The Oliver Club

www.math.cornell.edu/~oliver/

Real Rooted Polynomials in Discrete Geometry and Koszul Algebras

It is classical and well understood what conditions on the coefficients of a polynomial $f(t) = f_{d-1} + f_{d-2}\, t + \cdots + f_0\, t^{d-1} + t^d \in \mathbf{R}[t]$ imply that $f(t)$ has only real roots. In discrete geometry and geometric combinatorics one is interested in polynomials $f^{\Delta}(t) = f_{d-1} + f_{d-2}\, t + \cdots + f_0\, t^{d-1} + t^d$ where f_i is the number of i-dimensional faces of a polyhedral or simplicial complex Δ. We will present answers to the questions: Are there interesting classes of complexes Δ for which $f^{\Delta}(t)$ is real rooted? Are there geometric conditions on Δ that relate to the real rootedness of $f^{\Delta}(t)$? The two questions will lead us to the concept of Koszulness from algebra. Indeed it is well known that the numerator polynomial of the Hilbert-series of a Koszul algebra has at least 1 real root. Finally we will explain speculative relations of real rootedness of $f^{\Delta}(t)$ to the classical Kruskal-Katona and g-theorems from geometric combinatorics. (Joint work with Francesco Brenti.)

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Refreshments will be served at 3:55 PM in the Mathematics Department lounge (532 Malott Hall).

Tuesday, March 11, 2008
at 4:25 PM in 406 Malott Hall