

CombinaTexas 2018

February 10–11, 2018

All the activities will be held at Blocker Building on the campus of Texas A&M University. The registration and breaks are at BLOC 140-141. All the plenary talks will be at the main lecture room, BLOC 166. For contributed talks, session A is in BLOC 166, and session B is in BLOC 164.

Saturday, Feb. 10, 2018

- 07:45: Shuttle from Hampton Inn to Blocker Building
- 08:00–08:30: Registration and Breakfast (BLOC 140-141)
- 08:30–09:20: Plenary Talk 1: Matthias Beck (BLOC 166)
- 09:30–11:10: Contributed Session 1 (BLOC 166 & 164)
- 11:10–11:30: Break (BLOC 141)
- 11:30–12:20: Plenary Talk 2: Caroline Klivans (BLOC 166)

- 12:30–02:00: Lunch

- 02:00–02:50: Plenary Talk 3: Pavlo Pylyavskyy (BLOC 166)
- 02:55–03:55: Contributed Session II (BLOC 166 & 164)
- 03:55–04:15: Break (BLOC 141)
- 04:15–04:55: Contributed Session II (Cont) (BLOC 166 & 164)
- 05:00–05:50: Plenary Talk 4: Isabella Novik (BLOC 166)
- 06:00–08:00: Conference Dinner (catered) (BLOC 141)
- 08:00: Shuttle from Blocker Building to Hampton Inn

Sunday, Feb. 11, 2018

- 07:45: Shuttle from Hampton Inn to Blocker Building
- 08:00–08:30: Breakfast (BLOC 140-141)
- 08:30–10:10: Contributed Session III (BLOC 166 & 164)
- 10:10–10:30: Break (BLOC 141)
- 10:30–11:20: Plenary Talk 5: Kyungyong Lee (BLOC 166)
- 11:30–12:20: Plenary Talk 6: Matthew Kahle (BLOC 166)

Schedule for Contributed Talks

Saturday Morning, Contributed Session I		
	Session A, BLOC 166	Session B, BLOC 164
09:30–09:50	Yue Cai	Shaohui Wang
09:50–10:10	Ozlem Ugurlu	Lindsey-Kay Lauderdale
10:10–10:30	Xingwei Wang	Lucas Rusnak
10:30–10:50	Tri Lai	Randy Davila
10:50–11:10	Zachary Moring	Bhaswar Bhattacharya
Saturday Afternoon, Contributed Session II		
	Session A, BLOC 166	Session B, BLOC 164
2:55–3:15	Bo Lin	Jerry Hu
3:15–3:35	Federico Castillo	Stephen Graves
3:35–3:55	Li Ying	Archie Rowe
4:15–4:35	Anton Dochterman	Juan Alberto Rodrigues-Velazquez
4:35–4:55	Eric Bucher	Lohans de Oliveira Miranda
Sunday Morning, Contributed Session III		
	Session A, BLOC 166	Session B, BLOC 164
8:30–8:50	Suho Oh	
8:50–9:10	Robert McAlmon	Boris Brimkov
9:10–9:30	Art Duval	Mustafa Gezek
9:30–9:50	Jacob White	Pani Seneviratne
9:50–10:10	Kassie Archer	Criel Merino

Abstracts–Plenary Talks

1. **Matthias Beck**, San Francisco State University.

Title: *Combinatorial Reciprocity Theorems*

Abstract: A common theme of enumerative combinatorics is formed by counting functions that are polynomials. For example, one proves in any introductory graph theory course that the number of proper k -colorings of a given graph G is a polynomial in k , the chromatic polynomial of G . Combinatorics is abundant with polynomials that count something when evaluated at positive integers, and many of these polynomials have a (completely different) interpretation when evaluated at negative integers: these instances go by the name of combinatorial reciprocity theorems. For example, when we evaluate the chromatic polynomial of G at -1 , we obtain (up to a sign) the number of acyclic orientations of G , that is, those orientations of G that do not contain a coherently oriented cycle.

Combinatorial reciprocity theorems appear all over combinatorics. This talk will attempt to show some of the charm (and usefulness!) these theorems exhibit. Our goal is to weave a unifying thread through various combinatorial reciprocity theorems, by looking at them through the lens of geometry.

2. **Matthew Kahle**, Ohio State University.

Title: *Configuration spaces of disks in a strip*

Abstract: This is work in progress with Bob MacPherson. We study configuration spaces of disks in an infinite strip. These spaces naturally generalize the well-studied configuration spaces of points in the plane, but giving the points thickness also has clear physical meaning: this is the energy landscape of a hard spheres gas.

We are interested in the topology of these spaces, and we find qualitatively different “regimes” of behavior: solid (where homology is trivial), liquid (where homology is unstable), and gas (where homology is stable). I will emphasize the combinatorial aspects of our methods in the talk.

3. **Caroline Klivans**, Brown University

Title: *On the connectivity of three-dimensional tilings*

Abstract: In this talk, I will discuss domino tilings of three dimensional manifolds. In particular, I will focus on the connected components of the space of tilings of such regions under local moves. Using topological techniques we introduce two parameters of tilings: the flux and the twist. Our main result characterizes when two tilings are connected by local moves in terms of these two parameters. (I will not assume any familiarity with the theory of tilings for the talk.)

4. **Kyungyong Lee**, University of Nebraska, Lincoln

Title: *The dimension of the frieze variety*

Abstract: Conway and Coxeter introduced frieze patterns in 1973. These are arrays of positive integers satisfying a certain local rule. With the development of cluster algebras, more generalized frieze patterns have been defined and studied in the last decade. We define an algebraic variety associated to each frieze pattern, and show that the dimension of this variety is a new numerical invariant which exhibits the trichotomy: finite type, affine type, and wild type. This is based on a joint work with Matt Mills and Alexandra Seceleanu, and another joint work with Li Li and Ralf Schiffler.

5. **Isabella Novik**, University of Washington

Title: *Face numbers of centrally symmetric polytopes*

Abstract: Many objects around us are symmetric. Yet, at present, we know much more about the face numbers of general (simplicial) polytopes than about those of centrally symmetric ones. This talk will survey several recent results as well as many remaining mysteries in the study of face numbers of centrally symmetric polytopes.

6. **Pavlo Pylyavskyy**, University of Minnesota

Title: *Zamolodchikov periodicity and integrability*

Abstract: T-systems are certain discrete dynamical systems associated with quivers. They appear in several different contexts: quantum affine algebras and Yangians, commuting transfer matrices of vertex models, character theory of quantum groups, analytic Bethe ansatz, Wronskian-Casoratian duality in ODE, gauge/string theories, etc. Periodicity of certain T-systems was the main conjecture in the area until it was proven by Keller in 2013 using cluster categories. In this work we completely classify periodic T-systems, which turn out to consist of 5 infinite families and 4 exceptional cases, only one of the infinite families being known previously. We then proceed to classify T-systems that exhibit two forms of integrability: linearization and zero algebraic entropy. All three classifications rely on reduction of the problem to study of commuting Cartan matrices, either of finite or affine types. The finite type classification was obtained by Stembridge in his study of Kazhdan-Lusztig theory for dihedral groups, the other two classifications are new. This is joint work with Pavel Galashin.

Abstracts–Contributed Talks

Saturday Morning, Contributed Session I

February 10, Morning, Contributed Session I		
	Session A, BLOC 166	Session B, BLOC 164
09:30–09:50	Yue Cai	Shaohui Wang
09:50–10:10	Ozlem Ugurlu	Lindsey-Kay Lauderdale
10:10–10:30	Xingwei Wang	Lucas Rusnak
10:30–10:50	Tri Lai	Randy Davila
10:50–11:10	Zachary Moring	Bhaswar Bhattacharya

[A. 9:30–9:50] Yue Cai, Texas A&M University

Title: *q-Stirling identities*

Abstract: In this talk we give combinatorial proofs of q -Stirling identities using restricted growth words. This includes a poset theoretic proof of Carlitz’s identity, a new proof of the q -Frobenius identity of Garsia and Remmel and of Ehrenborg’s Hankel q -Stirling determinantal identity. We also develop a two parameter generalization to unify identities of Mercier and include a symmetric function version.

[A. 9:50–10:10] Ozlem Ugurlu, Tulane University

Title: *Counting Borel Orbits in Symmetric Varieties of Types BI and CII*

Abstract: Let G be a reductive group, B be a Borel subgroup and let K be symmetric subgroup of G . The study of B orbits in G/K , or equivalently the study of K orbits in G/B has importance of Harish-Chandra modules and such a study comes with many interesting Schubert calculus problems. Although this subject is very well studied, it still has many open problems from combinatorial point of view. The most basic question that we want to be able to answer is that how many B orbits are there in G/K ? In this talk, we will present our recent progress on this enumeration problem in the cases of classical symmetric varieties $SO(2n+1, \mathbb{C})/S(O(2p, \mathbb{C}) \times O(2q+1, \mathbb{C}))$, (Type BI), and $Sp(2n, \mathbb{C})/(Sp(2p, \mathbb{C}) \times Sp(2q+1, \mathbb{C}))$, (Type CII). In particular, we will present our result on generating series of these numbers and we will show how our counting is related to the lattice path combinatorics.

[A. 10:10–10:30] Xingwei Wang, Nankai University and Texas A&M University

Title: *corners of (a,b) -core partitions*

Abstract: We introduce the concepts of stitches and anti-stitches, certain pairs of cells in a quotient space which we call wrap-up space. We prove that the anti-stitches of a rational Dyck path are in bijection with the segments of structure sets of the

corresponding core partition, therefore the number of corners of a core partition can be counted by the number of stitches or anti-stitches. Based on these results, for coprime positive integers a and b , we give two essentially different formulae for the number of corners in all (a, b) -cores. This leads to an unexpected identity, expressing the rational Catalan numbers as weighed sums of binomial numbers. Moreover, we show that for an $(n, n + 1)$ -core partition λ determined by certain $(n, n + 1)$ -Dyck path P , the corners of λ correspond to pairs of consecutive right steps in P . As a consequence, we show that the number of $(n, n + 1)$ -cores with k corners is Narayana number $N(n, k + 1)$. We also extend these results to multi-cores.

[A. 10:30–10:50] Tri Lai, University of Nebraska

Title: *Tiling Enumeration of Hexagons with Central Holes*

Abstract: Abstract: Motivated by MacMahon’s classical theorem on plane partitions and by an open problem posed by Propp, we investigate lozenge tilings of a hexagon in which three chains of arbitrary numbers of triangles have been removed. It is the first time a region with both central holes and boundary holes has been considered in the field of enumeration of tilings. Our main theorem generalizes a number of known enumerations of hexagons with central holes, including Ciucu-Krattenthaler-Okada’s work on ‘punctured hexagons’, Ciucu-Eisenkölbl-Krattenthaler-Zare’s enumeration of ‘cored hexagons’, and Ciucu’s recent result on ‘F-cored hexagons’. Especially, our result implies two longstanding conjectures posed by Ciucu–Eisenkölbl–Krattenthaler–Zare as two very special cases.

[A. 10:50–11:10] Zachary Moring, Trinity University

Title: *A, B-Minimal Stirling Numbers*

Abstract: Let n be a positive integer, and denote by $P = B_1/B_2/\cdots/B_k \in \Pi_{n,k}$ a set partition of $I_n = \{1, 2, \dots, n\}$ into k non-empty parts, where $\min(B_1) < \min(B_2) < \cdots < \min(B_k)$. A well-known result states that $|\Pi_{n,k}|$ is $S(n, k)$, the n, k -th Stirling number of the second kind. Several generalizations of $S(n, k)$ have appeared in the literature. We give a new generalization, the *A, B-minimal Stirling number of the second kind*; this new generalization not only subsumes many existing generalizations but also introduces some novel generalizations.

[B. 9:30–9:50] Shaohui Wang, Savannah State University

Title: *On the sharp lower bounds of Zagreb indices of graphs with given number of cut vertices*

Abstract: The first Zagreb index of a graph G is the sum of the square of every vertex degree, while the second Zagreb index is the sum of the product of vertex degrees of each edge over all edges. In our work, we solve an open question about Zagreb indices of graphs with given number of cut vertices. The sharp lower bounds are obtained for these indices of graphs in $\mathbb{V}_{n,k}$, where $\mathbb{V}_{n,k}$ denotes the set of all n -vertex graphs with k cut vertices and at least one cycle. As consequences, those graphs with the smallest Zagreb indices are characterized. (With Shengjin Ji)

[B. 9:50–10:10] Lindsey-Kay Lauderdale, University of Texas at Tyler

Title: *Vertex-Minimal Planar Graphs with Cyclic Automorphism Groups*

Abstract: A theorem of Frucht states that for any finite group G , there exists a graph Γ such that the automorphism group of Γ is isomorphic G . Naturally, this result gave rise to numerous extremal problems in graph theory. For instance, vertex-minimal graphs with a prescribed automorphism group are the subject of prior research by numerous authors. In this talk, we will discuss vertex-minimal *planar* graphs with a cyclic automorphism group.

[B. 10:10–10:30] Lucas Rusnak, Texas State University

Title: *Oriented incidence and naturality in hypergraphic generalization*

Abstract: An oriented hypergraph provides for the natural generalization of graph theoretic concepts through its locally signed graphic sub-structure. In this talk, we will discuss how sub-monic path embeddings produce hypergraphic versions of Sachs Coefficient Theorem and Chaiken's All Minors Matrix-tree Theorem for hypergraphic adjacency and Laplacian matrices. The naturality of these theorems lies in the comparison of graph-like categories.

[B. 10:30–10:50] Randy Davila, University of Houston-Downtown

Title: *Conjecturing with TxGraffiti*

Abstract: Automated conjecturing seeks to write computer programs which formulate mathematical conjectures. Some well known examples include Fajtlowcz's Graffiti and DeLaVina's Graffiti.pc These conjecturing programs have led to a myriad of surprising results, and thus, have motivated the design and introduction of a new conjecturing program called TxGraffiti. Originally written by Davila during the summer of 2016, this program seeks to stimulate interest in graph theoretic parameters which have previously not been related. In this talk, we give a brief description of the program, as well as consider several conjectures of TxGraffiti on the zero forcing number of a graph. This represents the first known use of automated conjecturing to study the zero forcing number.

[B. 10:50–11:00] Bhaswar Bhattacharya, University of Pennsylvania

Title: *Birthday Paradox, Monochromatic Subgraphs, and the Second Moment Phenomenon*

Abstract: What is the chance that among a group of n friends, there are s friends all of whom have the same birthday? This is the celebrated birthday problem which can be formulated as the existence of a monochromatic s -clique K_s (s -matching birthdays) in the complete graph K_n , where every vertex of K_n is uniformly colored with 365 colors (corresponding to birthdays). More generally, for a general connected graph H , let $T(H, G_n)$ be the number of monochromatic copies of H in a uniformly random coloring of the vertices of the graph G_n with c colors.

In this talk we will discuss the limiting distribution of $T(H, G_n)$ in various asymptotic regimes. In particular, $T(H, G_n)$ exhibits an interesting second-moment phenomenon,

converging to a Poisson distribution whenever its expectation and variance are asymptotically equal. As an application, we derive the distribution of $T(H, G_n)$, for Erdos-Renyi random graphs, where multiple phase-transitions emerge, depending on whether the graph H is balanced or unbalanced. We also discuss the asymptotics of $T(H, G_n)$, when G_n is a converging sequence of dense graphs (graphons).

Saturday Afternoon, Contributed Session II

February 10, Afternoon, Contributed Session II		
	Session A, BLOC 166	Session B, BLOC 164
2:55–3:15	Bo Lin	Jerry Hu
3:15–3:35	Federico Castillo	Stephen Graves
3:35–3:55	Li Ying	Archie Rowe
4:15–4:35	Anton Dochterman	Juan Alberto Rodrigues-Velazquez
4:35–4:55	Eric Bucher	Lohans de Oliveiroira Miranda

[A. 2:55–3:15] Bo Lin, University of Texas at Austin

Title: *Tropical Fermat-Weber point*

Abstract: in a metric space, the Fermat-Weber points of a sample are statistics to measure the central tendency of the sample and it is well-known that the Fermat-Weber point of a sample is not necessarily unique in the metric space. We investigate the computation of Fermat-Weber points under the tropical metric on the quotient space $\mathbb{R}^n/\mathbb{R}\mathbf{1}$ with a fixed $n \in \mathbb{N}$, motivated by its application to the space of equidistant phylogenetic trees with N leaves (in this case $n = \binom{N}{2}$) realized as the tropical linear space of all ultrametrics. We show that the set of all tropical Fermat-Weber points of a finite sample is always a classical convex polytope, and we present a combinatorial formula for the minimal sum of distances from an arbitrary point to the points in the sample (which is attained at this set). We identify conditions under which this set is a singleton. We apply numerical experiments to analyze the set of the tropical Fermat-Weber points within a space of phylogenetic trees. We discuss the issues in the computation of the tropical Fermat-Weber points and the k -ellipses that are generalizations of the Fermat-Weber points. This is a joint work with Ruriko Yoshida.

[A. 3:15–3:35] Federico Castillo, Kansas University

Title: *Deformations of the nested braid fan*

Abstract: Generalized permutohedra are defined as polytopes whose normal fan coarsens the Braid fan. We wanted to generalize the construction so that we allowed a bigger set of edges. In joint work with Fu Liu, we introduce the nested Braid fan, which is a refinement of Braid by considering the first difference of ordered coordinates. We show that the nested Braid Fan is the normal fan of some polytope and study its combinatorics.

[A. 3:35–3:55] Li Ying, Texas A&M University

Title: *Stability of the Heisenberg product on symmetric functions.*

Abstract: The Heisenberg product is an associative product defined on symmetric functions which interpolates between the usual product and Kronecker product. I will give the definition of this product and describe some properties of it. One well known thing about the Kronecker product of Schur functions is the stability phenomenon discovered by Murnaghan in 1938. I will give an analogous result for the Heisenberg product of Schur functions.

[A. 4:15–4:35] Anton Dochtermann, Texas State University

Title: *Coparking functions and h-vectors of matroids*

Abstract: The h-vector of a simplicial complex X is a well-studied invariant with connections to commutative algebra and combinatorial topology. When X is the independence complex of a matroid Stanley has conjectured that its h-vector is a ‘pure O-sequence, i.e. the degree sequence of a monomial order ideal where all maximal elements have the same degree. The conjecture has inspired a good deal of research and is proven for some classes of matroids, but is open in general. Merino has established the conjecture for the case that X is a cographical matroid by relating the h-vector to properties of chip-firing and ‘G-parking functions’ on the underlying graph G . We introduce and study the notion of a coparking function on a graph (and more general matroids) inspired by a dual version of chip-firing. As an application, we establish Stanley’s conjecture for new classes of binary matroids that admit a well-behaved ‘circuit covering’. Joint work with Kolja Knauer.

[A. 4:35–4:55] Eric Bucher, Michigan State University

Title: *Component preserving mutations: building up maximal green sequences from sub-quivers.*

Abstract: Quiver mutation is a operation one can define on a directed graph that has shown to model the behavior of a large variety of mathematical objects. We will discuss a bit about quiver mutation, and then proceed to exploring quivers for a special sequence of mutations called maximal green sequences. The aim of the talk is to discuss recent work that allows one to build maximal green sequences for larger quivers by looking at ”component preserving” sequences on induced subquivers. These new techniques have allowed us to construct maximal green sequences for large families of quivers where their existence was previously unknown.

[B. 2:55–3:15] Jerry Hu, University of Houston-Victoria

Title: *Values Sets of Polynomial Maps On Unequal Dimensional Spaces over Finite Fields*

Abstract: Let F_q be a finite field of cardinality q , and f be a polynomial map from F_q^n to F_q^n . Gary Mullen, Daqing Wan, Qiang Wang considered the problem of estimating the cardinality of the set of points missed by f , and give a lower bound of it if f is not surjective, relying on p-adic lifting of f . Michiel Kosters proved an improved lower

bound using a different technique. We consider the problem in the case of unequal dimensional spaces: If f is a polynomial map from F_q^m to F_q^n , with m less than or equal to n . We want to estimate the cardinality of set of subvarieties of dimension $n - m$ and degree d missed by f . We prove a lower bound for the the cardinality of set of subspaces of dimension $n - m$ missed by f if there is such a subspace of dimension $n - m$.

[B. 3:15–3:35] Stephen Graves, The University of Texas at Tyler

Title: *Growth of Face-Homogeneous Tessellations*

Abstract: A tessellation of the plane is *face-homogeneous* if for some integer $k \geq 3$ there exists a cyclic sequence $\sigma = [p_0, p_1, \dots, p_{k-1}]$ of integers ≥ 3 such that, for every face f of the tessellation, the valences of the vertices incident with f are given by the terms of σ in either clockwise or counter-clockwise order. When a given cyclic sequence σ is realizable in this way, it may determine a unique tessellation (up to isomorphism), in which case σ is called *monomorphic*, or it may be the valence sequence of two or more non-isomorphic tessellations (*polymorphic*). A tessellation whose faces are uniformly bounded in the hyperbolic plane but not uniformly bounded in the Euclidean plane is called a *hyperbolic tessellation*. Such tessellations are well-known to have exponential growth. We seek the face-homogeneous hyperbolic tessellation(s) of slowest growth and show that the least growth rate of such monomorphic tessellations is the “golden mean,” $\gamma = (1 + \sqrt{5})/2$, attained by the sequences $[4, 6, 14]$ and $[3, 4, 7, 4]$. A polymorphic sequence may yield non-isomorphic tessellations with different growth rates. However, all such tessellations found thus far grow at rates greater than γ .

[B. 3:35–3:55] Archie Rowe, Tarleton University

Title: *Improving the bounds of Ramsey Numbers using Gibb’s Sampler and Deep Learning*

Abstract: The Ramsey number $R(m_1, \dots, m_k)$ is the minimum number of vertices n such that any k -coloring of the edges of the complete graph K_n , there is at least one color i for which there exists a clique of size m_i that is monochromatically i . These numbers are traditionally hard to establish analytically. They are also hard to find computationally because of the size of the space of possible colorings. We will discuss a search method which combines a Gibbs Sampler search algorithm and Deep Learning techniques. This allows us to move rapidly and intelligently through the state space, harnessing the power of modern NVIDIA GPU hardware and MCMC techniques. We will present our current partial progress toward increasing the lower bounds smaller, non-trivial Ramsey numbers.

[B. 4:15–4:35] Juan Alberto Rodrigues-Velazquez, Universitat Rovira i Virgili

Title: *On the k -metric dimension of metric spaces*

Abstract: The metric dimension of a general metric space was introduced in 1953 but attracted little attention until, about twenty years later, it was applied to the distances between vertices of a graph. Since then it has been frequently used in graph theory, biology, robotics and many other disciplines. The theory was developed further in

2013 for general metric spaces. More recently, the theory of metric dimension has been generalized, again in the context of graph theory, to the notion of a k -metric dimension, where k is any positive integer, and where the case $k = 1$ corresponds to the original theory. Here we develop the idea of the k -metric dimension both in graph theory and in metric spaces.

[B. 4:35–4:55] Lohans de Oliveira Miranda, UFPI, UNISUL, Brazil

Title: *Combinatorial Dickson’s Method for Generating Pythagorean Triples*

Abstract: From the Newton’s binomial formula and geometric procedures is established the Dickson’s method for Pythagorean triples.

Sunday Morning, Contributed Session III

February 11, Morning, Contributed Session III		
	Session A, BLOC 166	Session B, BLOC 164
8:30–8:50	Suho Oh	
8:50–9:10	Robert McAlmon	Boris Brimkov
9:10–9:30	Art Duval	Mustafa Gezek
9:30–9:50	Jacob White	Pani Seneviratne
9:50–10:10	Kassie Archer	Criel Merino

[A. 8:30–8:50] Suho Oh, Texas State University

Title: *Positroids, rank function and non-crossing partitions*

Abstract: Positroids are matroids encoding the totally nonnegative part of the Grassmannian. Positroids are in bijection with decorated permutations. In this talk, we present a new method obtaining the rank function of a positroid directly from the associated permutation (joint work with R. McAlmon). As a by-product, we can describe explicitly the facets of the matroid polytope and the independent set polytope of a positroid, and also present a conjecture on flag positroids.

[A. 8:50–9:10] Robert McAlmon, Texas State University

Title: *Bruhat Order and Hyperplane Arrangements*

Abstract:

[A. 9:10–9:30] Art Duval, University of Texas at El Paso

Title: *Matroids and statistical dependency*

Abstract: What does it mean for a set of more than two variables to be statistically dependent, even if no two of them are pairwise dependent? We compare different ways of determining this dependency and show they are consistent. We show that, if we make common statistical assumptions on data, then the resulting structure of dependencies may be described by a matroid. We use real examples from biology to demonstrate

how the description with matroids helps simplify the presentation of complex variable dependency. This is joint work with Amy Wagler.

[A. 9:30–9:50] Jacob White, UTRGV

Title: *Introduction to megagreedoids*

Abstract: Many polynomials in combinatorics, such as the chromatic polynomial of a graph, or order polynomial of a poset, have nonnegative h-vectors. These polynomials are special cases of polynomial invariants associated to generalized permutohedra, which Aguiar and Ardila showed satisfy a combinatorial reciprocity law. We introduce the notion of megagreedoid, which generalizes graphs, posets, matroids, greedoids, and generalized permutohedra. We also introduce a polynomial invariant, and show that it has a nonnegative h-vector. The proof relies on using the greedy algorithm to show that a related relative simplicial complex is shellable.

[A. 9:50–11:10] Kassie Archer, University of Texas at Tyler

Title: *On λ -unimodal permutations*

Abstract: A permutation is called λ -unimodal if it comprised of unimodal segments whose lengths are determined by the composition λ . These permutations first appeared in the formulas for different characters of the symmetric group. In this talk, we enumerate λ -unimodal permutations with certain important properties.

[B. 8:50–9:10] Boris Brimkov, Rice University

Title: *Connected power domination in graphs*

Abstract: Power domination in graphs arises from the problem of placing a minimum number of measurement devices in an electrical network while monitoring the entire network. A power dominating set of a graph is a set of vertices from which every vertex in the graph can be observed, following a set of rules for power system monitoring. This talk focuses on the problem of finding a minimum power dominating set which is connected; the cardinality of such a set is called the connected power domination number of the graph. We show that this parameter is NP-hard to compute in general, but can be computed in linear time in cactus graphs and block graphs. We also characterize the effects of local modifications of a graph on its connected power domination number, and give various structural results. Finally, we present novel integer programming formulations for power domination and connected power domination, and give computational results.

[A. 9:10–9:30] Mustafa Gezek, Namik Kemal University

Title: *New Maximal arcs in the projective planes of order 16 and related designs*

Abstract: The resolutions and maximal sets of compatible resolutions of all 2-(52,4,1) designs arising from previously known maximal (52,4)-arcs, as well as some newly discovered maximal (52,4)-arcs in the known projective planes of order 16, are computed. The computations of the maximal sets of compatible resolutions of the 2-(52,4,1) designs associated with maximal (52,4)-arcs show that five of the known projective planes

of order 16 contain maximal arcs whose associated designs are embeddable in two non-isomorphic planes of order 16. Previously the number of pairwise non-isomorphic resolutions of 2 -(52,4,1) designs was > 29 , with our results, this bound is improved as well.

[A. 9:30–9:50] Pani Seveviratne, Texas A&M University-Commerce

Title: *Linear codes from Paley-Type bipartite graphs*

Abstract: In this work we derive classes of self-dual, self-orthogonal and linear complementary dual codes from neighborhood designs of Paley-type bipartite graphs $P(q, k)$. Further, we determine the structure of the automorphism group of $P(q, k)$ and use this information to find partial permutation decoding sets. This is a joint work with Kenza Guenda (University of Victoria, Canada) and Fella Nazahet (UMMB, Algeria).

[A. 9:50–11:10] Criel Merino, UNAM

Title: *Counting spanning trees on the complement graph*

Abstract: Counting spanning trees in connected graphs is a classic theme in Combinatorics. There are many techniques to compute this number, and while some of these are very much in use today, some have been forgotten. For this talk, I want to recover one technique and place it in the language of a very general algebraic invariant associated to a graph. The invariant is the U -polynomial which was introduced in 1999 by Noble and Welsh. I exemplify the technique with stars, the disjoint union of q edges, and paths. In this latter case, there is a relation to Chebyshev polynomials.