

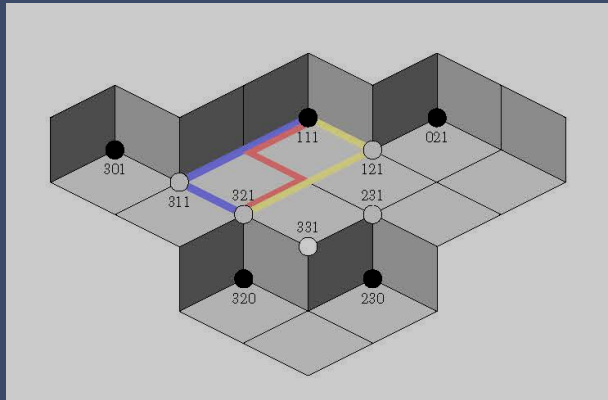
My research lies at the intersection of commutative algebra, combinatorics, and topology. I study higher-order algebraic ramifications that arise from systems of polynomial equations in which each equation sets a monomial -- that is, a polynomial with one term -- equal to 0. These systems and their higher-order consequences have intricate but concrete combinatorial structure. When the monomials are in three variables, for example, they can be visualized using staircase diagrams like the one pictured. In these pictures, as in the more general case of arbitrary numbers of variables, staircase diagrams encode information about how the monomials relate to each other. As part of work for my dissertation, John Eagon, Ezra Miller, and I gave a full solution to a central problem that has been open in the field since the early 1960s. The solution involves summing over lattice paths (like the ones in the picture) along the grid lines between appropriate points on the staircase.



Erika Ordog

PhD Thesis

Minimal Resolutions of Monomial Ideals



To be more precise, given any monomial ideal in finitely many variables, we construct a free resolution that is canonical, minimal, universal, closed form, and combinatorial. We call this the canonical syzygy resolution. The differentials are weighted sums over lattice paths whose weights come from higher-dimensional analogues of spanning trees in simplicial complexes indexed by integer vectors. This construction works over fields of characteristic zero and most positive characteristics. Over a field of any characteristic, we also construct more efficient noncanonical syzygy resolutions, whose differentials sum over noncanonical choices of these generalized spanning trees at points along the lattice paths.