Pure Mathematics Seminar

Linear Decision Trees, Subspace Arrangements, and Discrete Morse Theory

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A linear decision tree is a computational model for determining membership in a subset $X \subseteq \mathbb{R}^n$. One motivating example is the k-equal arrangement, which consists of all n-tuples that have at least k equal coordinates.

In 1995, Björner and Lovász gave a topological lower bound for the number of leaves in a linear decision tree to determine membership in a union of affine subspaces $\mathcal{A}$. They showed that the number of leaves is at least $\sum_{i=0}^{\infty} \widetilde{\beta}^i(\mathbb{R}^n \setminus \mathcal{A})$. Then Björner and Welker computed the Betti numbers for the k-equal arrangement. These results spurred significant research activity into the study of subspace arrangements.

We give a new proof of the Björner-Lovász theorem, using discrete Morse theory. We show that, given a linear decision tree T for a subspace arrangement $\mathcal{A}$, there exists a cellular model for $\mathbb{R}^n \setminus \mathcal{A}$ whose cells are indexed by the NO-leaves of T. This implies new lower bounds for decision tree complexity which take into account torsion elements in $\mathbb{R}^n \setminus \mathcal{A}$, and not just the Betti numbers. We also give at least one new example of a 'natural' decision problem for which torsion arises.

Date: **Wednesday, October 31, 2018**
Time: **12:15 pm**
Place: **Edinburg:** EMAGC 1.410, **Brownsville:** BLIBR 2.206

The talk will delivered live at the *Edinburg* campus and will be streamed to the Brownsville campus

Coffee might be served.

For further information or for special accommodations, please contact Dr. Sergey Grigorian via email at [sergey.grigorian@utrgv.edu], or Dr. Alexey Garber at [alexey.garber@utrgv.edu], or visit the webpage http://www.utrgv.edu/math/news-events/seminars/puremath/index.htm