAROSŁAW GRYTCZUK, Technical University of Warsaw

[Thursday May 27, 17:00]

Variations on twins in permutations

Let π be a permutation of the set $[n] = \{1, 2, \ldots, n\}$. Two disjoint order-isomorphic subsequences of π are called *twins*. How long twins are contained in every permutation? The well-known Erdős-Szekeres theorem implies that there is always a pair of twins of length $\Omega(\sqrt{n})$. On the other hand, by a simple probabilistic argument, Gawron proved that for every $n \geqslant 1$ there exist permutations with all twins having length $O(n^{2/3})$. He conjectured that the latter bound is the correct size of the longest twins guaranteed in every permutation. We present what is known and what is not known on this problem.

PIOTR MICEK, Jagellonian University

[Thursday May 27, 17:30]

Excluding a ladder

A k-ladder is a $2 \times k$ grid graph. Which graph classes C exclude some ladder as a minor? We show that this is the case if and only if all graphs G in C admit a proper vertex coloring with a bounded number of colors such that for every 2-connected subgraph H of G, there is a color that appears exactly once in H. Our structural results have applications to poset dimension: Posets whose cover graphs exclude a fixed ladder as a minor have bounded dimension.

Joint work with Tony Huynh, Gwenaël Joret, Michał Seweryn, Paul Wollan.

Back to Table of Contents

Org: Nicolas Bousquet (CNRS, Université de Lyon) and **Anna Lubiw** (University of Waterloo)

"Reconfiguration" is about changing one configuration to another via discrete steps, for example sorting a list by swapping pairs of adjacent elements, or changing one proper colouring of a graph to another by recolouring one vertex at a time. We may ask: Is there a reconfiguration path between any two configurations? How short a path? How efficiently can it be found? How many reconfiguration steps to a random configuration? These questions arise in various fields such as discrete geometry (flip distance), combinatorics (graph recoloring, token swapping), bio-informatics (phylogenetics), combinatorial game theory (puzzles), random sampling (Monte Carlo Markov chains), and combinatorial optimization (Hirsch's conjecture). The talks in this minisymposium give a sample of recent results in these areas.

Abstracts

ERIK DEMAINE & NICOLE WEIN, MIT & University of Waterloo

[Thursday May 27, 15:30]

Hardness of Token Swapping on Trees

In the token swapping problem we are given a graph, an initial assignment of one labeled token on each vertex, and a target permutation of the tokens. The goal is to perform the fewest number of swaps to reach the target permutation, where each swap exchanges the two tokens incident to an edge. Token swapping is studied in discrete mathematics, theoretical computer science, robot motion planning, game theory, and engineering. It is known to be NP-hard for general graphs. We study the natural setting where the graph is a tree, and show that token swapping remains NP-hard even for trees.

COLIN R DEFANT & NOAH KRAVITZ, Princeton University

[Thursday May 27, 16:00]

Random Friends and Strangers Walking on Random Graphs

The friends-and-strangers graph $\mathsf{FS}(X,Y)$ associated with n-vertex graphs X and Y is a specific graph on the set of bijections $V(X) \to V(Y)$ whose edges are determined by certain local flips. These graphs provide a framework for generalizing transposition Cayley graphs of symmetric groups, the famous 15-puzzle, generalizations of the 15-puzzle as studied by Wilson, and work of Stanley related to flag h-vectors. We will discuss several results about the number and sizes of the connected components of these friends-and-strangers graphs, with special emphasis on the case where X and Y are Erdős–Rényi random graphs. Joint work with Noga Alon.

EMO WELZL, ETH Zurich

[Thursday May 27, 16:30]

Vertex-Connectivity of Triangulation Flip Graphs of Planar Point Sets

Full triangulations of a finite planar point set P are maximal straight-line embedded plane graphs on P. In partial triangulations some non-extreme points can be skipped. Flips are minimal changes in triangulations. They define an adjacency relation on the set of triangulations of P, giving rise to the flip graph of all (full or partial) triangulations of P. In the seventies Lawson showed that flip graphs are connected.

Our goal is to investigate the structure of flip graphs, with emphasis on their vertex-connectivity. We obtain similar bounds as they follow for regular triangulations from secondary polytopes via Balinski's Theorem.

Back to Table of Contents

JEAN CARDINAL, Université Libre de Bruxelles

[Thursday May 27, 17:00]

Flip Distances between Graph Orientations

We consider α-orientations of a graph, in which every vertex v has a specified outdegree $\alpha(v)$, and a flip consists of reversing all edges of a directed cycle. We prove that deciding whether the flip distance between two α-orientations of a planar graph is at most two is NP-complete. This also holds in the special case of perfect matchings, where flips involve alternating cycles. This problem amounts to finding geodesics on the common base polytope of two partition matroids. We also consider the dual question on graph orientations in which every cycle has a specified number of forward edges.

LINDA KLEIST, Technische Universität Braunschweig

[Thursday May 27, 17:30]

Flip graphs and Rainbow cycles

Flip graphs are fundamental structures associated with families of geometric objects. In a flip graph, vertices correspond to geometric objects and the edges correspond to flip operations which naturally partition into several types. A rainbow cycle is a cycle in which every flip type (color) appears exactly once.

In this talk, we investigate rainbow cycles in a number of flip graphs, i.e., in the flip graph of triangulations, plane trees on point sets, non-crossing perfect matchings on convex point sets, permutations, and k-subsets of [n]. The talk is based on joint work with Stefan Felsner, Torsten Mütze and Leon Sering.

Org: Jozef Skokan (London School of Economics)

Abstracts

ANNIKA HECKEL, Ludwig-Maximilians-Universität München

[Thursday May 27, 15:30]

How does the chromatic number of a random graph vary?

How much does the chromatic number of the random graph $G(n, \frac{1}{2})$ vary? Shamir and Spencer proved that it is contained in some sequence of intervals of length about $n^{1/2}$. Alon improved this slightly to $\frac{n^{1/2}}{\log n}$. Until recently, however, no lower bounds whatsoever on the fluctuations of the chromatic number of $G(n, \frac{1}{2})$ were known, even though the question was raised by Bollobás many years ago. I will talk about the main ideas needed to prove that, at least for infinitely many n, the chromatic number of $G(n, \frac{1}{2})$ is not concentrated on fewer than $n^{1/2-o(1)}$ consecutive values.

I will also discuss the Zigzag Conjecture, made recently by Bollobás, Heckel, Morris, Panagiotou, Riordan and Smith: this proposes that the correct concentration interval length 'zigzags' between $n^{1/4+o(1)}$ and $n^{1/2+o(1)}$, depending on n.

Joint work with Oliver Riordan.

MATTHEW JENSSEN, University of Birmingham

[Thursday May 27, 16:00]

Singularity of random symmetric matrices revisited

Let M_n be drawn uniformly from all $n \times n$ symmetric matrices with entries in $\{-1, 1\}$. A well-known conjecture states that M_n is singular with probability $\Theta(n^2 2^{-n})$. In this talk, I will discuss some recent progress toward this conjecture. Joint work with Marcelo Campos, Marcus Michelen, and Julian Sahasrabudhe.

JINYOUNG PARK, Institute for Advanced Study

[Thursday May 27, 16:30]

On a problem of M. Talagrand

We will discuss some special cases of a conjecture of M. Talagrand relating two notions of "threshold" for an increasing family F of subsets of a finite set X. The full conjecture implies equivalence of the "Fractional ExpectationThreshold Conjecture," due to Talagrand and recently proved by Frankston, Kahn, Narayanan, and myself, and the (stronger) "Expectation-Threshold Conjecture" of Kahn and Kalai.

Talagrand showed that his conjecture is true in some special cases and suggested a couple of more challenging test cases. In the talk, I will give more detailed descriptions of this problem, and some proof ideas if time allows.

This is joint work with Keith Frankston and Jeff Kahn.

Back to Table of Contents

WILL PERKINS, University of Illinois at Chicago

[Thursday May 27, 17:00]

Correlation decay, phase transitions, and enumeration

I will describe some probabilistic techniques for combinatorial enumeration based on intuition from correlation decay and phase transitions in statistical physics. The techniques combine large deviation bounds, the cluster expansion, and local central limit theorems.

MEHTAAB SAWHNEY, Massachusetts Institute of Technology

[Thursday May 27, 17:30]

Friendly bisections of random graphs

We prove that with high probability, the random graph $G(n, \frac{1}{2})$ on an even number of vertices admits a partition of its vertex set into two parts of equal size in which $n - o(n)$ vertices have more neighbours on their own side than across. This settles an old conjecture of Füredi from 1988, which also appears as Problem 91 in Green's list of 100 open problems. This is joint work with Asaf Ferber, Matthew Kwan, Bhargav Narayanan and Ashwin Sah.

Org: Alyssa Sankey (University of New Brunswick)

Coherent configurations are sets of association schemes, linked by additional relations. They arise naturally in relation to the graph isomorphism problem and to finite permutation groups, which provide numerous examples of Schurian cc's – those in which the orbits, under the action of the group on ordered pairs, form the relations. The fruitful and interesting interplay between graphs, designs, finite geometries and other combinatorial objects is apparent in many constructions of both Schurian and non-Schurian cc's. Some headway has been made in recent work employing computer experimentation to construct and enumerate small cc's. The cc's with very few vertices have been catalogued, yet the classification of cc's with few fibers has not been approached in a systematic way. This minisymposium highlights work towards that goal.

Abstracts

DENNIS EPPLE, University of Toronto

[Thursday May 27, 15:30]

The Shrikhande Graph on the Crossroads of Algebraic and Topological Graph Theory

The Shrikhande graph Sh is the smallest strongly regular graph which is not a rank 3 graph. Its automorphism group G has order 192. We consider Sh, its toroidal dual (the Dyck graph), and the dual of its Petrie dual. The action of G (or of a subgroup) on the vertex sets of these graphs defines a coherent configuration of order 60 with three fibres of size 16, 32, and 12. Using computer algebra packages we investigate some non-Schurian association schemes that appear as mergings of these coherent configurations and give combinatorial descriptions. (Joint work with Mikhail Klin, Be'er Sheva).

SVEN REICHARD, Dresden International University

[Thursday May 27, 16:00]

On Jordan Schemes II

Jordan schemes as introduced by Cameron are non-associative generalizations of commutative association schemes. Such a scheme is proper if it is not the symmetrization of an association scheme.

Inspired by the discovery of the first proper Jordan schemes, and based on work by Hanaki and Miyamoto, an algorithmic search for small proper Jordan schemes was initiated. It relies on orderly generation and dynamic bounds on structure constants. Work is in progress.

It was confirmed that the smallest such scheme has 15 points. Further new objects on 16 and 18 points were found. Computer-free descriptions of these objects are being elaborated.

ALYSSA SANKEY, University of New Brunswick

[Thursday May 27, 16:30]

Strongly regular designs admitting fusion to strongly regular decomposition

A strongly regular decomposition of a strongly regular graph is a partition of the vertex set into two parts on which the induced subgraphs are strongly regular. Strongly regular designs are coherent configurations of rank 10 with two fibers in which the configuration on each fiber is a strongly regular graph. Haemers and Higman proved the equivalence between strongly regular decompositions, excluding special cases, and strongly regular designs with certain parameter conditions. In this talk we examine the SRDs that admit a fusion to SRG, and discuss parameter conditions, known families and (non)existence results.

Back to Table of Contents

JASON WILLIFORD, University of Wyoming

[Thursday May 27, 17:00]

Coherent Configurations and Extremal Graph Theory

In this talk, we will discuss some of the ways that the theory of coherent configurations can contribute to extremal graph theory, specifically to so-called degenerate Turàn-type problems on graphs. These are problems where, given a number of vertices n and a bipartite graph B, one tries to maximize the number of edges of a graph with n vertices with no copy of B as a subgraph. Constructing such graphs is very difficult, we will discuss how coherent configurations are a natural tool to use in this search.

Org: Iain Beaton (Dalhousie University) and **Ben Cameron** (University of Guelph)

For a variety of combinatorial problems, such as network reliability and graph colourings, the models turn out to be graph polynomials. On the other hand, the investigation of various subgraph properties leads one to explore the associated combinatorial sequences by formulating generating polynomials. In all cases, polynomials carry useful information about the underlying combinatorics, and one can draw on classical areas of mathematics, such as analysis and algebra, in the investigations. Combinatorial properties such as unimodality and log-concavity of various graphical sequences can surprisingly be extracted from the location of the roots of such polynomials. In this two part minisymposium, we aim to draw on the research of people working on a variety of graph polynomials to share techniques and methods to help advance the study of each polynomial.

Abstracts

FERENC BENCS, Alfréd Rényi Institute of Mathematics

[Thursday May 27, 15:30]

Zero-free regions for some graph polynomials.

In this talk, I will show regions that contain no zeros in the complex plane for some graph polynomials. The edge cover polynomial of a graph G is the generating function of edges, that covers $V(G)$. It is known that the zeros of this polynomial have length at most $\frac{(2+\sqrt{3})^2}{1+\sqrt{3}}$, that we strengthen by showing that it is at most 4. We use the general subgraph counting polynomial of Wagner to establish this result along with its generalization for hypergraphs, and to obtain further results for another graph polynomial. Joint work with Péter Csikvári and Guus Regts.

JASON BROWN, Dalhousie University

[Thursday May 27, 16:00]

Recent Results in Network Reliability

Network reliability is a probabilistic model of a graph's robustness to independent failures of either edges or vertices (or both); under a variety of scenarios, the functions turn out to be polynomials that encode important combinatorial information. In this talk we will survey some recent results, focusing particular attention on the roots of these polynomials.

BEN CAMERON, University of Guelph

[Thursday May 27, 16:30]

The largest real root of the independence polynomial of a unicyclic graph

The independence polynomial of a graph G, denoted $I(G,x)$, is the generating polynomial for the number of independent sets of each size. It is known that for every graph G, the root of $I(G,x)$ of smallest modulus, denoted $\xi(G)$, is real. Extending results due to Csikvári (2013) and answering an open question due to Oboudi (2018), we find the graphs that minimize/maximize $\xi(G)$ among all connected (well-covered) unicyclic graphs. Our methods involve showing a stronger result on a partial order on graphs induced by their independence polynomials evaluated at small negative values. This is joint work with Iain Beaton.

Back to Table of Contents

PÉTER CSIKVÁRI, Eötvös Loránd University

[Thursday May 27, 17:00]

Evaluations of Tutte polynomials of large girth regular graphs

In this talk we study Tutte polynomials of regular graphs. Let $T_G(x,y)$ be the Tutte polynomial of a graph G with $v(G)$ vertices. Let $(G_n)_n$ be a sequence of d-regular graphs with girth $g(G_n) \to \infty$. (Girth is the length of the shortest cycle.) We determine the limit

$$\lim_{n\to\infty} T_{G_n}(x,y)^{1/v(G_n)}$$

for $0 \le y \le 1$ and $x \ge 1$. In particular, we determine the limit value for the number of spanning forests (the value of $T_G(2,1)$) and for the number of acyclic orientations (the value of $T_G(2,0)$). Joint work with Ferenc Bencs.

STEPHAN WAGNER, Uppsala University

[Thursday May 27, 17:30]

Distribution of the coefficients of the subtree polynomial

A subtree of a graph is a (not necessarily induced) subgraph that is also a tree. Writing $s_k(G)$ for the number of k-vertex subtrees of a graph G, the subtree polynomial of G is the polynomial $S(G,x) = \sum_{k\ge 0} s_k(G)x^k$. In this talk, some recent results on the distribution of the coefficients and related questions regarding the subtree polynomial will be discussed. In particular, we consider the situation where G is a random graph or tree.

Back to Table of Contents

Org: Stephen Melczer (University of Waterloo)

The use of analytic methods to derive asymptotic behaviour of combinatorial sequences is a cornerstone of modern enumeration. This minisymposium aims to highlight new research directions in the area, including tools for multivariate generating functions, sequences with "exotic" asymptotic behaviour, generating function classes beyond the common D-finite framework, and an entropy approach to asymptotics; applications include topics in theoretical computer science, representation theory, and algebraic combinatorics. By combining both theory and practice, and focusing on current research, the session aims to strengthen old collaborations and foster new ones.

Abstracts

MICHAEL WALLNER, TU Wein

[Thursday May 27, 15:30]

Compacted binary trees and minimal automata admit stretched exponentials

A compacted binary tree is a directed acyclic graph encoding a binary tree in which common subtrees are factored and represented only once. We show that the number of such trees of size n is equal to

$$\Theta(n!\,4^n e^{3a_1 n^{1/3}} n^{3/4}),$$

where $a_1 \approx -2.338$ is the largest root of the Airy function. Our approach involves bijections to enrichted Dyck paths, two-parameter recurrences, induction, asymptotically tight bounds, and adapted Newton polygons. This method also allows to enumerate minimal DFAs recognizing a finite binary language. This is joint work with Andrew Elvey Price and Wenjie Fang.

VERONIKA PILLWEIN, RISC - Johannes Kepler University

[Thursday May 27, 16:00]

Algorithms beyond the holonomic universe

A function is called holonomic or D-finite, if it satisfies a linear differential equation with polynomial coefficients. It is well known that D-finite functions are closed under certain operations that can be implemented and used to automatically prove identities on D-finite functions. We introduced the notion of DD-finite functions that satisfy linear differential equations with D-finite function coefficients and showed that also this class satisfies several closure properties. This construction can be iterated, yielding D^n-finite functions. In this talk, we report on what is currently known about these extensions. This is joint work with Antonio Jiménez Pastor.

Back to Table of Contents

STEPHEN GILLEN, University of Pennsylvania

[Thursday May 27, 16:30]

Gillis-Reznick-Zeilberger's power series and the mysterious factor of 3

Analytic combinatorics in several variables (ACSV) is the study of approximating series coefficients of generating functions asymptotically using methods from topology and complex analysis. We examine two examples of generating functions with "lacunas", where the minimal singularity does not contribute asymptotically and lower critical points dominate. In one example, the coefficient asymptotics are exactly what would be expected from the smooth-point formula at the lower critical points, but in the other, they appear to be off by a factor of three. We aim to determine the source of the enigmatic factor of three.

GRETA PANOVA, University of Southern California

[Thursday May 27, 17:00]

Unimodality and Kronecker asymptotics via random variables

Cayley conjectured, and Sylvester proved some 25 years later, that the number of integer partitions of n inside a rectangle is a unimodal sequence of n. All subsequent proofs relied on representation theory, linear algebra and combinatorics without effective tight bounds for the size of these numbers. We derive tight asymptotics for these numbers and their consecutive differences using tilted geometric random variables. As a corollary, we have exact asymptotics for a family of Kronecker coefficients of the Symmetric group.

MARCUS MICHELEN, University of Illinois at Chicago

[Thursday May 27, 17:30]

Maximum entropy and integer partitions

We derive asymptotic formulas for the number of integer partitions with given sums of jth powers of the parts for j belonging to a finite, non-empty set $J \subset \mathbb{N}$. The method we use is based on the "principle of maximum entropy" of Jaynes. This principle leads to an intuitive variational formula for the asymptotics of the logarithm of the number of constrained partitions as the solution to a convex optimization problem over real-valued functions. Based on joint work with Gweneth McKinley and Will Perkins.

Org: Karoly Bezdek (University of Calgary, Canada) and **Oleg Musin** (The University of Texas Rio Grande Valley, USA)

Sphere packings have been studied from the birth of geometry. The minisymposium will focus on selected latest developments about densest packings of spheres and extremal properties of contact graphs of sphere packings. Particular emphases are given for estimating kissing numbers and contact numbers of congruent sphere packings in Euclidean as well as non-Euclidean spaces. The methods to be discussed use techniques from combinatorial geometry, convex geometry; geometry of numbers; Voronoi tilings; geometric rigidity; coding theory; linear programming as well as semidefinite programming. Together with the latest results we hope to discuss some open problems that appear to be within reach and have the potential to progress the interplay between analysis, geometry, and combinatorics. Part I will have 5 talks each being centered around kissing numbers. Part II will consist of 5 talks investigating densest sphere packings and contact graphs of sphere packings.

Abstracts

ROBERT CONNELLY, Cornell University, Ithaca, NY, USA

[Thursday May 27, 15:30]

Flipping and flowing

The well-known Koebe–Andreev–Thurston circle packing theorem states that for every planar graph G with n vertices, there is a corresponding packing of n disks in the plane, whose contact graph is isomorphic to G. Moreover, if G has all its faces triangles, then this packing is unique up to Möbius transformations and reflections. The idea is to take a given triangulated packing, move the whole packing removing one contact, while, at the end, creating another contact, keeping the whole collection a packing in between. This is an idea going back to László Fejes Tóth. (Joint work with Steven Gortler.)

THOMAS FERNIQUE, University of Paris 13, Paris, France

[Thursday May 27, 16:00]

Maximally dense sphere packings

It is well known that to cover the greatest proportion of the Euclidean plane with identical disks, we have to center these disks in a triangular grid. This problem can be generalized in two directions: in higher dimensions or with different sizes of disks. The first direction has been the most studied (for example, in dimension 3, the Kepler's conjecture was proved by Hales and Ferguson in 1998). In this talk, we will rather focus on the second direction, in particular on the cases of two or three disc sizes. We will survey recent results for a large audience.

PHILIPPE MOUSTROU, UiT – The Arctic University of Norway, Norway

[Thursday May 27, 16:30]

Coloring the Voronoi cell of a lattice

We define the chromatic number of a lattice as the least number of colors one needs to color the interiors of the cells of the Voronoi tessellation of a lattice so that no two cells sharing a facet receive the same color. In this talk we give a brief overview of the techniques that can be applied to obtain bounds on the chromatic number of a lattice, with a special focus on the connections with sphere packings. This is a joint work with Mathieu Dutour Sikirić, David Madore, and Frank Vallentin.

DUSTIN G. MIXON, The Ohio State University, Columbus, USA

[Thursday May 27, 17:00]

Uniquely optimal codes of low complexity are symmetric

Consider the problem of arranging a given number of points in a compact metric space so that the minimum distance is maximized. Strikingly, solutions to this coding problem often exhibit some degree of symmetry. In this talk, we introduce a large family of spaces in which optimality implies symmetry, and we pose various open problems. Joint work with Chris Cox, Emily King, and Hans Parshall.

KAROLY BEZDEK, University of Calgary, Canada

[Thursday May 27, 17:30]

Bounds for contact numbers of locally separable unit sphere packings

The contact number of a sphere packing is the number of touching pairs of balls in the packing. A packing of balls in Euclidean d-space is called totally separable if any two balls can be separated by a hyperplane such that it is disjoint from the interior of each ball in the packing. We call a packing of balls locally separable if each ball of the packing together with the balls that are tangent to it form a totally separable packing. We prove bounds for the contact numbers of locally separable packings of n unit balls in Euclidean d-space.

Abstracts

TOMÁŠ MADARAS, Pavol Jozef Šafárik University in Košice, Slovakia

[Thursday May 27, 15:30]

Facial homogeneous colourings of graphs

A proper vertex k-colouring of a plane graph G is called facial ℓ-homogeneous if every face of G sees precisely ℓ colours. The case $k = \ell$ corresponds to proper polychromatic colouring (the general version of which was introduced by Alon et al. in 2008). We present (rare) examples of plane graphs which are not facial homogeneously colourable at all, or require significantly more colours than chromatic number; in addition, we study various sufficient conditions (related to girth, face sizes or weak dual structure) for facial homogeneous colourability of plane graphs, its relation to other facial colourings, and the extension of this concept for embedded graphs.

SIMONA RINDOŠOVÁ, Pavol Jozef Šafárik University in Košice

[Thursday May 27, 16:00]

Unique maximum and minimum (double maximum) coloring of plane graphs

Unique maximum (UM) coloring of a plane graph is a coloring in which for each face the maximum color occurs exactly once on its elements (vertices/edges).

Two adjacent edges of a plane graph are *facially adjacent* if they are consecutive in a cyclic order around their common end vertex. A coloring is *proper* if adjacent vertices (facially adjacent edges) are colored differently.

Unique maximum and minimum (*double maximum*) coloring of a plane graph G is a proper UM coloring of G in which for each face there is by the lowest (second highest) color of that face colored exactly one element.

In this talk, we present upper bounds on the chromatic numbers for these four types of UM coloring. For unique maximum and minimum coloring we proved that each plane graph is 7-vertex-colorable and 7-edge-colorable and similarly for unique double maximum coloring that each plane graph is 10-vertex-colorable and 7-edge-colorable.

ALFRÉD ONDERKO, Pavol Jozef Šafárik University in Košice, Slovakia

[Thursday May 27, 16:30]

On M_f*-edge colorings of cacti*

Given a function f which assigns positive integers to vertices of a graph G, we define an M_f-edge coloring of G to be a coloring of edges of G which uses, for each vertex v, at most $f(v)$ colors on the set of edges incident to v. The problem is to maximize the total number of used colors. In 2016 Adamaszek and Popa proved that this problem is NP-hard. We focus on M_f-edge colorings of cacti, i.e., connected simple graphs in which every edge lies on at most one cycle. We show that in this case, an M_f-edge coloring with the maximum number of colors can be found in quadratic time with respect to the order of the cactus.

Back to Table of Contents

JIALU ZHU, Zhejiang Normal University

[Thursday May 27, 17:00]

Ohba type result on lambda choosability

For a multi-set $\lambda = \{k_1, k_2, \ldots, k_q\}$ of positive integers, let $k_\lambda = \sum_{i=1}^{q} k_i$. A λ-list assignment of G is a k_λ-list assignment L for which the colour set $\cup_{v \in V(G)} L(v)$ can be partitioned into the disjoint union $C_1 \cup C_2 \cup \ldots \cup C_q$ of q sets so that for each i and each vertex v of G, $|L(v) \cap C_i| \geq k_i$. G is λ-choosable if G is L-colourable for any λ-list assignment L of G. λ is trivial if λ consists of k_λ copies of 1. For any non-trivial λ, let $\phi(\lambda)$ be the minimum number of vertices in a non-λ-choosable k_λ-chromatic graph. Let 1_λ be the multiplicity of 1 in λ, and let o_λ be the number of elements in λ that are odd. We prove that for any non-trivial λ, $2k_\lambda + 1_\lambda + 2 \leqslant \phi(\lambda) \leqslant \min\{2k_\lambda + o_\lambda + 2, 2k_\lambda + 51_\lambda + 3\}$.

RONGXING XU, Zhejiang Normal University

[Thursday May 27, 17:30]

The strong fractional choice number of graphs

An *a-list assignment* of a graph G is a mapping L which assigns to each vertex v of G a set $L(v)$ of a colors. A *b-fold coloring* of G is a mapping ϕ which assigns to each vertex $v \in G$ a set $\phi(v)$ of b colors such that $\phi(u) \cap \phi(v) = \emptyset$ for every edge uv. An(L, b)-*coloring* of G is a b-fold coloring ϕ of G such that $\phi(v) \subseteq L(v)$ for each vertex v. G is (a, b)-*choosable* if for any a-list assignment L of G, there is an (L, b)-coloring of G. G is strongly fractional r-choosable if G is (a, b)-choosable for all positive integers a, b for which $a/b \geq r$. The strong fractional choice number of G is $ch_f^s(G) = \inf\{r : G \text{is strongly fractional } r\text{-choosable}\}$. In this talk, I will introduce some joint works with Xuding Zhu on this topic.

Abstracts

MICHAEL BARRUS, University of Rhode Island

[Thursday May 27, 15:30]

Unigraphs and hereditary graph classes

A unigraph is a graph that is the unique realization of its degree sequence up to isomorphism. Most graphs are not unigraphs, but the class of unigraphs contains several remarkable families of graphs, such as the threshold graphs, the matroidal graphs, and the matrogenic graphs.

Though each of these subclasses is hereditary, the class of unigraphs itself is not hereditary, though it "almost" is. We characterize the largest hereditary subclass and the minimal hereditary superclass of the unigraphs. We will see that like the classes of threshold, matroidal, and matrogenic graphs, these larger hereditary classes have several alternate characterizations in terms of forbidden subgraphs, structural decompositions, and degree sequence conditions.

FERNANDO ESTEBAN CONTRERAS-MENDOZA, Universidad Nacional Autónoma de México

[Thursday May 27, 16:00]

Forbidden subgraph characterization for (∞, k)-polar cographs

A graph without induced paths of length four is called a cograph. An (s, k)-polar partition of a graph is a partition (A, B) of its vertex set such that A induces a complete multipartite graph with at most s parts, and B induces the disjoint union of at most k complete graphs. A graph is said to be (s, k)-polar if it admits an (s, k)-polar partition; (s, ∞)- and (∞, k)-polar graphs can be analogously defined.

In this talk, we will focus on the problem of characterizing the (∞, k)-polar cographs (for a fixed k) by means of a finite family of forbidden subgraphs. We will show a partial recursive construction for such obstructions, and we will give complete lists of them for the cases $k = 2$ and $k = 3$.

TERRY MCKEE, Wright State University, Dayton Ohio

[Thursday May 27, 16:30]

Graphs in which every cycle has a 'major chord'

Define a graph to be *majorly chordal* if every cycle of length $k \geq 4$ has a *major chord*, meaning a $\lfloor \frac{k}{2} \rfloor$-chord of the k-cycle. Majorly chordal graphs are always chordal, but this newly-named graph class is incomparable with the long-studied class of strongly chordal graphs. In spite of that discord, I'll show a certain harmony between these two notions, along with a forbidden induced subgraph characterization of the majorly chordal graphs.

ELHAM ROSHANBIN, Alzahra University

[Thursday May 27, 17:00]

Burning number of some families of graphs

Graph burning is a graph process that is defined on the vertex set of a simple finite graph G (It in fact can be seen as a model for the spread of any sort of influence among the members of a social network that are now represented by the vertices of G). The burning number of G is the minimum number of steps that is needed in a graph burning process for G, and is denoted by $b(G)$. In this talk, we consider the graph burning problem for caterpillars and the asymptotic value of the burning number for the caterpillars in a random space. We also consider the burning number of n-dimensional hypercubes and show that a conjecture on the burning number of n-cubes indeed had been proved many years ago in a paper by Noga Alon. This is joint work with Yong Gao and Pawel Pralat.

MILOŠ STOJAKOVIĆ, University of Novi Sad

[Thursday May 27, 17:30]

Structural properties of bichromatic non-crossing matchings

Given a set of n red and n blue points in the plane, we are interested in matching red points with blue points by straight line segments so that the segments do not cross. We develop a range of tools for dealing with the non-crossing matchings of points in convex position. It turns out that the points naturally partition into groups that we refer to as orbits, with a number of properties that prove useful for studying and efficiently processing the non-crossing matchings.

Bottleneck matching is such a matching that minimizes the length of the longest segment. Illustrating the use of the developed tools, we show how to solve the problem of finding bottleneck matchings of points in convex position faster than before.

Joint work with Marko Savić.

Back to Table of Contents

Abstract

GIL KALAI, Einstein Institute of Mathematics, Hebrew University

[Friday May 28, 10:00]

The beautiful combinatorics of convex polytopes

Convex polytopes attracted human attention since ancient times. Euler's formula, $\mathbf{V}-\mathbf{E}+\mathbf{F}=\mathbf{2}$, for the numbers of vertices $\mathbf{V}$, edges $\mathbf{E}$, and faces $\mathbf{F}$ of a spacial polytope, is among the most important landmarks of mathematics, and it is a starting point for a rich theory of face numbers of polytopes in high dimensions. In the lecture I will present some major combinatorial results about polytopes, some connections to other areas of mathematics, pure and applied, a few mysterious phenomena, and some fascinating open problems.

Back to Table of Contents

Org: Tom Trotter (Georgia Institute of Technology)

Abstracts

TORSTEN UECKERDT, Karlsruhe Institute of Technology

[Friday May 28, 11:20]

The queue number of posets

The queue number of a poset is the minimum k such that there exists a linear extension for which no $k+1$ cover relations $a_i b_i$ appear as $a_1 < \cdots < a_{k+1} < b_{k+1} < \cdots < b_1$ in the linear extension. In 1997, Heath and Pemmaraju conjectured that the queue number of a poset is at most its width. This was recently disproven by a construction of posets of width w and queue number $w+1$. We construct posets of width w and queue number $\Omega(w^2)$, and discuss several related results and research directions.

ŁUKASZ BOŻYK, University of Warsaw

[Friday May 28, 11:50]

Vertex deletion into bipartite permutation graphs

A bipartite permutation graph is a comparability graph of a height-2 2-dimensional poset. We study the parameterized complexity of the bipartite permutation vertex deletion problem, which asks, for a given n-vertex graph, whether we can remove at most k vertices to obtain a bipartite permutation graph. We analyze the structure of the so-called almost bipartite permutation graphs which may contain large induced cycles and exploit the structural properties of the shortest hole in such graphs. We use it to obtain an algorithm with running time $O(9^k \cdot n^9)$.

Joint work with Jan Derbisz, Tomasz Krawczyk, Jana Novotná, and Karolina Okrasa.

MICHAŁ SEWERYN, Jagellonian University

[Friday May 28, 12:20]

Dimension of posets with k-outerplanar cover graphs.

A k-outerplanar graph is a planar graph which admits an embedding on the plane such that after a k-fold removal of vertices from the exterior face, no vertices of the graph are left. We show that posets with k-outerplanar cover graphs have dimension $O(k^3)$. As a consequence, we show that posets of height h with planar cover graphs have dimension $O(h^3)$. This improves the best currently known $O(h^6)$ bound by Kozik, Micek and Trotter. This is joint work with Maximilian Gorsky.

Back to Table of Contents

MARCIN WITKOWSKI, Adam Mickiewicz University

[Friday May 28, 12:50]

Adjacency posets of outerplanar graphs

Felsner, Li and Trotter [1] showed that the dimension of the adjacency poset of an outerplanar graph is at most 5, and gave an example of an outerplanar graph whose adjacency poset has dimension 4. In the talk, we present proof that adjacency posets of outerplanar graphs have dimension at most 4.

[1] S.Felsner, Ch.M.Li, W.T.Trotter, ”Adjacency Posets of Planar Graphs”, Discrete Mathematics, Volume 310, (2010), pp 1097-1104

[2] M. Witkowski, "Adjacency posets of outerplanar graphs", Discrete Mathematics, Volume 344, (2021), pp 112338

Back to Table of Contents

Org: Thomas Dreyfus (CNRS, Université de Strasbourg) and **Andrew Elvey Price** (CNRS, Université de Tours)

Abstracts

IRÈNE MARKOVICI, Université de Lorraine

[Friday May 28, 11:20]

Bijections between walks inside a triangular domain and Motzkin paths of bounded amplitude

I will present some connections between two families of walks. The first family is formed by two-dimensional walks moving in three directions, and confined within a triangle. The other family consists of Motzkin paths with bounded height, in which the horizontal steps may be forbidden at maximal height. After showing a symmetry property for the triangular paths, I will describe different bijections between these two families of walks, answering an open question of Mortimer and Prellberg.

This is a joint work with Julien Courtiel and Andrew Elvey Price.

ALIN BOSTAN, INRIA Saclay Île-de-France

[Friday May 28, 11:50]

On the D-transcendence of generating functions for singular walks in the quarter plane

In their recent article “Walks in the quarter plane: Genus zero case”, Thomas Dreyfus, Charlotte Hardouin, Julien Roques and Michael F. Singer used Galois theory of difference equations to study the nature of the generating function $Q(x,y,t)$ of walks in the quarter plane for the so-called "singular models", i.e., with kernel curve of genus zero. They proved that for transcendental values of t, the generating function is differentially transcendental both in x and in y. I will discuss the situation when one also looks at algebraic values of t. This is joint work with Lucia Di Vizio and Kilian Raschel.

MANUEL KAUERS, Johannes Kepler Universität

[Friday May 28, 12:20]

Quadrant Walks Starting Outside the Quadrant

We investigate a functional equation which resembles the functional equation for the generating function of a quarter plane lattice walk model. It has the interesting feature that its orbit sum is zero while its solution is not algebraic. The solution can be interpreted as the generating function of lattice walks in $\mathbb{Z}^2$ starting at $(-1,-1)$ and subject to the restriction that the coordinate axes can be crossed only in one direction. We also consider certain variants of the equation, all of which seem to have transcendental solutions. This is joint work with Manfred Buchacher and Amélie Trotignon.

MARNI MISHNA, Simon Fraser University

[Friday May 28, 12:50]

Lattice Walk Classification: algebraic, analytic, and geometric perspectives

This talk will examine the rich topic of lattice path enumeration. Recent attention on classifiction has brought together techniques from many mathematical sub-disciplines. In this talk, we will see how lattice walks arise in algebraic combinatorics, and illustrate the results of enumerative techniques that use analysis and geometry. One goal of this talk is to clarify the connection between algebraic sources of lattice walks and certain classes of generating functions, especially D-finite. A second outcome is a geometric understanding of the asymptotic enumeration formulas for weighted models.

Org: Yixin Cao (Hong Kong Polytechnic University) and **Derek G. Corneil** (University of Toronto)

Interval graphs are intersection graphs of intervals on the real line. For their natural applications (e.g., representation of temporal objects) and nice mathematical properties, interval graphs have been among the most studied in algorithmic graph theory. The study of these families have brought forth new techniques as well as new structures. Their popularity also benefits from many interesting kins, e.g., circular-arc graphs, interval bigraphs, and circular-ones matrices, not to mention chordal graphs, AT-free graphs and many subclasses. On the one hand, even the recognition of interval graphs, for which a linear-time algorithm has been presented nearly 50 years ago, is still under intensive investigation. On the other hand, there are recently a lot of exciting new results on problems formulated on these families. We plan to bring together experts in graph theory and in algorithms to explore the properties and algorithms of these families.

Abstracts

DEREK G. CORNEIL, University of Toronto

[Friday May 28, 11:20]

Early days of interval graph algorithms

This talk presents a low teck, personal voyage into interval graphs and related graph families. The talk starts with needed definitions of various graph families and early interval graph recognition algorithms leading to a discussion of the Lekkerkerker Boland Theorem and Asteroidal Triple-free graphs. The voyage continues into the role played by graph searches, most notably LexBFS. Along the way, we encounter surprising observations, false steps and shifting perspectives.

AKANKSHA AGRAWAL, Indian Institute of Technology Madras

[Friday May 28, 11:50]

Polynomial Kernel for Interval Vertex Deletion

Given a graph G and an integer k, Interval Vertex Deletion (IVD) asks whether there exists $S \subseteq V(G)$ of size at most k, such that $G \breve{\ } S$ is an interval graph. The existence of polynomial kernel for IVD remained a well-known open problem in Parameterized Complexity. In this talk we will look at a sketch of polynomial kernel for IVD. We will mainly focus on a kernel for IVD, when parameterized by the vertex cover number. The ideas that will be presented are (some of the) key ingredients in our kernel for IVD, when parameterized by the solution size.

GUILLAUME DUCOFFE, University of Bucharest, Romania

[Friday May 28, 12:20]

Faster computation of graph diameter by using one (or two) properties of the interval graphs

For communication networks, and many others, important characteristics such as maximum communication delays, and centralities of nodes, can be derived from the computation of classic graph parameters, such as diameter, radius, average distance and median. One can solve all these problems in linear time on interval graphs, but which of these properties of this graph class are the true reason? We will review whether similar computational results can be achieved by relaxing the definition of interval graphs and/or keeping only a few of their nice properties (say, Helly property of the balls, chordality, AT-freeness, bounded VC-dimension, etc.).

FRANCISCO SOULIGNAC, University of Buenos Aires

[Friday May 28, 12:50]

Representation problems for unit interval and unit circular-arc graphs

The last decade saw an increasing research on numerical representation problems for unit circular-arc models (UCA) and related classes. In these problems we are given a proper circular-arc model $\mathcal{M}$ and we have to find a UCA model $\mathcal{U}$, related to $\mathcal{M}$, that satisfies certain numerical constraints. In the classical representation problem, for instance, we are given a proper circular-arc model and we have to find an equivalent unit circular-arc model whose extremes are all integer and have a polynomial size. In this talk I present a common framework to efficiently solve different numerical representation problems for UCA models.

FLAVIA BONOMO, University of Buenos Aires

[Friday May 28, 13:20]

Algorithms for k-thin and proper k-thin graphs

The (proper) thinness of a graph is a with parameter generalizing (proper) interval graphs, which are exactly the (proper) 1-thin graphs. A wide family of problems (including list matrix partition with bounded size matrix) can be polynomially solved for graphs with bounded thinness, and it can be enlarged in the proper case. We will survey these results, along with some structural characterizations and algorithmic problems related to recognition, which is open. We will also describe the behavior of both parameters under some graph operations, and relate them to other graph invariants in the literature.

Org: Carolina Benedetti (Universidad de los Andes), **Christopher Hanusa** (Queens College of the City University of New York), **Pamela E. Harris** (Williams College) and **Alejandro Morales** (UMass, Amherst)

Flow polytopes of graphs are an important family of polytopes with connections to algebraic combinatorics, representation theory and optimization. There has been recent progress and connections of this class of polytopes with diagonal harmonics, Schubert polynomials, generalized permutahedra and Lorentzian polynomials. This minisymposium will bring together established and young researchers with closely related interests to share the latest results and open problems.

Abstracts

JIHYEUG JANG, Sungkyunkwan University

[Friday May 28, 11:20]

Volumes of flow polytopes related to the caracol graphs

Recently, Benedetti et al. introduced an Ehrhart-like polynomial associated to a graph. This polynomial is defined as the volume of a certain flow polytope related to a graph and has the property that the leading coefficient is the volume of the flow polytope of the original graph with net flow vector $(1, 1, \ldots, 1)$.

Benedetti et al. conjectured a formula for the Ehrhart-like polynomial of what they call a caracol graph. In this talk we prove their conjecture using constant term identities, labeled Dyck paths, and a cyclic lemma.

KAROLA MÉSZÁROS, Cornell University

[Friday May 28, 11:50]

Flow polytopes in combinatorics and algebra

The flow polytope $\mathcal{F}_G(\mathbf{v})$ is associated to a graph G on the vertex set $\{1, \ldots, n\}$ with edges directed from smaller to larger vertices and a netflow vector $\mathbf{v} = (v_1, \ldots, v_n) \in \mathbb{Z}^n$. Postnikov and Stanley established a remarkable connection of flow polytopes and Kostant partition functions two decades ago, developed further by Baldoni and Vergne. Since then, flow polytopes have been discovered in the context of Schubert and Grothendieck polynomials and the space of diagonal harmonics, among others. This talk will survey a selection of results about the ubiquitous flow polytopes.

AVERY ST. DIZIER, University of Illinois, Urbana-Champaign

[Friday May 28, 12:20]

Flow Polytopes and Grothendieck polynomials

I will first describe a process for subdividing certain flow polytopes into simplices, due to Meszaros. Then, I will explain a connection between a polynomial invariant of the resulting simplices and a family of Grothendieck polynomials.

Back to Table of Contents

EMILY BARNARD, DePaul University

[Friday May 28, 12:50]

Pairwise Completability for 2-Simple Minded Collections

Let Λ be a basic, finite dimensional algebra over an arbitrary field, and let $\mathrm{mod}(\Lambda)$ be the category of finitely generated right modules over Lambda. A 2-term simple minded collection is a special set of modules that generate the bounded derived category for $\mathrm{mod}(\Lambda)$. In this talk we describe how 2-term simple minded collections are related to certain simplicial fans, and we show how to model 2-term simple minded collections for the preprojective algebra of type A.

MARTHA YIP, University of Kentucky

[Friday May 28, 13:20]

A unifying framework for the ν-Tamari lattice and principal order ideals in Young's lattice

We present a unifying framework in which the ν-Tamari lattice, introduced by Préville-Ratelle and Viennot, and principal order ideals in Young's lattice indexed by lattice paths ν, are realized as the dual graphs of two triangulations of a family of flow polytopes. The first triangulation gives a new geometric realization of the ν-Tamari complex introduced by Ceballos, Padrol and Sarmiento. The second triangulation shows that the h^*-vector of this family of flow polytopes is given by the ν-Narayana numbers, extending a result of Mészáros. This is joint work with von Bell, González D'León, and Mayorga Cetina.

Org: Rick Brewster (Thompson Rivers University) and **Benjamin Moore** (University of Waterloo)

The study of colouring has deep roots in graph theory and remains a source of many interesting problems. In this collection of diverse speakers and talks, we visit both topological and algebraic questions. Two talks reach back to the 4 Colour Theorem with results on local choosability of planar graphs, and Grunbaum colourings. The other talks examine more algebraic questions. Two talks focus on homomorphisms, namely a density bound for triangle free 4-critical graphs and the circular chromatic number of signed graphs. While the remaining talk connects to automorphisms, namely, the distinguishing number of graphs.

Abstracts

DEBRA BOUTIN, Hamilton College

[Friday May 28, 11:20]

Distinguishing Cube Families

A coloring of a graph with colors from $\{1, 2, \ldots, d\}$ is said to be d-distinguishing if no nontrivial automorphism preserves the color classes. The distinguishing number of a graph is the smallest d for which it has a d-distinguishing coloring. If a graph G can be distinguished with 2 colors, we measure the *cost* of distinguishing to be the minimum number of vertices that need to be colored say red over all 2-distinguishing colorings. In this talk, we'll go over definitions and a few examples before looking at distinguishing hypercubes, augmented cubes, and powers of cubes.

ZHOUNINGXIN WANG, IRIF, Universite de Paris

[Friday May 28, 11:50]

Circular chromatic number of signed graphs

A circular r-coloring of a signed graph (G, σ) is an assignment φ of points of a circle of circumference r to vertices of G such that for positive edge uv, $\varphi(u)$ and $\varphi(v)$ have distance at least 1, and for negative edge uv, $\varphi(v)$ and the antipodal of $\varphi(u)$ have distance at least 1. The circular chromatic number of (G, σ) is $\chi_c(G, \sigma) = \inf\{r \mid (G, \sigma)$ admits a circular r-coloring$\}$. We bound the circular chromatic number of several classes: signed k-chromatic graphs, signed d-degenerate graphs and signed planar graphs. This is joint work with Reza Naserasr and Xuding Zhu.

ARNOTT KIDNER, University of Victoria

[Friday May 28, 12:20]

Switchable 2-Colouring is Polynomial

Let G be a (m, n)-mixed graph, Γ be a permutation group acting on the colours of G, and $\pi \in \Gamma$ be a permutation. We define *switching a vertex* v with respect to π as applying π on the colour of each edge incident to v and on the colour and direction of each arc incident to v.

Given an (m, n)-mixed graph G, we study of the question "Is there a sequence of switchings so that the resulting (m, n)-mixed graph admits a homomorphism to a 2-vertex target?"

We show that this problem is polynomial for all Γ.

Back to Table of Contents

EVELYNE SMITH-ROBERGE, University of Waterloo

[Friday May 28, 12:50]

Local choosability of planar graphs

In 1994, Thomassen famously proved that every planar graph is 5-choosable. Later, he proved that every planar graph of girth at least five is 3-choosable. In this talk, I will introduce the concept of a local girth list assignment: a list assignment wherein the list size of each vertex depends not on the girth of the graph, but only on the length of the shortest cycle in which the vertex itself is contained. I will present a local choosability theorem for planar graphs, unifying the two theorems of Thomassen mentioned above. (Joint work with Luke Postle.)

BENJAMIN MOORE, University of Waterloo

[Friday May 28, 13:20]

A density bound for triangle free 4-critical graphs

I'll prove that every triangle free 4-critical graph satisfies $e(G) \geq \frac{5v(G)+2}{3}$.
This is joint work with Evelyne Smith Roberge.

Back to Table of Contents

Org: Karen Gunderson (University of Manitoba), **Karen Meagher** (University of Regina) and **Joy Morris** (University of Lethbridge)

In algebraic graph theory, combinatorial matrix theory, infection processes on graphs, and extremal combinatorics, the best modern results are often found using an interdisciplinary approach, leveraging tools and techniques from these other fields. The tools developed in solving these types of problems are often strong and transferable. Algebraic techniques, a deeper understanding of graph symmetries, probabilistic techniques and structural extremal results show a great promise to develop a deep and general theory that encompasses many graph and hypergraph classes all at once.
This minisymposium will be highlighting recent results in these areas that connect to the planned research topics and projects for the PIMS-funded CRG “Movement and symmetry in graphs”.

Abstracts

EDWARD DOBSON, University of Primorska

[Friday May 28, 11:20]

Recognizing vertex-transitive digraphs which are wreath products and double coset digraphs

We show that a Cayley digraph of a group G with connection set S is isomorphic to a nontrivial wreath product of digraphs if and only if there is a proper nontrivial subgroup $H \leq G$ such that $S \setminus H$ is a union of double cosets of H in G. We then give applications of this result which include showing the problem of determining automorphism groups of vertex-transitive digraphs is equivalent to the problem of determining automorphism groups of Cayley digraphs.

VENKATA RAGHU TEJ PANTANGI, Southern University of Science and Technology

[Friday May 28, 11:50]

Intersecting sets in Permutation groups.

An intersecting set in a transitive permutation group $G \leq Sym(\Omega)$ is a subset $\mathcal{F} \subset G$ such that given $g, h \in \mathcal{F}$, there exists $\omega \in \Omega$ with $\omega^g = \omega^h$. Cosets of point stabilizers are natural examples of intersecting sets. In view of the classical Erdos-Ko-Rado theorem, it is of interest to find the size of the largest intersecting set. A group is said to satisfy the EKR property if $|\mathcal{F}| \leq |G_\omega|$, for every intersecting set $\mathcal{F}$. It is known that 2-transitive groups satisfy the EKR property. We will show that general permutation groups are “quite far” from satisfying the EKR property.

JASON SEMERARO, University of Leicester

[Friday May 28, 12:20]

Higher tournaments, hypergraphs, automorphisms and extremal results

In 2017, Karen Gunderson and I use switching classes of tournaments to provide constructions of r-hypergraphs with the maximum number of hyperedges, subject to the condition that every set of $r + 1$ vertices spans at most 2 hyperedges. Here we assume $r \geq 3$. A d-tournament is a set together with an inductively defined orientation on each of its d-sets. Generalising results of Babai–Cameron, we show that 3-tournaments admit a switching operation and use our results to obtain some new lower bounds for extremal numbers.

Back to Table of Contents

MAHSA NASROLLAHI, University of Regina

[Friday May 28, 12:50]

On a generalization of the Erdos-Ko-Rado theorem to intersecting and set-wise intersecting perfect matchings

A perfect matching ($\mathcal{PM}$) in the complete graph K_{2k} is a set of edges in which every vertex is covered exactly once. Two $\mathcal{PM}$s are t-intersecting if they have at least t edges in common. Two $\mathcal{PM}$s P and Q of a graph on $2k$ vertices are said to be set-wise t-intersecting if there exist edges $P_1, \ldots, P_t$ in P and $Q_1, \ldots, Q_t$ in Q whose unions of edges have the same set of vertices. In this talk we show an extension of the famous Erdős-Ko-Rado theorem to intersecting and set-wise intersecting $\mathcal{PM}$ for $t = 2$ and $t = 3$.

GABRIEL VERRET, University of Auckland

[Friday May 28, 13:20]

Regular Cayley maps and skew morphisms of monolithic groups

Skew morphisms, which generalise automorphisms for groups, provide a fundamental tool for the study of regular Cayley maps and, more generally, for finite groups with a complementary factorisation $G = BY$, where Y is cyclic and core-free in G. We will explain the connection between these topics and discuss some recent results on the case when B is a monolithic group.

Org: Thaís Bardini Idalino (Universidade Federal de Santa Catarina, Brazil), **Jonathan Jedwab** (Simon Fraser University) and **Shuxing Li** (Simon Fraser University)

Practical questions about how to design experiments were the historical inspiration for the rich and beautiful study of modern design theory, which has deep connections to coding theory, finite geometry, graph theory, and other branches of combinatorics. This minisymposium showcases the fruitful interplay between theory and application, by exploring some of the diverse ways in which design theory continues to be used in practical applications.

Abstracts

YASMEEN AKHTAR, IISER Pune, India

[Friday May 28, 11:20]

Level-wise Screening via Locating Arrays

A (d,t)-locating array (LA) is a covering array of strength t with the property that any set of d number of t-tuples can be distinguished from any other such set by appearing in a distinct set of rows. The number of rows in LA grows logarithmically in the number of columns, making it a cost-efficient design. We propose a screening method based on LA to identify important factors that significantly impact the response and validate our method on well-studied data sets.

This talk is based on joint work with F. Zhang, C.J. Colbourn, J. Stufken, and V.R. Syrotiuk.

LUCIA MOURA, University of Ottawa

[Friday May 28, 11:50]

Variable-strength arrays and applications

In this talk, we discuss variable-strength versions of covering arrays, orthogonal arrays and cover-free families. Applications include software testing, secret sharing and modification-tolerant digital signatures.

MAURA PATERSON, Birkbeck, University of London

[Friday May 28, 12:20]

Authentication codes with perfect secrecy and algebraic manipulation detection codes

The construction and analysis of authentication codes for providing authentication in an unconditionally secure setting is a long-standing practical application of design theory. Algebraic manipulation detection (AMD) codes were introduced by Cramer et al. in EUROCRYPT 2008 in order to apply ideas used in the construction of robust secret sharing schemes to more general cryptographic systems. In this talk we examine automorphism groups of authentication codes and show that AMD codes can be viewed as a special case of splitting authentication codes with perfect secrecy.

This talk is based on joint work with Doug Stinson.

Back to Table of Contents

BRETT STEVENS, Carleton University

[Friday May 28, 12:50]

Single change covering designs

A single change covering design (SCCD) is an ordered list of blocks with the property that every pair of consecutive blocks differ by the removal and introduction of one point. They were independently proposed twice as the solution to minimizing costs of testing and of algorithm implementations. We will discuss two applications and survey construction techniques.

DOUG STINSON, University of Waterloo

[Friday May 28, 13:20]

On equitably ordered splitting BIBDs

A splitting BIBD is a combinatorial design that can be used to construct splitting authentication codes with good properties. If a splitting BIBD can be equitably ordered, then the associated authentication code also provides perfect secrecy.

For various pairs $(k; c)$, we determine necessary and almost sufficient conditions for the existence of $(v; k \times c; 1)$-splitting BIBDs that can be equitably ordered. Our results cover the pairs $(k; c) = (3; 2)$; $(4; 2)$; $(3; 3)$ and $(3; 4)$, as well as all cases with $k = 2$.

This talk is based on joint work with Maura Paterson.

Back to Table of Contents

Org: Sebastian Cioaba (University of Delaware) and **Michael Tait** (Villanova University)

Spectral methods have become ubiquitous in graph theory for several reasons including efficiently giving bounds on hard to compute graph parameters (e.g. the Hoffman-ratio bound), quantifying edge distribution and pseudo-randomness (e.g. the expander-mixing lemma and Cheeger-type inequalities), and giving well-performing graph algorithms (e.g. spectral partitioning and max-cut approximations). We propose a minisymposiumon "Spectral graph theory" focused on recent developments in the field. We propose a 2 part minisymposium with the following confirmed speakers:
Aida Abiad, Krystal Guo, Ferdinand Ihringer, Jephian Lin, Nathan Lindzey, Theo McKenzie, Siddanth Mohanty, Sjanne Zeijlemaker

Abstracts

SJANNE ZEIJLEMAKER, Eindhoven University of Technology

[Friday May 28, 11:20]

Optimization of eigenvalue bounds for the independence and chromatic number of graph powers

The kth power of a graph G is the graph in which two vertices are adjacent if their distance is at most k. This talk presents eigenvalue bounds for the independence and chromatic number of G^k which purely depend on the spectrum of G, together with a method to optimize them. Some new bounds for the k-independence number also work for its quantum counterpart, which is not known to be computable in general. Infinite graph families for which the bounds are sharp are presented as well. This is joint work with A. Abiad, G. Coutinho, M.A. Fiol and B.D. Nogueira.

NATHAN LINDZEY, University of Colorado, Boulder

[Friday May 28, 11:50]

Some Recent Applications of Association Schemes

Association schemes are families of regular graphs that possess remarkable spectral properties. Born from design and coding theory, their impact on this area has been profound, but in recent years they have also found utility beyond their raison d'être. In this talk, we give a brief overview of such recent applications of association schemes to other areas of discrete mathematics. In particular, we survey a few recent results in extremal combinatorics and theoretical computer science that have been obtained through the theory of association schemes, with an emphasis on the latter.

SIDHANTH MOHANTY, University of California, Berkeley

[Friday May 28, 12:20]

On the relationship between spectra, girth and vertex expansion in regular graphs

1. For every $d = p + 1$, prime p and infinitely many n, we exhibit an n-vertex d-regular graph with girth $\Omega(\log_{d-1} n)$ and vertex expansion of sublinear sized sets bounded by $(d + 1)/2$ whose nontrivial eigenvalues are bounded in magnitude by $2\sqrt{d-1} + O(1/\log n)$.

2. In any near-Ramanujan graph with girth $C \log n$, sets of size bounded by $n^{0.99C/4}$ have near-lossless vertex expansion $(1 - o_d(1))d$.

Our tools include the nonbacktracking operator of an infinite graph, the Ihara-Bass formula, a Bordenave inspired trace moment method, and a method of Kahale to study dispersion of eigenvalues of perturbed graphs.

Joint with Theo McKenzie (https://arxiv.org/abs/2007.13630).

Back to Table of Contents

THEO MCKENZIE, University of California, Berkeley

[Friday May 28, 12:50]

Support of Closed Walks and Second Eigenvalue Multiplicity of Graphs

In this talk, we bound the multiplicity of the second eigenvalue of the normalized adjacency matrix, assuming the graph is connected. The main ingredient is a lower bound on the typical support of a random walk that is conditioned to be "closed" (namely, the walk ends where it starts). This, in turn, is shown by proving that the spectral radius of principal submatrices of the normalized adjacency matrix must satisfy certain bounds. Throughout the talk, we also give examples showing the tightness of our results.

This is joint work with Peter Rasmussen and Nikhil Srivastava

Abstracts

ANDRIY PRYMAK, University of Manitoba

[Friday May 28, 11:20]

Spherical coverings and X-raying convex bodies of constant width

We give constructions of certain spherical coverings in small dimensions. K. Bezdek and Gy. Kiss showed that existence of origin-symmetric coverings of unit sphere in $\mathbb{E}^n$ by at most 2^n congruent spherical caps with radius not exceeding $\arccos\sqrt{\frac{n-1}{2n}}$ implies the X-ray conjecture and the illumination conjecture for convex bodies of constant width in $\mathbb{E}^n$, and constructed such coverings for $4 \le n \le 6$. We give such constructions with fewer than 2^n caps for dimensions $5 \le n \le 15$. In combination with the known result for higher dimensions due to O. Schramm, this completely settles the above mentioned conjectures for convex bodies of constant width in all dimensions. We also show how to calculate the covering radius of a given discrete point set on the sphere efficiently on a computer.

This is a joint work with A. Bondarenko and D. Radchenko.

MÁRIA MACEKOVÁ, P.J. Šafárik University in Košice, Slovakia

[Friday May 28, 11:50]

Scarce and frequent cycles in polyhedral graphs

Let $\mathcal{G}$ be a class of graphs. Given a positive integer $n \ge 3$, an n-vertex graph H is called *frequent* in a graph family $\mathcal{G}$ if there exists a real function f such that each graph of $\mathcal{G}$ with at least $f(n)$ vertices contains a subgraph isomorphic to H. If H is not frequent in $\mathcal{G}$, then it is called *scarce* in $\mathcal{G}$; this means that there exists an infinite sequence $\{G_i\}_{i=1}^{\infty}$ of graphs from $\mathcal{G}$ such that no G_i contains an isomorphic copy of H.

In the talk we present some results on the frequent and scarce cycles in the family of polyhedral graphs and its particular subfamilies.

VENKITESH S., Indian Institute of Technology Bombay

[Friday May 28, 12:20]

Covering Symmetric Subsets of the Cube by Affine Hyperplanes

Alon and Füredi (1993) proved that any family of hyperplanes covering the Boolean hypercube $\{0, 1\}^n$, except the origin, must contain at least n hyperplanes. We will obtain two extensions of this result to hyperplane covers of symmetric subsets of the hypercube (subsets that are closed under permutations of coordinates).

To prove our results, we introduce *hyperplane closures*, a family of closure operators defined using hyperplane covers, for subsets of the hypercube. We will give a combinatorial characterization of the hyperplane closures of symmetric subsets, which enables us to compute these efficiently, via a greedy algorithm.

This characterization may also be of independent interest; indeed, we consider two other applications. Firstly, we obtain an easy proof of a lemma by Alon et al. (1988). Secondly, we characterize the symmetric hitting sets for polynomial functions with degree at most d, for all d, and characterize the certifying degrees of all symmetric subsets.

Back to Table of Contents

ZACH WALSH, Louisiana State University

[Friday May 28, 12:50]

Totally D-Modular Matroids

For a positive integer D, an integer matrix is totally D-modular if the determinant of each square submatrix has absolute value at most D. Tutte proved that a matroid is representable over every field if and only if it has a representation as a totally 1-modular matrix. When D is at least two, what can be said about the class of matroids with a representation as a totally D-modular matrix?

SEAN MCGUINNESS, Thompson Rivers University

[Friday May 28, 13:20]

Rota's Basis Conjecture for Binary Matroids: the case for constructing bases one-at-a-time.

Rota's basis conjecture (RBC) states that given a collection $\mathbb{B}$ of n bases in a matroid M of rank n, one can always find n disjoint rainbow bases with respect to $\mathbb{B}$. In this talk, we examine this conjecture in the case of binary matroids, in particular binary matroids having $n + k$ elements where k is small. We introduce a heuristic for constructing n disjoint rainbow bases, one-at-a-time which we conjecture will work for all binary matroids. A key ingredient in the method is the requirement that at each step, the rainbow basis constructed satisfy certain inequalities.

Back to Table of Contents

Org: Nicolas Bousquet (CNRS, Université de Lyon) and **Anna Lubiw** (University of Waterloo)

"Reconfiguration" is about changing one configuration to another via discrete steps, for example sorting a list by swapping pairs of adjacent elements, or changing one proper colouring of a graph to another by recolouring one vertex at a time. We may ask: Is there a reconfiguration path between any two configurations? How short a path? How efficiently can it be found? How many reconfiguration steps to a random configuration? These questions arise in various fields such as discrete geometry (flip distance), combinatorics (graph recoloring, token swapping), bio-informatics (phylogenetics), combinatorial game theory (puzzles), random sampling (Monte Carlo Markov chains), and combinatorial optimization (Hirsch's conjecture). The talks in this minisymposium give a sample of recent results in these areas.

Abstracts

SATYAN DEVADOSS, University of San Diego

[Friday May 28, 15:30]

Associativity reconfigurations: Colors, Graphs, Polytopes

Fifty years ago, the associahedron made its debut, a polytope that captured reconfigurations of associativity structures in homotopy theory. The beauty of this polytope is the multiplicity of areas in which it now appears, a sampling of which include root systems, real algebraic geometry, phylogenetics, string theory, computational geometry, and holomorphic curves. This should not surprise us since the principle of associativity is ubiquitous. We showcase this marvelous polytope and consider its generalizations into triangulations of polygons, connectivity of graphs, and colorings of tubes.

JONATHAN NARBONI, Université de Bordeaux

[Friday May 28, 16:00]

On Vizing's edge colouring question

In his 1965 seminal paper on edge colouring, Vizing asked the following question: can an optimal edge colouring be reached from any given proper edge colouring through a series of Kempe changes (*i.e.* swapping the colours of a maximal bichromatic component)? We answer this question in the affirmative for triangle-free graphs.

This is joint work with Marthe Bonamy, Oscar Defrain, Tereza Klimošová, Aurélie Lagoutte

---

DANIEL CRANSTON, Virginia Commonwealth University

[Friday May 28, 16:30]

In Most 6-regular Toroidal Graphs All 5-colorings are Kempe Equivalent

A Kempe swap in a proper coloring interchanges the colors on some maximal connected 2-colored subgraph. Two k-colorings are k-equivalent if we can transform one into the other using Kempe swaps. We show that if G is 6-regular with a toroidal embedding where every non-contractible cycle has length at least 7, then all 5-colorings of G are 5-equivalent. Bonamy, Bousquet, Feghali, and Johnson asked if this holds when G is formed from the Cartesian product of C_m and C_n by adding parallel diagonals inside all 4-faces. We answer their question affirmatively when $m, n \geq 6$. Joint with Reem Mahmoud.

Back to Table of Contents

MARC HEINRICH, University of Leeds

[Friday May 28, 17:00]

Glauber dynamics for colourings of chordal graphs and graphs of bounded treewidth

The Glauber dynamics is a random process recolouring at each step a random vertex of a graph with a new colour chosen uniformly at random. It is known that when the total number of colours available is at least $\Delta + 2$, this process converges to a uniform distribution. A well known conjecture states that under this condition the time it takes for the convergence to happen, called the mixing time, is polynomial in the size of the graph. We study this problem for two specific class of graphs: graphs of bounded treewidth and chordal graph.

KUIKUI LIU, University of Washington

[Friday May 28, 17:30]

Markov Chain Analysis Through the Lens of High-Dimensional Expanders

The Markov Chain Monte Carlo paradigm is one of the most widely used methods for sampling from challenging distributions, both practically and theoretically. We discuss a recent line of work that leverages the perspective of high-dimensional expanders and their local-to-global properties to analyze Markov chains in the discrete setting. We will highlight numerous connections with other areas including geometry of polynomials, statistical physics, and more. Specific applications include sampling from bases of matroids, and spin systems in statistical physics. Based on several joint works with Nima Anari, Zongchen Chen, Shayan Oveis Gharan, Eric Vigoda, and Cynthia Vinzant.

Org: Sergey Norin (McGill University)

Abstracts

ROSE MCCARTY, University of Waterloo

[Friday May 28, 15:30]

Connectivity for adjacency matrices and vertex-minors

Standard notions of graph connectivity do not translate well to its adjacency matrix (i.e. the complete bipartite graph is highly vertex- and edge-connected, but its adjacency matrix has rank 2). The cut-rank function addresses this issue and is very closely related to vertex-minors. We will discuss the "connectivity" issues that come up when forbidding a vertex-minor. Essentially, we characterize when the "connectivity" of many disjoint sets can be decreased by adding a low-rank matrix (over the binary field). Joint work with Jim Geelen and Paul Wollan.

ÉDOUARD BONNET, CNRS, ÉNS Lyon

[Friday May 28, 16:00]

Twin-width

We will survey some combinatorial properties of the recently introduced classes of bounded twin-width.

RICHARD MONTGOMERY, University of Birmingham

[Friday May 28, 16:30]

A solution to Erdős and Hajnal's odd cycle problem

I will discuss how to construct cycles of many different lengths in graphs, in particular answering the following two problems on odd and even cycles. Erdős and Hajnal asked in 1981 whether the sum of the reciprocals of the odd cycle lengths in a graph diverges as the chromatic number increases, while, in 1984, Erdős asked whether there is a constant C such that every graph with average degree at least C contains a cycle whose length is a power of 2.

This is joint work with Hong Liu.

SOPHIE SPIRKL, University of Waterloo

[Friday May 28, 17:00]

Excluding a tree and a biclique

The Gyarfas-Sumner conjecture states that for every tree T, there is a function f such that graphs with no induced T have chromatic number bounded by f of their clique number. Hajnal and Rodl proved that if we replace "clique number" by "biclique number" (the largest t such that the graph contains $K_{t,t}$ as a subgraph) then the conjecture holds.

Bonamy, Bousquet, Pilipczuk, Rzazewski, Thomasse and Walczak recently showed that in this setting, if T is a path, f is polynomial. I will talk about a result extending this to all trees.

Joint work with Alex Scott and Paul Seymour.

Back to Table of Contents

CHUN-HUNG LIU, Texas A&M University

[Friday May 28, 17:30]

Asymptotic dimension of minor-closed families and beyond

We prove that the asymptotic dimension of any minor-closed families of graphs, any class of graphs of bounded tree-width, and any class of graphs with bounded layered tree-width are at most 2, 1 and 2, respectively. The first result solves a question of Fujiwara and Papasoglu; the second and third results solve a number of questions of Bonamy, Bousquet, Esperet, Groenland, Pirot and Scott. These results are optimal, improve a number of results in the literature, and imply known and new results about weak diameter coloring and clustered coloring on graphs.

Back to Table of Contents

Org: Yixin Cao (Hong Kong Polytechnic University) and **Derek G. Corneil** (University of Toronto)

Interval graphs are intersection graphs of intervals on the real line. For their natural applications (e.g., representation of temporal objects) and nice mathematical properties, interval graphs have been among the most studied in algorithmic graph theory. The study of these families have brought forth new techniques as well as new structures. Their popularity also benefits from many interesting kins, e.g., circular-arc graphs, interval bigraphs, and circular-ones matrices, not to mention chordal graphs, AT-free graphs and many subclasses. On the one hand, even the recognition of interval graphs, for which a linear-time algorithm has been presented nearly 50 years ago, is still under intensive investigation. On the other hand, there are recently a lot of exciting new results on problems formulated on these families. We plan to bring together experts in graph theory and in algorithms to explore the properties and algorithms of these families.

Abstracts

YIXIN CAO, Hong Kong Polytechnic University

[Friday May 28, 15:30]

Recognizing (unit) interval graphs by zigzag graph searches

Corneil, Olariu, and Stewart [SODA1998; SIDMA2009] presented a recognition algorithm for interval graphs by six graph searches. Li and Wu [DMTCS2014] simplified it to only four. The great simplicity of the latter algorithm is however eclipsed by the complicated and long proofs. The main purpose of this paper is to present a new and significantly shorter proof for Li and Wu's algorithm, as well as a simpler implementation. We also give a self-contained presentation of the recognition of unit interval graphs, based on three sweeps of graph searches. We make several new structural observations that might be of independent interests.

CELINA DE FIGUEIREDO, Universidade Federal do Rio de Janeiro

[Friday May 28, 16:00]

Maximum cut and Steiner tree restricted to interval graphs and related families

We consider Column 16 – Graph Restrictions and Their Effect – of D. S. Johnson's Ongoing guide, where several puzzles were proposed in a summary table with 30 graph classes as rows and 11 problems as columns, and several of the 330 entries remain unclassified into Polynomial or NP-complete after 35 years. We focus on columns MaxCut and StTree, where there are recent resolved entries for interval graphs and related families.

PAVOL HELL, Simon Fraser University

[Friday May 28, 16:30]

Variants of interval graphs and related families

In this survey talk I will explore the best analogues of interval graphs (and of closely related families) for digraphs, bigraphs, and for graphs with loops allowed. I will focus on interval graphs, while mentioning other families, including strongly chordal graphs fully discussed in a talk by Cesar Hernandez-Cruz in another session. Most of the results are joint work with Jing Huang, Cesar Hernandez-Cruz, Jephian Lin, Ross McConnell, Arash Rafiey, and others; I will also mention other work by Akbar Rafiey and Arash Rafiey.

Back to Table of Contents

MICHEL HABIB, Paris University

[Friday May 28, 17:00]

Grounded intersection graphs and forbidden patterns on 4 vertices

In the 90s Damaschke noticed that classic graph classes, such as interval and chordal can be characterized by the existence of an ordering of the nodes avoiding some of ordered subgraphs, called patterns. Hell, Mohar and Rafiey 2014 showed that all the classes corresponding to set of patterns on three vertices can be recognized polynomially. Very recently we list all the classes corresponding to set of patterns on three vertices. For patterns on four nodes we may have graph classes that are NP-complete to recognize (example 3-colorable graphs). In this work, we study grounded intersection graphs, and their forbidden patterns.

LALLA MOUATADID, University of Toronto and Google

[Friday May 28, 17:30]

(α,β)-Modules in Graphs

We introduce the notion of an (α,β)-module, a relaxation that allows a bounded number of errors in each node and maintains some of the algebraic structures. This leads to a new combinatorial decomposition with very interesting properties. In this talk, we'll discuss minimal (α,β)-modules, (α,β)-modular decomposition trees, (α,β)-cographs, and other new findings and interesting conjectures on this new decomposition.

Joint work with Michel Habib, Eric Sopena, and Mengchuan Zou.

Org: Stijn Cambie (Radboud University Nijmegen, the Netherlands)

Continuing the sessions held last year, we want to get together with enthusiasts working on different average graph parameters. From the minisymposium in 2019 arised some papers, so we are hopeful for this year as well. During the talks, the state of the art and intriguing open problems in the field will be shared.
Starting with the oldest and most well-known average graph parameter, the Wiener index (which dates back to 1947) or equivalently the average distance of a graph. But there will also be talks on the average connectivity, order and size of certain substructures of graphs such as independent sets, dominating sets and subtrees.

Abstracts

IAIN BEATON, Dalhousie University

[Friday May 28, 15:30]

The Average Order of Dominating Sets of a Graph

This talk focuses on the average order of dominating sets of a graph. We find the extremal graphs for the maximum and minimum value over all graphs on n vertices, while for trees we prove that the star minimizes the average order of dominating sets. We prove the average order of dominating sets in graphs without isolated vertices is at most $3n/4$, but provide evidence that the actual upper bound is $2n/3$. Finally, we show that the normalized average, while dense in $[1/2, 1]$, tends to $\frac{1}{2}$ for almost all graphs. This is joint work with Jason Brown (Dalhousie University)

VALISOA MISANANTENAINA, Stellenbosch University

[Friday May 28, 16:00]

The average size of independent vertex/edge sets of a graph

In this talk, we characterize both the average size of independent vertex sets and independent edge sets of a graph. These invariants are the logarithmic derivative of the independence (resp. matching) polynomial evaluated at one. We show that although they are not monotone, under an addition or a removal of an edge, like the number of vertex (resp. edge) independent sets, the extremal graphs remain the same for general graphs (the empty and complete graph) and the class of trees (the star and the path).

ANDREW VINCE, University of Florida

[Friday May 28, 16:30]

The Average Size of a Connected Vertex Set of a Graph

Although connectivity is a basic concept in graph theory, the enumeration of connected subgraphs of a graph has only recently received attention. The topic of this talk is the average order of a connected induced subgraph of a graph. This generalizes, to graphs in general, the average order of a subtree of a tree, a topic initiated in a 1984 paper by R. Jamison.

JOHN HASLEGRAVE, University of Warwick

[Friday May 28, 17:00]

The average size of a connected set in a connected graph with degree constraints

We consider the average density of sets of vertices which are internally connected by edges of a fixed graph. When that graph is a tree, these sets are subtrees, and Jamison established the smallest and largest possible values. If the tree has no degree-2 vertex, both bounds change, and optimal values were given by Vince and Wang.

Much less is known for general graphs, and techniques for trees typically do not generalise. Again, it seems degree-2 vertices are critical. I shall discuss some new bounds, in particular answering a question of Vince, and some open questions.

SUIL O, The State University of New York, Korea

[Friday May 28, 17:30]

The average connectivity matrix of a graph

In this talk, we introduce the average connectivity matrix of a graph and examine some properties of the matrix.

Back to Table of Contents

Org: Rachel Kirsch (Iowa State University)

This minisymposium will highlight recent advances in graph theory, hypergraph theory, and combinatorics, with an emphasis on problems involving counting or optimizing some parameter.

Abstracts

GABRIELA ARAUJO-PARDO, Universidad Nacional Autónoma de México

[Friday May 28, 15:30]

The Moore and Cage Problems on Mixed Graphs

The Moore and Cage Problems are two classical topics on Extremal Graph Theory. In both of them the goal is find regular graphs, in the first they have fixed diameter and maximum order and in the second the graphs have fixed girth and minimum order.

We study both problems on Mixed Graphs, a *Mixed regular graph* is a (z, r)-graph, z-regular by arcs and r-regular by edges, a $(z, r; d)$-mixed Moore graph is a mixed graph with fixed diameter d and maximum order whereas a $[z, r; g]$-mixed cage is a mixed graph with fixed girth g and minimum order.

ZHANAR BERIKKYZY, Fairfield University

[Friday May 28, 16:00]

Rainbow solutions to the Sidon equation in cyclic groups and in the interval

Given a coloring of group elements, a rainbow solution to an equation is solution whose every element is assigned a different color. Rainbow number of $\mathbb{Z}_n$ for an equation eq, denoted $rb(\mathbb{Z}_n, eq)$, is the smallest number of colors r such that every exact r-coloring of $\mathbb{Z}_n$ admits a rainbow solution to this equation. We show that for every exact 4-coloring of $\mathbb{Z}_p$, where $p \geq 3$ is prime, there exists a rainbow solution to the Sidon equation $x_1 + x_2 = x_3 + x_4$. Furthermore, we determine the rainbow numbers of $\mathbb{Z}_n$ and the set of integers $[n] = \{1, \ldots, n\}$ for the Sidon equation. Joint work with Jürgen Kritschgau.

JESSICA DE SILVA, California State University Stanislaus

[Friday May 28, 16:30]

Image Segmentation via Hypergraph-based MRF Models

X-ray micro-tomography (μ-CT) is a non-destructive 3D imaging technique often used to image material samples. Synchrotron-based μ-CT instruments produce high volumes of data at a fast rate. This leads to the need for image processing techniques capable of extracting valuable information in large complex data sets. Recent approaches to image segmentation exploit the local properties of Markov Random Fields (MRFs) to run computations in parallel. We have developed an image segmentation algorithm using a hypergraph-based MRF model. The algorithm is coded in C++ and preliminary results indicate that this generalized model improves the precision of the segmentation of μ-CT images.

Back to Table of Contents

MICHAEL GUYER, Auburn University

[Friday May 28, 17:00]

On clique immersions in line graphs

In this talk we will discuss the immersion relation on graphs. This relation is similar but incomparable to the well-known minor relation. We will explore the relationship between coloring and such containment relations. In particular, we prove that if $L(G)$ immerses K_t then $L(mG)$ immerses K_{mt}, where mG is the graph obtained from G by replacing each edge in G with a parallel edge of multiplicity m. We also show that when G is a line graph, G has a K_t-immersion iff G has a K_t-minor whenever $t \leq 4$. This equivalence fails in both directions when $t \geq 5$.

LINDA LESNIAK, Western Michigan University

[Friday May 28, 17:30]

On the necessity of Chvátal's hamiltonian degree condition

In 1972, Chvátal gave a well-known sufficient condition for a degree sequence to be forcibly hamiltonian, and showed that in some sense his condition is best possible. In this paper, we conjecture that with probability 1 as $n \to \infty$, Chvátal's sufficient condition is also necessary. In contrast, we essentially prove that the sufficient condition of Bondy and Boesch for forcible k-connectedness is not necessary in the same way, for every $k \geq 1$.

Back to Table of Contents

Org: Thaís Bardini Idalino (Universidade Federal de Santa Catarina, Brazil), **Jonathan Jedwab** (Simon Fraser University) and **Shuxing Li** (Simon Fraser University)

Practical questions about how to design experiments were the historical inspiration for the rich and beautiful study of modern design theory, which has deep connections to coding theory, finite geometry, graph theory, and other branches of combinatorics. This minisymposium showcases the fruitful interplay between theory and application, by exploring some of the diverse ways in which design theory continues to be used in practical applications.

Abstracts

CHARLIE COLBOURN, Arizona State University

[Friday May 28, 15:30]

Popularity Block Ordering for Steiner Systems

Steiner systems are used for data layout in distributed storage systems. However, assignment of data items to storage units often ignores the long-term item popularity. To address popularity, we order the blocks of a design, computing the point sum of an element as the sum of the indices of blocks containing that element. Popularity block ordering asks for the point sums to be as equal as possible. Remarkably, for many parameter sets, the blocks of a Steiner system can be ordered to make all point sums equal! In this talk, we outline some techniques for constructing such egalitarian Steiner systems.

PETER DUKES, University of Victoria

[Friday May 28, 16:00]

The use of graph decompositions for variance-balanced designs in the presence of correlated errors

Designs have a long tradition in statistical experiments. A standard model is

$$y_{ij} = \theta_i + \beta_j + \epsilon_{ij},$$

where y_{ij} is an observed value for treatment i in block j, θ_i is a treatment effect, β_j is a block effect, and ϵ_{ij} are i.i.d. errors. The covariance matrix for the least-squares estimator $\widehat{\theta}$ is computed from the design incidence matrix. When a BIBD is used for the model, $\mathrm{Cov}(\widehat{\theta})$ is a linear combination of I and J, something statistically desirable.

This research explores graph decompositions in place of BIBDs when ϵ_{ij} are correlated, say for spatial or temporal reasons.

GUANG GONG, University of Waterloo

[Friday May 28, 16:30]

Polynomials, Sequences and Complementary Codes

In this talk, I will present our recent results on how to recursively construct Golay complementary sequences (GCS) and complete complementary codes (CCC) using unitary matrices with polynomial entries (the so-called PU matrix method) and how to retrieve their multi-linear multivariate polynomial representation. In this way, we have constructed abundant new GCS/CCC and include all the known cases as our special cases. Especially, we have discovered an extremely fascinating hidden connection between these sequences and sequences with 2-level autocorrelation, which are two completely separate fields in the literature for more than 7 decades.

Back to Table of Contents

KIRSTEN NELSON, Carleton University

[Friday May 28, 17:00]

Construction of Covering Arrays from Interleaved Sequences

A covering array CA$(N; t, k, v)$ is an $N \times k$ array over an alphabet of v elements such that for any t-set of columns, each possible arrangement of t alphabet elements occurs at least once in a row. Finding the smallest number of rows N is a central problem. We will examine interleaved sequences, created by combining a base sequence with desirable coverage properties with a shift sequence. We show what properties are inherited from the base sequence, and by which shift sequences. Finally, we demonstrate the potential for interleaved sequences to create ϵ-almost covering arrays.

DANIEL PANARIO, Carleton University

[Friday May 28, 17:30]

LDPC codes based on trade designs

Low-Density Parity-Check (LDPC) codes are a practically important class of linear codes. We provide a novel approach to construct the parity-check matrix of an LDPC code with girth at least 6 using trades of directed designs. Then we use those trade-based matrices to construct a base matrix of a multiple-edge quasi-cyclic LDPC code with improved cycle detection and reduced computational complexity. We also use trade-based matrices to construct the parity-check matrix of time-varying spatially-coupled LDPC codes. These techniques are structural and applicable to any directed design. Joint work with Farzane Amirzade and Mohammad Sadeghi.

Abstracts

MATTHEW SULLIVAN, University of Waterloo

[Friday May 28, 15:30]

Simple Drawings of K_n from Rotation Systems

A complete rotation system on n vertices is a collection consisting of the cyclic permutations of the elements $[n]\backslash\{i\}$. If D is a drawing of a labelled graph, then a rotation at vertex v is the cyclic ordering of the edges at v. In particular, the collection of all vertex rotations of a simple drawing of K_n is a rotation system. Conversely, can we characterize when a complete rotation system can be represented as a simple drawing of K_n (a.k.a. realizable)? In 2011, Jan Kynčl published a proof using homotopy implying that if all 6 vertex rotation systems of an n vertex rotation system R_n are realizable, then R_n is realizable. In this talk, we will briefly review the full characterization of realizable rotation systems and see a combinatorial proof that if rotation systems of size 10 are realizable, then the associated n vertex rotation system is realizable.

MACKENZIE CARR, Simon Fraser University

[Friday May 28, 16:00]

Digital Convexity in Cycles and Cartesian Products

Given a finite set V, a *convexity*, $\mathcal{C}$, is a collection of subsets of V that contains both the empty set and the set V and is closed under intersections. The elements of $\mathcal{C}$ are called *convex sets*. The *digital convexity* on the vertex set of a graph, originally introduced as a tool for processing digital images, is defined as follows: a subset $S \subseteq V(G)$ is digitally convex if, for every $v \in V(G)$, we have $N[v] \subseteq N[S]$ implies $v \in S$. Or, equivalently, S contains every vertex for which it is a local dominating set. In this talk, we discuss the use of cyclic binary strings and certain types of $n \times m$ binary arrays to enumerate the digitally convex sets of the k^{th} power of a cycle and of the Cartesian product of paths, $P_n \square P_m$.

ALEXANDER KOLPAKOV, Université de Neuchâtel

[Friday May 28, 16:30]

Space vectors forming rational angles

We classify all sets of nonzero vectors in $\mathbb{R}^3$ such that the angle formed by each pair is a rational multiple of π. The special case of four-element subsets lets us classify all tetrahedra whose dihedral angles are multiples of π, solving a 1976 problem of Conway and Jones: there are 2 one-parameter families and 59 sporadic tetrahedra, all but three of which are related to either the icosidodecahedron or the B_3 root lattice. The proof requires the solution in roots of unity of a $W(D_6)$-symmetric polynomial equation with 105 monomials (the previous record was only 12 monomials). This is a joint work with Kiran Kedlaya, Bjorn Poonen, and Michael Rubinstein.

JAMES TUITE, Open University, UK

[Friday May 28, 17:00]

The degree/geodecity problem for mixed graphs

The degree/girth problem asks for the smallest possible order of an undirected graph with given girth and minimum degree. In this talk we explore a new analogue of this problem for mixed graphs, i.e. graphs that contain both undirected edges and directed arcs. A mixed graph G is k-geodetic for some $k \geq 2$ if for any pair of vertices u, v of G there is at most one non-backtracking mixed path from u to v with length not exceeding k; we ask for the order of the smallest k-geodetic mixed graph with given undirected and directed degrees. An extremal mixed graph for this problem is called a geodetic cage. We present new lower bounds on the order of k-geodetic mixed graphs, results on their regularity and constructions of geodetic cages.

AARON WILLIAMS, Williams College

[Friday May 28, 17:30]

Constructing Universal Cycles for Fixed-Content Strings

Consider the circular string 123313321323 of length twelve. Its substrings of length three — $123, 233, 331, \ldots, 231, 312$ — encode the twelve permutations of the multiset $\{1, 2, 3, 3\}$ with the redundant final symbol omitted. We provide the first explicit construction of these fixed-content universal cycles, along with efficient algorithms that generate each successive symbol in amortized O(1)-time, regardless of the specific multiset of symbols.

When universal cycles of this type are decoded, the resulting order of strings (e.g. $1233, 2331, 3312, \ldots, 2313, 3123$) have a nice property: Successive strings differ by a prefix rotation of length n or $n-1$. We illustrate how this property can be used to speed-up exhaustive computations for the stacker crane problem, and other combinatorial problems whose candidate solutions can be represented by fixed-content strings.

Joint work with Joe Sawada (University of Guelph).

Abstracts

RINOVIA SIMANJUNTAK, Institut Teknologi Bandung

[Friday May 28, 15:30]

Multiset Dimension of Cartesian Product Graphs

Let G be a connected graph and W be a set of vertices of G. The representation multiset of a vertex v with respect to W, $r_m(v|W)$, is defined as a multiset of distances between v and the vertices in W. If $r_m(u|W) \neq r_m(v|W)$ for every pair of distinct vertices u and v, then W is called an m-resolving set of G. If G has an m-resolving set, then the cardinality of a smallest m-resolving set is called the multiset dimension of G, denoted by $md(G)$; otherwise, we say that $md(G) = \infty$.

In this talk, we shall derive lower bounds for multiset dimension of Cartesian product graphs. We shall also study the conditions for the sharpness of the bounds.

MICHAEL YATAURO, Penn State - Brandywine

[Friday May 28, 16:00]

A Parameterized Extension of the Binding Number

We define an extension of the standard binding number of a graph which introduces parameters into the computation. This extension is motivated by a number of theorems that use bounds on the order of neighbor sets of vertices to determine the existence of cycles or factors within the graph. We demonstrate how this extended binding number can be integrated into such theorems. Additionally, we provide a theorem that indicates sufficient conditions on the degree sequence of a graph which guarantees a prescribed lower bound on this extended binding number. Finally, we show how these conditions can be combined with known theorems to produce sufficient conditions on the degree sequence which guarantees certain cycles or factors within the graph.

KATHERINE MOORE, Wake Forest University

[Friday May 28, 16:30]

Communities in Data via Partitioned Local Depths

Although clustering is a crucial component of human experience, there are relatively few methods which harness the richness of a social perspective. Here, we introduce a probabilistically-interpretable measure of local depth from which the cohesion between points can be obtained, via partitioning. The PaLD approach allows one to obtain graph-type community structure (with resulting clusters) in a holistic manner which accounts for varying density and is entirely free of extraneous inputs (e.g., number of communities, neighbourhood size, optimization criteria, etc.). Some theoretical properties of cohesion are included. Joint work with Kenneth Berenhaut.

FARZANE AMIRZADE, Carleton University

[Friday May 28, 17:00]

Quasi-Cyclic Protograph-Based Raptor-Like LDPC Codes With Girth 6 and Shortest Length

Multiple-edge QC-LDPC codes with a large size base matrix are considered. We propose a new method, the degree reduction method, to obtain exponent matrices of these codes which considerably reduces the complexity of the search algorithm. We also provide a necessary and sufficient condition to avoid 4-cycles from occurrence in the Tanner graph of codes obtained based on our method. Then, we apply our method to quasi-cyclic protograph-based Raptor-Like LDPC (QC-PBRL-LDPC) codes whose base matrices are multiple-edge. The numerical results show that as a consequence of this study we can obtain the minimum lifting degree of girth-6 QC-PBRL-LDPC codes.

CHRISTOPHER MARY,

[Friday May 28, 17:30]

Geometric datatypes for geometric parsing algorithms

The MODOS is the computational logic for geometric datatypes, which is some common generalization of the constructive datatypes in logic and the sheaves in geometry. Correct? Complete? Questions?

https://github.com/1337777/cartier

Abstracts

RAFAEL GONZÁLEZ D'LEÓN, Universidad Sergio Arboleda, Colombia

[Friday May 28, 15:30]

Column-convex 0,1-matrices, consecutive coordinate polytopes and flow polytopes

We study normalized volumes of a family of polytopes associated with column-convex 0,1-matrices. Such a family is a generalization of the family of consecutive coordinate polytopes, studied by Ayyer, Josuat-Vergès, and Ramassamy, which in turn generalizes a family of polytopes originally proposed by Stanley in EC1. We prove that a polytope associated with a column-convex 0,1-matrix is integrally equivalent to a certain flow polytope. We use the recently developed machinery in the theory of volumes and lattice point enumeration of flow polytopes to find various expressions for the volume of these polytopes, providing new proofs and extending results of Ayyer, Josuat-Vergès, and Ramassamy. A consequence of our techniques is that the set of higher-dimensional Entringer numbers are log-concave in root directions.

ANDREW GOODALL, Charles University Prague

[Friday May 28, 16:00]

Tutte's dichromate for signed graphs

A signed graph is a graph with signed edges (positive or negative). Two signed graphs are considered equivalent if their edge signs differ on a cutset of the graph. Proper colourings and nowhere-zero flows of signed graphs are defined analogously to those of graphs. For graphs, these are both enumerated by evaluations of the Tutte polynomial. For signed graphs, Zaslavsky enumerated proper colourings, and recently DeVos–Rollová–Šámal showed that the number of nowhere-zero flows satisfies a deletion-contraction recurrence, and, independently, Qian–Ren and Goodall–Litjens–Regts–Vena gave a subset expansion formula. We construct a trivariate polynomial invariant of signed graphs that contains both the number of proper colourings and the number of nowhere-zero flows as evaluations: for this, three variables are needed. Specializations include Zaslavsky's bivariate rank-generating polynomial of the (frame matroid of the) signed graph and the Tutte polynomial of the (cycle matroid of the) underlying graph.

ROBERT ŠÁMAL, Charles University

[Friday May 28, 16:30]

Many flows in the group connectivity setting

Two well-known results about nowhere-zero flows are Jaeger's 4-flow theorem asserting that every 4-edge-connected graph has a nowhere-zero $\mathbb{Z}_2 \times \mathbb{Z}_2$-flow and Seymour's 6-flow theorem asserting that every 2-edge-connected graph has a nowhere-zero $\mathbb{Z}_6$-flow. In both of these settings, exponentially many flows exist; we improve earlier results in this direction.

The concept of a nowhere-zero flow was extended by Jaeger, Linial, Payan, and Tarsi to a choosability-type setting. An oriented graph $G = (V, E)$ is called Γ-*connected* if for every function $f : E \to \Gamma$ there is a flow $\phi : E \to \Gamma$ with $\phi(e) \neq f(e)$ for every $e \in E$. Jaeger et al. proved that every oriented 3-edge-connected graph is Γ-connected whenever $|\Gamma| \geq 6$. We prove that there are exponentially many solutions whenever $|\Gamma| \geq 8$. For the group $\mathbb{Z}_6$ we prove that for every oriented 3-edge-connected $G = (V, E)$ with $\ell = |E| - |V| \geq 11$ and every $f : E \to \mathbb{Z}_6$, there are at least $2^{\sqrt{\ell}/\log \ell}$ flows ϕ with $\phi(e) \neq f(e)$ for every $e \in E$.

Joint work with M.DeVos, R.Langhede, and B.Mohar.

Back to Table of Contents

YITING JIANG, Université de Paris (IRIF), France and Zhejiang Normal University, China

[Friday May 28, 17:00]

Colouring of generalized signed planar graphs

Assume G is a graph and S is a set of permutations of positive integers. An S-signature of G is a pair (D, σ), where D is an orientation of G and $\sigma : E(D) \longrightarrow S$ is a mapping which assigns to each arc $e = (u, v)$ a permutation $\sigma(e)$ in S. We say G is S-k-colourable if for any S-signature (D, σ) of G, there is a mapping $f : V(G) \longrightarrow [k]$ such that for each arc $e = (u, v)$ of G, $\sigma(e)(f(u)) \neq f(v)$. The concept of S-k-colourable is a common generalization of many colouring concepts. We call a set $S \in S_4$ *good* if every planar graph is S-4-colourable. The Four Colour Theorem is equivalent to say that $S = \{id\}$ is good. In this talk, we figure out the good sets in S_4. We also consider similar problems on triangle-free planar graphs, since Grötzsch's theorem says that every triangle-free planar graph is 3-colourable.

HIRANYA KISHORE DEY, IIT Bombay, India

[Friday May 28, 17:30]

Signed Alternating-runs Enumeration in Classical Weyl Groups

The alternating-runs polynomial enumerates alternating runs in the symmetric group $\mathfrak{S}_n$. Three formulae are known for $R_{n,k}$, the number of permutations in $\mathfrak{S}_n$ with k alternating runs, but all of them are complicated. We show that when alternating runs are enumerated with sign taken into account, one gets a *neat formula*. This has several consequences: we firstly get a near refinement of a result of Wilf on the exponent of $(1 + t)$ that divides the alternating-runs polynomial in $\mathcal{A}_n$, the alternating group. Other applications include a moment-type identity, and enumeration of alternating permutations in $\mathcal{A}_n$. Similar results are obtained for the type B and type D Coxeter groups. This is a joint work with Krishnan Sivasubramanian.

Abstracts

JOHN MACHACEK, Hampden-Sydney College

[Friday May 28, 15:30]

Lattice walks ending on a coordinate hyperplane using ± 1 *steps*

We work with lattice walks in $\mathbb{Z}^{r+1}$ using step set $\{\pm 1\}^{r+1}$ that finish with $x_{r+1} = 0$. We further impose conditions of avoiding backtracking (i.e. $[v, -v]$) and avoiding consecutive steps (i.e. $[v, v]$) each possibly combined with restricting to the half space $x_{r+1} \geq 0$. We find in all cases the generating functions for such walks are algebraic and give polynomial recurrences for their coefficients. The enumeration in special cases includes central binomial coefficients and Catalan numbers as well as relations to enumeration of other families of walks previously studied.

LLUÍS VENA, Universitat Politècnica de Catalunya

[Friday May 28, 16:00]

Characterization of extremal families for the shadow minimization problem in the Boolean lattice

Kruskal-Katona's theorem states that the initial segments in the colex order minimize the size of the shadow $\Delta(\cdot)$ among families $S \subset \binom{[n]}{k}$ with the same cardinality. Füredi and Griggs asked for their characterization after showing that that these initial segments are the unique minimizing families for some cardinalities. We answer this question by a new approach which provides structural properties of the extremal families. We show that $\Delta^{\log(n)}(S)$ of an extremal family S is always the initial segment in the colex order (as when the $\Delta^s(S)$ is not the initial colex segment, then the coefficients of the k-binomial decomposition of $|S|$ decrease as fast as the hypotenusal numbers (OEIS: A001660)). We can also determine in time $O(n\,\mathrm{poly}(k))$ whether there exists an extremal family $S \subset \binom{[n]}{k}$ with $|S|$ elements and s the smallest integer with $\Delta^s(S)$ not being the initial colex segment. Joint work with Oriol Serra.

ANDREW BEVERIDGE, Macalester College

[Friday May 28, 16:30]

de Finetti Lattices and Magog Triangles

The order ideal $B_{n,2}$ of the Boolean lattice B_n consists of all subsets of size at most 2. Let $F_{n,2}$ denote the poset refinement of $B_{n,2}$ induced by the rules: $i < j$ implies $\{i\} \prec \{j\}$ and $\{i, k\} \prec \{j, k\}$. These rules are a special case of de Finetti's axiom from probability. We give a bijection from a family of poset refinements of $F_{n,2}$ to magog triangles. We then adopt our proof techniques to show that row reversal of an alternating sign matrix corresponds to a natural involution on gog triangles.

GAYEE PARK, University of Massachusettes Amherst

[Friday May 28, 17:00]

Naruse hook formula for linear extensions of mobile posets

Linear extensions of posets are important objects in enumerative and algebraic combinatorics that are difficult to count in general. Families of posets like straight shapes and d-complete posets have hook-length product formulas to count linear extensions, whereas families like skew shapes have determinant or positive sum formulas like the Naruse hook length formula from 2014. In 2020, Garver et. al. gave determinant formulas to count linear extensions of a family of posets called mobile posets that refine d-complete posets and border strip skew shapes. We give a Naruse type hook length formula to count linear extensions of such posets as well q-analogues of our formula in both major and inversion index.

GARA PRUESSE, Vancouver Island University

[Friday May 28, 17:30]

Plain Greed suffices to 2-approximate Jump Number for Interval Posets

The jump number problem is NP-complete for interval posets; the jump number is realized by a linear extension of the poset with the fewest consecutive pairs of incomparable elements. We show that shelling the poset while locally avoiding jumps always yields a linear extension with no more than twice the optimal number of jumps. This answers a question posed in 1985 by Faigle and Schrader. The jump number of interval posets has been the subject of recent research interest, and approximation ratios as low as 16/11 have been achieved by polynomial time algorithms. The advantage of greed is the extreme simplicity of implementation, as well as the linear time complexity of the algorithm.

Back to Table of Contents

Talk List

E

F

G

K

L

M

N

O

P

Q

R

S

Š

S

Š

X

Xu, Max Wenqiang, *Discrepancy in Modular Arithmetic Progressions*, CM2 (p. 49), Tuesday May 25, 12:20 - 12:45

Xu, Rongxing, *The strong fractional choice number of graphs*, CT15 (p. 152), Thursday May 27, 17:30 - 17:55

Y

Yang, Jianrong, *Developmental cell lineage trees, and the quantitative comparisons between them*, IM11 (p. 117), Thursday May 27, 11:20 - 11:45

Yatauro, Michael, *A Parameterized Extension of the Binding Number*, CT19 (p. 188), Friday May 28, 16:00 - 16:25

Ye, Dong, *Resonance graphs on perfect matchings*, CM3 (p. 52), Tuesday May 25, 12:50 - 13:15

Ye, Ying Ying (Fay), *Chordality of locally semicomplete and weakly quasi-transitive digraphs*, CT12 (p. 131), Thursday May 27, 11:50 - 12:15

Yero, Ismael Gonzalez, *Comparing the metric and edge metric dimensions of graphs*, CM15 (p. 91), Wednesday May 26, 11:50 - 12:15

Yip, Martha, *A unifying framework for the ν-Tamari lattice and principal order ideals in Young's lattice*, CM27 (p. 163), Friday May 28, 13:20 - 13:45

Z

Zahl, Josh, *Sphere tangencies, line incidences, and Lie's line-sphere correspondence*, IM4 (p. 78), Wednesday May 26, 13:20 - 13:45

Zamfirescu, Carol T., *K_2-hamiltonian graphs*, CT4 (p. 93), Wednesday May 26, 11:20 - 11:45

Zeijlemaker, Sjanne, *Optimization of eigenvalue bounds for the independence and chromatic number of graph powers*, CM31 (p. 170), Friday May 28, 11:20 - 11:45

Zhang, Louxin, *The Bourque Distances for Mutation Trees of Cancers*, IM11 (p. 117), Thursday May 27, 12:20 - 12:45

Zhang, Xiande, *Optimal ternary constant weight codes in l_1-metric*, CM7 (p. 64), Tuesday May 25, 17:30 - 17:55

Zhao, Yufei, *Extremal problems in discrete geometry*, Plenary (p. 40), Wednesday May 26, 10:00 - 10:00

Zhu, Jialu, *Ohba type result on lambda choosability*, CT15 (p. 152), Thursday May 27, 17:00 - 17:25

Zhu, Xuding, *On Hedetniemi's Conjecture*, IM6 (p. 81), Wednesday May 26, 11:20 - 11:45

Zhukovskii, Maksim, *Cycle saturation in random graphs*, CT1 (p. 60), Tuesday May 25, 12:50 - 13:15