UNIVERSITY OF MICHIGAN
Department of Mathematics

Seminar & Events Bulletin: Combinatorics

09-01-2011 to 06-30-2033

Friday, September 16, 2011	
4:10pm-5:00pm	**Combinatorics** -- Cynthia Vinzant (U. Michigan) *The central curve of a linear program* -- 3866 East Hall

Friday, September 23, 2011	
4:10pm-5:00pm	**Combinatorics** -- David Speyer (U. Michigan) *Wiring diagrams and alternating strand diagrams* -- 3866 East Hall

Friday, September 30, 2011	
4:10pm-5:00pm	**Combinatorics** -- Max Glick (U. Michigan) *On singularity confinement for the pentagram map* -- 3866 East Hall

Friday, October 07, 2011	
4:10pm-5:00pm	**Combinatorics** -- Leonid Petrov (Northeastern U.) *sl(2) operators and Markov dynamics on branching graphs* -- 3866 East Hall

Friday, October 14, 2011	
4:10pm-5:00pm	**Combinatorics** -- Seungjin Lee (U. Michigan) *Centrally symmetric polytopes with many faces* -- 3866 East Hall

Friday, October 21, 2011	
4:10pm-5:00pm	**Combinatorics** -- Lionel Levine (Cornell U.) *Abelian networks* -- 3866 East Hall

Friday, October 28, 2011	
4:10pm-5:00pm	**Combinatorics** -- Shmuel Friedland (UIC) *On the eigenvalues of graphs: results and conjectures* -- 3866 East Hall

Friday, November 04, 2011	
4:10pm-5:00pm	**Combinatorics** -- Daniele Rosso (U. Chicago) *Classic and mirabolic RSK correspondence for partial flags* -- 3866 East Hall

Friday, November 11, 2011	
4:10pm-5:00pm	**Combinatorics** -- Thomas Lam (U. Michigan) *The shape of a random affine Weyl group element, and random core partitions* -- 3866 East Hall

Friday, November 18, 2011	
4:10pm-5:00pm	**Combinatorics** -- Askold Khovanskii (U. Toronto) *Algebraic and convex geometries* -- 3866 East Hall

Friday, December 02, 2011	
4:10pm-5:00pm	**Combinatorics** -- Cristian Lenart (SUNY Albany) *The combinatorics of affine crystals and the energy function* -- 3866 East Hall

Friday, December 09, 2011	
4:10pm-5:00pm	**Combinatorics** -- Sean Keel (U. Texas) *Mirror symmetry and cluster varieties* -- 3866 East Hall

Seminar & Events Bulletin: Combinatorics

09-01-2011 to 06-30-2033

Friday, January 27, 2012	
4:10pm-5:00pm	**Combinatorics** -- Nathan Reading (NCSU) *Universal geometric cluster algebras* -- 3866 East Hall

Friday, February 03, 2012	
4:10pm-5:00pm	**Combinatorics** -- Suho Oh (University of Michigan) *Triangulations of product of simplices* -- 3866 East Hall

Friday, February 10, 2012	
4:10pm-5:00pm	**Combinatorics** -- John Stembridge (University of Michigan) *W-Cells from Scratch* -- 3866 East Hall

Friday, February 17, 2012	
4:10pm-5:00pm	**Combinatorics** -- Ivan Corwin (Microsoft and MIT) *Tropical combinatorics and Whittaker functions* -- 3866 East Hall

Friday, February 24, 2012	
4:10pm-5:00pm	**Combinatorics** -- Jinho Baik (University of Michigan) *Maximal crossing and nesting of random matchings* -- 3866 East Hall

Friday, March 09, 2012	
4:10pm-5:00pm	**Combinatorics** -- Svante Linusson (KTH) *TASEP on a circle with many types of particles* -- 3866 East Hall

Friday, March 16, 2012	
4:10pm-5:00pm	**Combinatorics** -- Reiho Sakamoto (Tokyo University of Science) *A survey on box-ball systems* -- 3866 East Hall

Friday, March 23, 2012	
4:10pm-5:00pm	**Combinatorics** -- Alexander Ellis (Columbia University) *Odd symmetric functions* -- 3866 East Hall

Friday, March 30, 2012	
4:10pm-5:00pm	**Combinatorics** -- Patricia Hersh (NCSU) *Symmetric chain decomposition for cyclic quotients of Boolean algebras and relation to cyclic crystals* -- 3866 East Hall

Friday, April 06, 2012	
4:10pm-5:00pm	**Combinatorics** -- David Perkinson (Reed College) *The algebraic geometry of sandpiles* -- 3866 East Hall

Friday, April 13, 2012	
4:10pm-5:00pm	**Combinatorics** -- Karola Meszaros (University of Michigan) *Flow polytopes and the Kostant partition function* -- 3866 East Hall

Friday, September 14, 2012	
4:10pm-5:00pm	**Combinatorics** -- Cynthia Vinzant (U. Michigan) *Hyperbolic Polynomials, Interlacers, and Sums of Squares* -- 3866 East Hall

Seminar & Events Bulletin: Combinatorics

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Friday, September 21, 2012	
4:10pm-5:00pm	**Combinatorics** -- Jonah Blasiak (UM) *Kronecker coefficients for one hook shape* -- 3866 East Hall

Friday, September 28, 2012	
4:10pm-5:00pm	**Combinatorics** -- Frank Sottile (Texas A&M) *An inequality of Kostka numbers and Galois groups of Schubert problems of lines* -- 3866 East Hall

Friday, October 05, 2012	
4:10pm-5:00pm	**Combinatorics** -- Jed Yang (UCLA) *Tiling simply connected regions with rectangles* -- 3866 East Hall

Friday, October 12, 2012	
4:10pm-5:00pm	**Combinatorics** -- Ricky Liu (UM) *Subalgebras of the Fomin-Kirillov algebra* -- 3866 East Hall

Friday, October 19, 2012	
4:10pm-5:00pm	**Combinatorics** -- David Speyer (U. Michigan) *Real Schubert problems, stable curves and tableaux combinatorics* -- 3866 East Hall

Friday, October 26, 2012	
4:10pm-5:00pm	**Combinatorics** -- Zach Hamaker (Dartmouth College) *Relating Edelman-Greene insertion and the Little map* -- 3866 East Hall

Friday, November 02, 2012	
4:10pm-5:00pm	**Combinatorics** -- Anders Buch (Rutgers U) *CANCELLED* -- 3866 East Hall

Friday, November 09, 2012	
4:10pm-5:00pm	**Combinatorics** -- Dustin Ross (Colorado State U.) *The Loop Murnaghan-Nakayama Rule* -- 3866 East Hall

Friday, November 16, 2012	
4:10pm-5:00pm	**Combinatorics** -- Anders Buch (Rutgers U.) *The puzzle conjecture for 2-step flag manifolds* -- 3866 East Hall

Friday, November 30, 2012	
4:10pm-5:00pm	**Combinatorics** -- Harm Derksen (U. Michigan) *The Graph Isomorphism Problem* -- 3866 East Hall

Friday, January 18, 2013	
4:10pm-5:00pm	**Combinatorics** -- Tomoo Matsumura (KAIST) *(Factorial) Schur functions and weighted Grassmannians* -- 3866 East Hall

Friday, February 01, 2013	
4:10pm-5:00pm	**Combinatorics** -- Andreas Blass (University of Michigan) *Shelah's bipartite matching algorithm* -- 3866 East Hall

Seminar & Events Bulletin: Combinatorics

09-01-2011 to 06-30-2033

Friday, February 08, 2013	
4:10pm-5:00pm	**Combinatorics** -- Michael Shapiro (Michigan State University) *Growth rate classification for cluster algebras* -- 3866 East Hall

Friday, February 22, 2013	
4:10pm-5:00pm	**Combinatorics** -- Li Li (Oakland University) *Positivity and tameness in rank 2 cluster algebras* -- 3866 East Hall

Friday, March 01, 2013	
4:10pm-5:00pm	**Combinatorics** -- Alexander Barvinok (University of Michigan) *Thrifty approximations of convex bodies by polytopes* -- 3866 East Hall

Friday, March 15, 2013	
4:10pm-5:00pm	**Combinatorics** -- Bruce Sagan (Michigan State University) *Factoring the characteristic polynomial of a poset* -- 3866 East Hall

Friday, March 22, 2013	
4:10pm-5:00pm	**Combinatorics** -- Michael Chmutov (University of Michigan) *Type A molecules are of Kazhdan-Lusztig type* -- 3866 East Hall

Friday, March 29, 2013	
4:10pm-5:00pm	**Combinatorics** -- Kevin Carde (University of Michigan) *Cluster structures on mixed invariant rings, and related combinatorics* -- 3866 East Hall

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Abstracts

Combinatorics
Friday, September 16, 2011, 4:10pm-5:00pm
3866 East Hall
Cynthia Vinzant (U. Michigan)
The central curve of a linear program

The central curve of a linear program is an algebraic curve specified by a hyperplane arrangement and a cost vector. This curve is the union of the various central paths for minimizing or maximizing the cost function over any region in this hyperplane arrangement. I will discuss the algebraic properties of this curve and its beautiful global geometry, both of which are controlled by the corresponding matroid of the hyperplane arrangement.

Combinatorics
Friday, September 23, 2011, 4:10pm-5:00pm
3866 East Hall
David Speyer (U. Michigan)
Wiring diagrams and alternating strand diagrams

Wiring diagrams are classical objects of combinatorics, and have many equivalent guises, including zonogonal tilings, strongly separated collections of subsets of [n], and sections of projections from a cube to a plane. Alternating strand diagrams were introduced by Alex Postnikov in order to describe coordinates on Postnikov's totally nonnegative decomposition of the Grassmannian. We show how to extend many of the descriptions of wiring diagrams to alternating strand diagrams, proving in the process a conjecture of Scott, and raising new questions about both subjects. Primarily based on joint work with Suho Oh and Alex Postnikov, with possible mentions of other projects of mine.

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Combinatorics
Friday, September 30, 2011, 4:10pm-5:00pm
3866 East Hall
Max Glick (U. Michigan)
On singularity confinement for the pentagram map

The pentagram map, introduced by R. Schwartz, is a birational map on the configuration space of polygons in the projective plane. We study the singularities of the iterates of the pentagram map. We show that a typical singularity disappears after a finite number of iterations, a confinement phenomenon first discovered by Schwartz. We provide a method to bypass such a singular patch by directly constructing the first subsequent iterate that is well defined on the singular locus under consideration. The key ingredient of this construction is the notion of a decorated (twisted) polygon, and the extension of the pentagram map to the corresponding decorated configuration space.

Combinatorics
Friday, October 07, 2011, 4:10pm-5:00pm
3866 East Hall
Leonid Petrov (Northeastern U.)
sl(2) operators and Markov dynamics on branching graphs

Back in the 1980s, S.Fomin and R.Stanley observed that certain commutation relations between linear operators associated with a graded poset (or a graded graph) lead to enumerative results and combinatorial correspondences. In the last decade, A. Borodin, J.Fulman, A.Okounkov, G.Olshanski, and myself used more general commutation relations to study probability measures and Markov processes on partitions.

I will start with operators satisfying sl(2) commutation relations as in Okounkov's paper, and use them to give a new characterization of important measures on partitions. Examples include the two-parameter Poisson-Dirichlet distributions as well as measures coming from representation theory of the infinite symmetric group. I will then explain how these sl(2) operators can be used to describe and study Markov dynamics on partitions in these examples in a unified manner.

Combinatorics
Friday, October 14, 2011, 4:10pm-5:00pm
3866 East Hall
Seungjin Lee (U. Michigan)
Centrally symmetric polytopes with many faces

I will present a construction, based on the symmetric moment curve, of centrally symmetric polytopes with many faces. The talk is based on a joint work with A. Barvinok and I. Novik.

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Combinatorics
Friday, October 21, 2011, 4:10pm-5:00pm
3866 East Hall
Lionel Levine (Cornell U.)
Abelian networks

An abelian network is a collection of finite automata that live at the vertices of a graph and communicate via the edges. It produces the same output no matter in what order the automata process their inputs. This talk will touch on three basic themes, using chip-firing and rotor-routing as illustrating examples.

1. Halting problem: how to tell whether an abelian network halts on all inputs.

2. Local-to-global principles: certain features of the automata are inherited by the whole network.

3. Critical group: a finite abelian group that governs the long-term behavior of the network.

Combinatorics
Friday, October 28, 2011, 4:10pm-5:00pm
3866 East Hall
Shmuel Friedland (UIC)
On the eigenvalues of graphs: results and conjectures

In this talk we will discuss two topics. First, upper estimates on the maximal eigenvalue, (Perron-Frobenius eigenvalue), of graphs: undirected, bipartite and directed graphs, with prescribed number of vertices and edges. We will characterize in certain cases the graphs which have the biggest maximal eigenvalue.

Second we will discuss the recent solution of the Grone-Merris conjecture by Hua Bai. This conjecture stated that the eigenvalue sequence of the Laplacian of a given simple undirected graph is majorized by the the dual sequence of the degrees of the graph, and equality holds for threshold graphs.

Combinatorics
Friday, November 04, 2011, 4:10pm-5:00pm
3866 East Hall
Daniele Rosso (U. Chicago)
Classic and mirabolic RSK correspondence for partial flags

The Robinson-Schensted-Knuth correspondence is a purely combinatorial statement, but Steinberg and Spaltenstein independently found that it relates the relative position of two complete flags to the irreducible components of the flag variety in which they lie. Travkin then gave an algorithm for the case of 'mirabolic' varieties of complete flags. We will go over these results and then see how to generalize them to the case of partial flags.

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Combinatorics
Friday, November 11, 2011, 4:10pm-5:00pm
3866 East Hall
Thomas Lam (U. Michigan)
The shape of a random affine Weyl group element, and random core partitions

I will discuss the "shape" of a random element of an affine Weyl group, where an element is randomly generated by (reduced) multiplication by simple generators. This is equivalent to looking at a random walk in the affine Coxeter arrangement that is conditioned to never cross a hyperplane twice. I will also connect this problem to the shape of random core partitions.

Combinatorics
Friday, November 18, 2011, 4:10pm-5:00pm
3866 East Hall
Askold Khovanskii (U. Toronto)
Algebraic and convex geometries

Traditionally, the connection between convex geometry and algebraic geometry has been restricted to the framework of toric varieties and Newton polyhedra. The theory of Newton-Okounkov bodies, developed in recent joint work with Kiumars Kaveh, transcends these limitations. Generalizing the notion of a Newton polyhedron, we define Newton-Okounkov bodies for semigroups of integral points, graded algebras and linear series on varieties. We show that for a large
class of graded algebras, the Hilbert functions have polynomial growth, and their growth coefficients satisfy a Brunn-Minkowski type inequality. If time permitted we will also discuss a new version of the intersection theory. Newton-Okounkov bodies together with this intersection theory allow to prove an algebraic analogues of Alexandrov-Fenchel inequality and to give elementary proof of the classical Alexandrov-Fenchel inequality. These results provide an interplay between algebraic and convex geometries, and suggest a new geometric Alexandrov-Fenchel type inequality for mixed covolumes of convex bodies inscribed in a given convex cone.

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Combinatorics
Friday, December 02, 2011, 4:10pm-5:00pm
3866 East Hall
Cristian Lenart (SUNY Albany)
The combinatorics of affine crystals and the energy function

Crystals are colored directed graphs encoding information about Lie algebra representations. Certain (not highest weight) crystals for affine Lie algebras known as Kirillov-Reshetikhin (KR) crystals are graded by the energy function. Since crystals have various combinatorial models, it is desirable to compute the energy as a related statistic. With A. Postnikov we defined the so-called alcove model for (highest weight) crystals. I will present a generalization which is conjectured to model tensor products of KR crystals of arbitrary Lie type. The conjecture implies that a related statistic computes the energy. There is reasonable evidence for this conjecture. For instance, it is proved for Lie types A and C (i.e., for the special linear and symplectic algebras). I rephrase the energy statistic in type A as a well-known word statistic (the charge), while in type C I define a similar one. The talk contains joint work with Anne Schilling and Arthur Lubovsky, and is largely self-contained.

Combinatorics
Friday, December 09, 2011, 4:10pm-5:00pm
3866 East Hall
Sean Keel (U. Texas)
Mirror symmetry and cluster varieties

I will recall the definitions of Fock-Goncharov cluster varieties, reformulate the theory in terms of birational geometry of Calabi-Yau varieties, and explain how the Fock-Goncharov conjectures on canonical dual bases are special cases of our general mirror conjecture, and then deduce from our theorem (discussed in the algebraic geometry seminar) their conjecture for skew symmetric matrices of rank two. No previous knowledge of cluster varieties will be required.

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Combinatorics
Friday, January 27, 2012, 4:10pm-5:00pm
3866 East Hall
Nathan Reading (NCSU)
Universal geometric cluster algebras

For each skew-symmetrizable integer matrix B, there are infinitely many cluster algebras of geometric type, differing by a choice of coefficients. These are related by maps called coefficient specializations. In this talk, I'll discuss the general problem of finding a cluster algebra of geometric type that is universal, in the sense of coefficient specializations, among geometric cluster algebras for B. If B is of finite type, then the problem was solved by Fomin and Zelevinsky. I'll show how the Fomin-Zelevinsky result can be rephrased in a form that admits generalization beyond finite type. The generalization revolves around a fan called the mutation fan for B.

Combinatorics
Friday, February 03, 2012, 4:10pm-5:00pm
3866 East Hall
Suho Oh (University of Michigan)
Triangulations of product of simplices

After the work of Develin and Sturmfels on tropical convexity, Ardila and Develin defined tropical oriented matroids, and showed that they encode subdivisions of product of simplices. In a joint work with Yoo, we show that every triangulation of product of simplices encode a tropical oriented matroid. In this talk, I will give a survey on this topic, and introduce an ongoing project, on connections to matching fields studied by Bernstein and Zelevinsky.

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Combinatorics
Friday, February 10, 2012, 4:10pm-5:00pm
3866 East Hall
John Stembridge (University of Michigan)
W-Cells from Scratch

A W-graph is an edge-weighted graph that encodes certain representations of a Weyl group W or its associated Hecke algebra. In particular, the action of the Hecke algebra by left or right
multiplication on its Kazhdan-Lusztig basis has this form. Knowing the W-graph makes the computation of Kazhdan-Lusztig polynomials relatively easy.

In this talk we will describe a method, not yet completely effective, for constructing the (necessarily finite) set of "admissible" W-cells. This is a class of W-graphs that includes the cells (i.e., strongly connected components) of the Kazhdan-Lusztig W-graph. For example, in type A up to rank 9, we know that the only admissible cells are the K-L cells, but this fails for general W.

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Combinatorics
Friday, February 17, 2012, 4:10pm-5:00pm
3866 East Hall
Ivan Corwin (Microsoft and MIT)
Tropical combinatorics and Whittaker functions

The Robinson-Schensted-Knuth (RSK) correspondence is a combinatorial mapping which plays a fundamental role in the theory of Young tableaux, symmetric functions, ultra-discrete integrable systems and representation theory. It is also the basic structure that lies behind the `solvability' of a particular family of combinatorial models in probability and statistical physics which include longest increasing subsequence problems, directed last passage percolation in 1+1 dimensions, the totally asymmetric exclusion process, queues in series and discrete models for surface growth. There is a geometric version of the RSK correspondence introduced by A.N. Kirillov, known as the `tropical RSK correspondence'. We show that, with a particular family of product measures on its domain, the tropical RSK correspondence is closely related to GL(N,R)-Whittaker functions and yields analogues in this setting of the Schur measures and Schur processes on integer partitions.

This is based on joint work with Neil O'Connell, Timo Seppalainen and Nikos Zygouras.

Combinatorics
Friday, February 24, 2012, 4:10pm-5:00pm
3866 East Hall
Jinho Baik (University of Michigan)
Maximal crossing and nesting of random matchings

The number of complete matchings on [2n] with no crossings equals the Catalan number and so does the number of matchings with no nestings. The notion of r-crossing (r-nesting) matchings is a generalization of matchings with no crossings (nestings). The number of matchings with no j-crossing and no k-nesting was evaluated by Chen, Deng, Du, Stanley and Yan in 2007 in terms of a Toeplitz determinant. This work was based on a bijection between partitions and vacillating tableaux. Building on their work, we study the limiting joint distribution of the maximal crossing and the maximal nesting of random Poissonized matchings. This is a joint work with Robert Jenkins (UM).

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09-01-2011 to 06-30-2033

Combinatorics
Friday, March 09, 2012, 4:10pm-5:00pm
3866 East Hall
Svante Linusson (KTH)
TASEP on a circle with many types of particles

Consider words of length N>n with letters from the alphabet {1,...,n}. We study the Markov chain where a letter i can jump to the left if the letter to its left is larger. This is called a multi-type TASEP and if all jump rates are equal, Ferrari and Martin have designed a model which gives a nice combinatorial description of the stationary measure. I will describe this model and discuss the problem when the different letters (particles) have different jump rates. Our work leads to progress on a recent positivity conjecture by Lam and Williams stemming originally from work by Lam on reduced infinite words in Affine Coxeter groups.

This is joint work with Arvind Ayyer.

Combinatorics
Friday, March 16, 2012, 4:10pm-5:00pm
3866 East Hall
Reiho Sakamoto (Tokyo University of Science)
A survey on box-ball systems

The box-ball systems are the typical example of ultradiscrete (or tropical) integrable systems. In this talk, I will give a brief survey of recent developments in the subject. The topics will include early history, definition based on the crystal bases of quantum affine algebras, the relation with the rigged configurations, several mathematical applications and a recently found variation called the box-basket-ball system.

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Combinatorics
Friday, March 23, 2012, 4:10pm-5:00pm
3866 East Hall
Alexander Ellis (Columbia University)
Odd symmetric functions

We introduce the odd symmetric functions, a Z-graded Hopf superalgebra which exhibits signed analogues of many of the combinatorial properties of the classical symmetric functions: elementary and complete bases, Kostka numbers, Schur functions, RSK and Littlewood-Richardson, and so forth. This superalgebra is obtained as a quotient of a q-Hopf algebra isomorphic to the graded dual of the quantum quasi-symmetric functions. It also arises as the kernel of odd divided difference operators which act on skew polynomials; these operators are part of an odd nilHecke algebra. Odd nilHecke algebras can be used to categorify half of quantum sl(2) and, conjecturally, give a 2-representation theoretic construction of odd Khovanov homology.

Combinatorics
Friday, March 30, 2012, 4:10pm-5:00pm
3866 East Hall
Patricia Hersh (NCSU)
Symmetric chain decomposition for cyclic quotients of Boolean algebras and relation to cyclic crystals

The quotient of a Boolean algebra by a cyclic group is proven to have a symmetric chain decomposition. This generalizes earlier work of Griggs, Killian and Savage on the case of prime order, giving an explicit construction for any order, prime or composite. The combinatorial map specifying how to proceed downward in a symmetric chain is shown to be a natural cyclic analogue of Kashiwara's sl_2 lowering operator in the theory of crystal bases. The talk will include a survey of related past work on symmetric chain decomposition and unimodality by Greene-Kleitman, Griggs-Killian-Savage, Proctor, Stanley and others as well as a discussion of open questions that still remain. This is joint work with Anne Schilling.

Combinatorics
Friday, April 06, 2012, 4:10pm-5:00pm
3866 East Hall
David Perkinson (Reed College)
The algebraic geometry of sandpiles

The Abelian Sandpile Model (ASM) is a game played on a graph realizing the dynamics implicit in the discrete Laplacian matrix of the graph. This introductory talk will apply the theory of lattice ideals from algebraic geometry to the Laplacian matrix, drawing out connections with the ASM.

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Combinatorics
Friday, April 13, 2012, 4:10pm-5:00pm
3866 East Hall
Karola Meszaros (University of Michigan)
Flow polytopes and the Kostant partition function

This talk will survey the remarkable connections between flow polytopes and Kostant partition functions. One intriguing result in this field is a theorem of Stanley and Postnikov, which expresses the volume of a flow polytope as a Kostant partition function. I'll present a generalization of this theorem, as well as constructions of flow polytopes with combinatorial volumes. The talk is based on joint work with Alejandro H. Morales.

Combinatorics
Friday, September 14, 2012, 4:10pm-5:00pm
3866 East Hall
Cynthia Vinzant (U. Michigan)
Hyperbolic Polynomials, Interlacers, and Sums of Squares

Hyperbolic polynomials are real polynomials whose real hypersurfaces are nested ovaloids, the inner most of which is convex. These polynomials appear in many areas of mathematics, including optimization, combinatorics and differential equations. I'll give an introduction to this topic and discuss the special connection between hyperbolic polynomials and their interlacing polynomials (whose real ovals interlace the those of the original). This will let us related inner oval of a hyperbolic hypersurface to the cone of nonnegative polynomials and, hopefully, to sums of squares. An important example will be the bases generating polynomial of a matroid.

Combinatorics
Friday, September 21, 2012, 4:10pm-5:00pm
3866 East Hall
Jonah Blasiak (UM)
Kronecker coefficients for one hook shape

The Kronecker coefficient g_{\lambda \mu \nu} is the multiplicity of an irreducible S_n-module M_\nu in the tensor product M_\lambda \otimes M_\mu. A fundamental open problem in algebraic combinatorics is to find a positive combinatorial formula for these coefficients. We give such a formula in the case that one of the partitions is a hook shape. Our main tool is Haiman's mixed insertion, which is a generalization of Schensted insertion to colored words.

Combinatorics
Friday, September 28, 2012, 4:10pm-5:00pm
3866 East Hall
Frank Sottile (Texas A&M)
An inequality of Kostka numbers and Galois groups of Schubert problems of lines

Tensor decompositions of rational sl_2-modules and Schubert calculus on the Grassmannians of lines are both goverened by fillings of Young tableaux with two rows, which are certain Kostka numbers. While these Kostka numbers satisfy a simple recursion, there is no closed formula for them in general.

This details of this recursion have geometric consequences, for if the terms are always unequal (or if both equal 1), then a lemma of Vakil and a geometric explaination of the recursion (due to Schubert) imply that all Schubert problems involving lines have Galois group that is at least aternating. Extensive computation suggested that this is the case.

The inequality is easy, in most cases. To treat the remaining cases, we discovered a formula for these Kostka numbers as a trigonometric integral, which should be of independent interest. This integral formula reduces the inequaity of Kostka numbers to the positivity of a trigonometric integral, which is established by estimation. This shows that Galois groups of Schubert problems of lines are at least alternating.

My talk will describe this story with a emphasis on its combinatorial aspects. This is joint work with Christopher Brooks and Abraham Martin del Campo, who were, respectively, an undergraduate and a graduate student at the time of this research.

Combinatorics
Friday, October 05, 2012, 4:10pm-5:00pm
3866 East Hall
Jed Yang (UCLA)
Tiling simply connected regions with rectangles

Given a set of tiles on a square grid (think polyominoes) and a region, can we tile the region by copies of the tiles? In general this decision problem is undecidable for infinite regions and NP-complete for finite regions. In the case of simply connected finite regions, the problem can be solved in polynomial time for some special sets of tiles using group theory; whereas the NP-completeness proofs rely heavily on the regions having lots of holes. We construct a fixed set of rectangular tiles whose tileability problem is NP-complete even for simply connected regions.

Joint work with Igor Pak.

Combinatorics
Friday, October 12, 2012, 4:10pm-5:00pm
3866 East Hall
Ricky Liu (UM)
Subalgebras of the Fomin-Kirillov algebra

The Fomin-Kirillov algebra is a quadratic algebra that was introduced to study the cohomology of the flag variety. We define for any graph a subalgebra of the Fomin-Kirillov algebra and investigate its properties. In particular, we conjecture that these subalgebras have a surprising number of nice properties analogous to those of finite Coxeter groups and their corresponding nil-Coxeter algebras. This is joint work with Jonah Blasiak and Karola Meszaros.

Combinatorics
Friday, October 19, 2012, 4:10pm-5:00pm
3866 East Hall
David Speyer (U. Michigan)
Real Schubert problems, stable curves and tableaux combinatorics

Given a finite list of points z_i on the projective line, we can write down a family of enumerative algebraic geometry problems; the simplest of which is to find rational functions with the z_i as critical points. The Shapiro-Shapiro conjecture, proved by Mukhin, Tarasov and Varchenko, states that, if the z_i are all real, then the solutions to the algebraic geometry problems are all real. I will describe how to extend this result to when the points collide. This will give us a collection of coverings of the moduli space of stable curves. Describing the topology of these coverings recovers standard manipulations of Young tableaux, and provides new explanations for them.

Combinatorics
Friday, October 26, 2012, 4:10pm-5:00pm
3866 East Hall
Zach Hamaker (Dartmouth College)
Relating Edelman-Greene insertion and the Little map

The study of reduced decompositions of symmetric group elements has been a rich source for combinatorial problems since being introduced by Stanley in 1980. Shortly after, major breakthroughs were made via an RSK-like insertion algorithm developed by Edelman and Greene and algebraic results of Lascoux and Schutzenberger. In 2000 David Little demonstrated a bijective realization of Lascoux and Schutzenberger's results. We relate Edelman-Greene insertion to the Little map, tying together this body of work and proving new properties about each map. This is joint work with Benjamin Young.

Combinatorics
Friday, November 02, 2012, 4:10pm-5:00pm
3866 East Hall
Anders Buch (Rutgers U)
CANCELLED

A conjecture of Allen Knutson from 1999 asserts that the Schubert structure constants of the cohomology ring of any flag variety SL(n)/P are equal to the number of triangular puzzles with specified border labels that can be constructed using a list of puzzle pieces. Knutson quickly found a counterexample to the general conjecture. Joint work of myself, Kresch, and Tamvakis later showed that the (3-point, genus zero) Gromov-Witten invariants of Grassmannians are special cases of the structure constants of two-step flag varieties, and we suggested that Knutson's conjecture might be true in this special case, backed up by computer verification for n <= 16. I will speak about a proof of this conjecture, joint with Andrew Kresch, Kevin Purbhoo, and Tamvakis. I will also explain a generalization to the equivariant structure constants of two-step flag varieties that I have recently found a proof of.

Combinatorics
Friday, November 09, 2012, 4:10pm-5:00pm
3866 East Hall
Dustin Ross (Colorado State U.)
The Loop Murnaghan-Nakayama Rule

Classically, Schur functions form a linear basis of the ring of symmetric functions are are ubiquitous in combinatorics, representation theory, and geometry. Recently, in the study of total positivity in matrix loop groups, Lam and Pylyavskyy developed a 'loop' generalization of these classical objects with a simple combinatorial interpretation. The loop Schur functions appeared more recently and independently in the study of the conjectural GW/DT correspondence for orbifolds where they are related to generating functions of ideal sheaves on orbifolds.

In this talk I will introduce loop Schur functions along with some basic properties. I will describe my motivations for studying them, and I will present a direct combinatorial proof of the loop Murnaghan-Nakayama rule which was pivotal in proving the GW/DT for a certain class of orbifold targets.

Seminar & Events Bulletin: Combinatorics

09-01-2011 to 06-30-2033

Combinatorics
Friday, November 16, 2012, 4:10pm-5:00pm
3866 East Hall
Anders Buch (Rutgers U.)
The puzzle conjecture for 2-step flag manifolds

A conjecture of Allen Knutson from 1999 asserts that the Schubert structure constants of the cohomology ring of any flag variety SL(n)/P are equal to the number of triangular puzzles with specified border labels that can be constructed using a list of puzzle pieces. Knutson quickly found a counterexample to the general conjecture. Joint work of myself, Kresch, and Tamvakis later showed that the (3-point, genus zero) Gromov-Witten invariants of Grassmannians are special cases of the structure constants of two-step flag varieties, and we suggested that Knutson's conjecture might be true in this special case, backed up by computer verification for n <= 16. I will speak about a proof of this conjecture, joint with Andrew Kresch, Kevin Purbhoo, and Tamvakis. I will also explain a generalization to the equivariant structure constants of two-step flag varieties that I have recently found a proof of.

Combinatorics
Friday, November 30, 2012, 4:10pm-5:00pm
3866 East Hall
Harm Derksen (U. Michigan)
The Graph Isomorphism Problem

It is unknown whether two graphs can be tested for isomorphism in polynomial time. A classical approach to the Graph Isomorphism Problem is the d-dimensional Weisfeiler-Lehman algorithm. For fixed d, the Weisfeiler-Lehman algorithm runs in polynomial time, and it can distinguish many, but not all pairs of non-isomorphic graphs. I will present different polynomial time algorithms that can distinguish more pairs of graphs in polynomial time.

Combinatorics
Friday, January 18, 2013, 4:10pm-5:00pm
3866 East Hall
Tomoo Matsumura (KAIST)
(Factorial) Schur functions and weighted Grassmannians

It is a well-known fact that the so-called Schur functions that form a basis of the algebra of symmetric functions represent the Schubert classes of the cohomology of Grassmannians. After a brief introduction, I will explain how to generalize this fact to the case of weighted Grassmannians.

Combinatorics
Friday, February 01, 2013, 4:10pm-5:00pm
3866 East Hall
Andreas Blass (University of Michigan)
Shelah's bipartite matching algorithm

I'll present an algorithm, due to Shelah, for deciding in choiceless polynomial time with counting whether a given bipartite graph admits a complete matching. I'll begin by describing what "choiceless polynomial time with counting" means, and then I'll describe two familiar bipartite matching algorithms that don't qualify: the path-augmenting algorithm isn't choiceless, and the marriage theorem isn't polynomial time. Both of these nevertheless play a role, along with some other ideas, in Shelah's result.

Combinatorics
Friday, February 08, 2013, 4:10pm-5:00pm
3866 East Hall
Michael Shapiro (Michigan State University)
Growth rate classification for cluster algebras

The growth rate function of a cluster algebra counts the number of cluster variables that can be obtained from the initial cluster in a given number of steps. We classify cluster algebras according to whether their growth rate is bounded, polynomial, or exponential. In particular, we show that all exceptional non-affine mutation-finite cluster algebras have exponential growth.

This is joint work with A. Felikson, H. Thomas, and P. Tumarkin.

Combinatorics
Friday, February 22, 2013, 4:10pm-5:00pm
3866 East Hall
Li Li (Oakland University)
Positivity and tameness in rank 2 cluster algebras

A lot of recent activity in the theory of cluster algebras has been directed towards various constructions of "natural" bases. In a joint work with A.Zelevinsky and K.Lee we construct a new basis in any rank 2 cluster algebra following an approach developed by P.Sherman and A.Zelevinsky. This basis consists of a special family of indecomposable positive elements that we called greedy elements. Inspired by the work of K.Lee, R.Schiffler and D.Rupel, we give an explicit combinatorial description for the greedy elements using the language of Dyck paths. Furthermore, we show that the indecomposable positive elements form a basis if and only if the cluster algebra is tame (that is, of finite or affine type).

Seminar & Events Bulletin: Combinatorics

09-01-2011 to 06-30-2033

Combinatorics
Friday, March 01, 2013, 4:10pm-5:00pm
3866 East Hall
Alexander Barvinok (University of Michigan)
Thrifty approximations of convex bodies by polytopes

Given a d-dimensional convex body C containing the origin in its interior and a real t>1, we seek to construct a polytope P with as few vertices as possible such that P is contained in C and C is contained in tP. I plan to present a construction which breaks some long-held records and is nearly optimal for a vide range of parameters d and t. The construction uses the maximum volume ellipsoid, the John decomposition of the identity and its recent sparsification by Batson, Spielman and Srivastava, Chebyshev polynomials, and some tensor algebra.

Combinatorics
Friday, March 15, 2013, 4:10pm-5:00pm
3866 East Hall
Bruce Sagan (Michigan State University)
Factoring the characteristic polynomial of a poset

Given a poset P, its characteristic polynomial x(P;t) is the generating function in the variable t for the Moebius function of P. For many families of posets, every root of x(P;t) is in the set P of positive integers. A number of different techniques have been devised for showing that x(P;t) factors over P including Zaslavsky's theory of signed graphs, results by Saito and Terao about free hyperplane arrangements, and Stanley's Supersolvability Theorem. We will present a new, totally combinatorial method for proving factorization. This is joint work with Joshua Hallam.

Seminar & Events Bulletin: Combinatorics

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Combinatorics
Friday, March 22, 2013, 4:10pm-5:00pm
3866 East Hall
Michael Chmutov (University of Michigan)
Type A molecules are of Kazhdan-Lusztig type

Let (W, S) be a Coxeter system. A W-graph is an encoding of a representation of the corresponding Iwahori-Hecke algebra. Especially important examples include the W-graph corresponding to the action of the Iwahori-Hecke algebra on the Kazhdan-Lusztig basis as well as this graph's strongly connected components (cells). In 2008, Stembridge identified some common features of the Kazhdan-Lusztig graphs and gave a combinatorial characterization of all W-graphs that have these features. He conjectured, and checked up to n = 9, that all such A_n-cells are of Kazhdan-Lusztig type. In this talk I will discuss a possible first step toward the proof of the conjecture. More concretely, I will describe why the connected subgraphs of A_n-cells consisting of "simple" (i.e. directed both ways) edges are of Kazhdan-Lusztig type.

Combinatorics
Friday, March 29, 2013, 4:10pm-5:00pm
3866 East Hall
Kevin Carde (University of Michigan)
Cluster structures on mixed invariant rings, and related combinatorics

Let V be a k-dimensional complex vector space. The Pluecker ring of polynomial SL(V) invariants of a collection of n vectors in V can be alternatively described as the homogeneous coordinate ring of the Grassmannian Gr(k,n). In 2003, using combinatorial tools developed by A. Postnikov, J. Scott showed that the Pluecker ring carries a cluster algebra structure. Over the ensuing decade, this has become one of the central examples of cluster algebra theory.

In the 1930s, H. Weyl described the structure of the "mixed" Pluecker ring, the ring of polynomial SL(V) invariants of a collection of n vectors in V and m covectors in V*. We generalize Scott's construction and Postnikov's combinatorics to this more general setting. In particular, we show that each mixed Pluecker ring carries a natural cluster algebra structure. This was previously established by S. Fomin and P. Pylyavskyy in the case k=3.