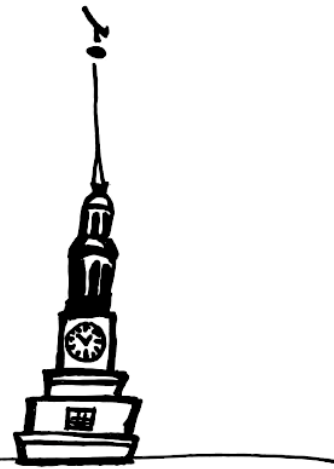


Discrete Math Days of the Northeast

at Dartmouth College

May 6, 2017



Discrete Math Days in the Northeast is a conference series that seeks to bring together a community of combinatorialists in the Northeast. We provide a relaxed atmosphere and a friendly environment conducive to fostering collaboration across institutions and disciplines. Today's edition is generously funded by the Mathematics Department at Dartmouth and a grant from the NSA.

Local organizers: Sergi Elizalde, Rosa Orellana, Jay Pantone, and Peter Winkler.

Schedule

All talks are in Haldeman Center 041. Haldeman Center and Kemeny Hall are the same building.

- 9:00 Coffee and breakfast (Haldeman 041) and poster set up (Kemeny 300)
- 9:45 Welcome and announcements (Haldeman 041)
- 10:00 Olivier Bernardi, *Bijections for deformations of the braid arrangement*
- 11:00 Brigitte Servatius, *Combinatorial maps and delta-matroids*
- 12:00 Lunch and posters (Kemeny 300)
- 1:30 Lou Billera, *On the real linear algebra of vectors of zeros and ones*
- 2:30 Svetlana Poznanovikj, *Mahonian-Stirling pairs of combinatorial statistics for labeled forests*
- 3:30 Break (Haldeman 041)
- 4:00 Michelle Wachs, *Recent developments on chromatic quasisymmetric functions*

Reimbursements

Students and postdocs traveling more than 50 miles each way may apply for a travel stipend, and any participant traveling more than 100 miles each way and staying overnight may apply for partial reimbursement of lodging expenses. To apply for reimbursement, please fill out the attached reimbursement form.

Mailing and participant lists

If you would like to be added to the conference mailing list or to the list of discrete mathematicians in the Northeast, please talk to Rosa Orellana, or email her at Rosa.C.Orellana@dartmouth.edu.

Titles and abstracts

Olivier Bernardi, Brandeis University

Bijections for deformations of the braid arrangement

We will talk about real hyperplane arrangements such that all the hyperplanes are of the form $x_i - x_j = s$ for some integer s . Classical examples include the braid, Catalan, Shi, semiorder and Linial arrangements, as well as graphical arrangements.

We will present general bijections and enumerative results for the regions of such arrangements. For instance, the braid, Catalan, Shi, semiorder and Linial arrangements will be shown to be in bijective correspondence with some natural families of labeled binary trees

Lou Billera, Cornell University

On the real linear algebra of vectors of zeros and ones

We are interested in understanding the real linear relations among the set of all 0-1 vectors in \mathbb{R}^n , that is, the linear matroid over \mathbb{R} of the set of the $2^n - 1$ nonzero n -vectors all of whose coordinates are 0 or 1. Equivalently, we seek the affine real matroid of all barycenters of nonempty faces of an $(n - 1)$ -dimensional simplex. This fundamental combinatorial object is at the root of questions that have arisen over the past 50 years in a variety of fields, from economics to circuit theory to quantum physics, roughly the same period during which most of modern enumerative combinatorics was being developed. Yet there has been little real progress in understanding some of the most basic questions here.

In particular, in many applications it is of interest to know the number of regions in \mathbb{R}^n that are determined by the set of $2^n - 1$ linear hyperplanes having 0-1 normals. This number, known asymptotically to be on the order of 2^{n^2} , can be obtained exactly from the characteristic polynomial of the geometric lattice of all subspaces spanned by these 0-1 vectors. These characteristic polynomials are known only through $n = 7$, while just the number of regions is known for $n = 8$.

We discuss the various contexts in which this question has come up, describe various general approaches to obtain the characteristic polynomial, and give some very partial results toward a general solution. My main purpose here is to try to arouse some interest in this question.

Svetlana Poznanovikj, Clemson University

Mahonian-Stirling pairs of combinatorial statistics for labeled forests

Björner and Wachs defined a major index for labeled plane forests and showed that it has the same distribution as the number of inversions. This can be viewed as a generalization of the classical result for permutations. In this talk I will discuss a few other natural statistics on labeled forests. Specifically, I will introduce the notions of bottom-to-top maxima, cyclic bottom-to-top maxima, sorting index, and cycle minima. These statistics are such that the pairs (inv, Bt-max), (sor, Cyc), and (maj, Cbt-max) are equidistributed. Even though our results extend the result of Björner and Wachs and further generalize results for permutations, the picture is not complete and I will discuss some current work on how to improve this.

Brigitte Servatius, Worcester Polytechnic Institute

Combinatorial maps and delta-matroids

We will review Tutte's theory of combinatorial maps and examine map duality versus matroid duality and the role that delta-matroids play in the study of cellularly embedded graphs.

This is joint work with Remi Cocou Avohou.

Michelle Wachs, University of Miami

Recent developments on chromatic quasisymmetric functions

The chromatic quasisymmetric function of a labeled graph was introduced by Shareshian and myself as a refinement of Stanley's chromatic symmetric function. We conjectured a refinement of the long standing Stanley-Stembridge e-positivity conjecture, and formulated an algebro-geometric approach to proving this refined conjecture involving Hessenberg varieties. Significant progress in this direction has recently been made by Brosnan and Chow and by Guay-Paquet. In this talk, I will discuss the connection with Hessenberg varieties, and also present some new directions, including results on generalizations to directed graphs obtained by my student Brittney Ellzey.