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Representation of Matroids by Homotopy Spheres

Abstract for the Combinatorics Seminar 2008 October 29

The Topological Representation Theorem for oriented matroids, loosely put, says that any oriented matroid is topologically “close” to being realizable as an arrangement of hyperplanes in \mathbb{R}^n . More specifically, any oriented matroid can be represented by an arrangement of topological equators on a sphere.

There is no reason to expect a similar result for non-orientable matroids. For instance, if a matroid M arises from an arrangement of hyperplanes in F^n , where F is a finite field, why should there be anything like an arrangement of equators on the sphere representing M ? However, several years ago Ed Swartz proved a truly weird “Topological Representation Theorem for Matroids”, representing any matroid by an arrangement of homotopy spheres. His representations are far from canonical, and his construction is not explicit. I will describe a new construction whose end result is slightly weaker than Swartz's but which is (almost) canonical, completely explicit, and indeed quite simple.

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Last update: **2020/01/29 19:03**

