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Oriented Matroids

Abstract for the Combinatorics Seminar

2008 February 12 I. Duality and Topology in Oriented Matroids

This talk will give some background on oriented matroids relevant to two talks that will follow. I hope it will also be interesting as a self-contained presentation of some intriguing topological combinatorics.

An oriented matroid can be viewed as a combinatorial abstraction of either a finite arrangement of vectors in \mathbb{R}^n or a finite arrangement of oriented hyperplanes in \mathbb{R}^n . I'll compare how oriented matroid duality plays out in the vector vs. hyperplane perspectives, describe topological representations for oriented matroids arising from the vector and hyperplane perspectives, and show how duality leads to an unexpected connection between the two types of representation.

2008 February 19 II. A Generalization of the Euclidean Property for Oriented Matroids

Non-Euclidean oriented matroids violate combinatorial analogs to both Euclid's Fifth Postulate and the Simplex Algorithm. They have been a longstanding source of counterexamples, frustration, and general discombobulation within combinatorics. This talk will present some new research that endeavors to make the situation worse.

I will give a topological characterization of the Euclidean property: an oriented matroid is Euclidean if it does not have a certain type of bad circle in its topological representation. This leads to a generalization: we will say an oriented matroid is k -Euclidean if it does not have a certain type of bad k -dimensional space in its topological representation. I'll discuss some of the (few) results and (many) conjectures about this new idea.

2008 February 26 III. Higher-order Non-Euclidean Oriented Matroids and the Triangulation Conjecture

The Triangulation Conjecture for oriented matroids states that every triangulation of an oriented matroid M is a PL sphere if M is totally cyclic and a PL ball otherwise. Interest in this conjecture comes from several fields, most notably convex polytopes and combinatorial differential manifolds. Surprisingly, this conjecture is equivalent to a fundamental conjecture on higher-order non-Euclidean oriented matroids. I'll explain the connection.

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