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Algebraic data structures for topological summaries

This talk introduces a combinatorial algebraic framework to encode, compute, and analyze topological summaries of geometric data. The motivating problem from evolutionary biology involves statistics on a dataset comprising images of fruit fly wing veins. The algebraic structures take their cue from graded polynomial rings and their modules, but the theory is complicated by the passage from integer exponent vectors to real exponent vectors. The path to effective methods is built on appropriate finiteness conditions, to replace the usual ones from commutative algebra, and on an understanding of how datasets of this nature interact with moduli of modules. I will introduce the biology and topology from first principles. Joint work with David Houle (Biology, Florida State), Ashleigh Thomas (grad student, Duke Math), Justin Curry (postdoc, Duke Math), and Surabhi Beriwal (undergrad, Duke Math).