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# SEMINARIO

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### ***Shellability and Betti Numbers for Codes and Matroids***

#### **Abstract:**

The notion of shellable simplicial complexes has proved extremely useful in algebraic combinatorics, commutative algebra, and combinatorial topology. As such, it has been much studied in the past four decades. Likewise, the study of minimal free resolutions of standard graded algebras and of graded Betti numbers is classical and goes back at least to Hilbert. About a decade ago, Johnsen and Verdure associated such Betti numbers to linear codes and more generally, matroids. They showed that these are closely related to important invariants of linear codes such as generalized Hamming weights. The study is partly facilitated by a classical result that matroid complexes, that is, simplicial complexes formed by the class of independent subsets in a matroid, are shellable.

In the recent past, there has been growing interest in rank metric codes. We now understand the analogs of generalized Hamming weights for rank metric codes, and these are known as generalized rank weights. There is a related notion of  $q$ -matroids, which has close connections with rank metric codes in a manner similar to the connection between matroids and codes. A recent result establishes shellability of  $q$ -matroid complexes and also determines the homology of these complexes in many cases. The determination of homology has now been completed for arbitrary  $q$ -matroid complexes.

We will outline these developments while making an attempt to keep the prerequisites at a minimum.

The contents of this talk are based on a joint work with Rakhi Pratihar and Tovohery Randrianarisoa (2022) and also with Rakhi Pratihar, Tovohery Randrianarisoa, Hugues Verdure and Glen Wilson (2024).

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