

Math 6410: Enumerative Combinatorics

Lecturer: Karola Mészáros

This is a graduate class on enumerative combinatorics.

1 Textbook

Most everything we will do is contained in:

- *Enumerative Combinatorics*, volumes 1 (referred to as EC1), by R. Stanley.
- *An Introduction to Hyperplane Arrangements*, by R. Stanley
<http://www.cis.upenn.edu/~cis610/sp06stanley.pdf>

2 Material covered thus far

date	topic
01/25	Catalan numbers, pattern avoidance, EC1 Sec 1.5, Kostant partition functions & flow polytopes
01/30	Permutation statistics and the fundamental bijection EC1 Sec 1.3, 1.4
02/01	Generating functions for (various sets of) partitions, set partitions (Stirling numbers of the second kind) EC1 Sec 1.8, 1.9; Tree representations of permutations, counting the number of k -dimensional subspaces of $\mathbb{F}_q^n$ EC1 Secs 1.5, 1.7; Ehrhart polynomial of integer polytopes, magic squares, Birkhoff polytope
02/06	Principle of inclusion-exclusion EC1 Secs 2.1, 2.2; Determinantal formulas, Gessel-Viennot Lemma EC1 Sec 2.7
02/08	Posets EC1 Secs 3.1, 3.2; order polytopes (Stanley: Two poset polytopes)
02/13	Distributive lattices EC1 Secs 3.3, 3.4
02/15	Counting chains in distributive lattices, zeta polynomial EC1 Secs 3.5, 3.12 Incidence algebras, Möbius inversion EC1 Secs 3.6, 3.7 order complex of a poset EC1 Sec 3.8
02/20	<i>Winter break</i>
02/22	integer point enumerators of cones, Ehrhart polynomials, volume, Stanley's nonnegativity theorem
02/27	Ehrhart reciprocity, Euler's relation, face lattice of polytopes and its Möbius function
03/01	Dehn-Sommerville relations for simplicial polytopes, flag f - and h -vectors, cd -index
03/06	Eulerian and simplicial posets and the Dehn-Sommerville relations EC1 Sec 3.17; faces of polytopes (Ziegler: Lectures on Polytopes, Ch 2)
03/08	structure theorem for face lattices (Ziegler: Lectures on Polytopes, Ch 2)
03/13	Stanley: Two Poset Polytopes (in Discrete & Computational Geometry, 1986)
03/15	polytopal complexes, duality of zonotopes and hyperplane arrangements

03/20	hyperplane arrangements (Lecture 1 from http://www.cis.upenn.edu/~cis610/sp06stanley.pdf)
03/22	(<i>detour, general overview</i>) Coxeter groups & diagrams; Bruhat order (source: Björner-Brenti: Combinatorics of Coxeter Groups, Ch 1 & 2)
03/27	(<i>detour, general overview</i>) Preliminaries on positive and simple roots (source: Humphrey: Introduction to Lie Algebras and Representation Theory, Sec 5.4, 5.6, 5.7),
03/29	(<i>detour, general overview</i>) proof of the Strong Exchange Property (source: Björner-Brenti: Combinatorics of Coxeter Groups, Ch 1 & 2)
04/10	hyperplane arrangements (Lecture 2 + Lecture 5 from http://www.cis.upenn.edu/~cis610/sp06stanley.pdf)
04/12	hyperplane arrangements (Lecture 2 continued); parking functions
04/17-05/08	permutahedra and other zonotopes corresponding to hyperplane arrangements we've seen relation to flow and root polytopes and the many things that there are...

3 What you are expected to do

You are expected to attend and participate in class. There will be problem sets that you will need to solve and hand in. These will appear on the course website <http://www.math.cornell.edu/~karola/class641-2018.html>.

The classroom is a technology-free zone. If you feel you have a serious reason to use some gadget, please discuss this with me in advance.