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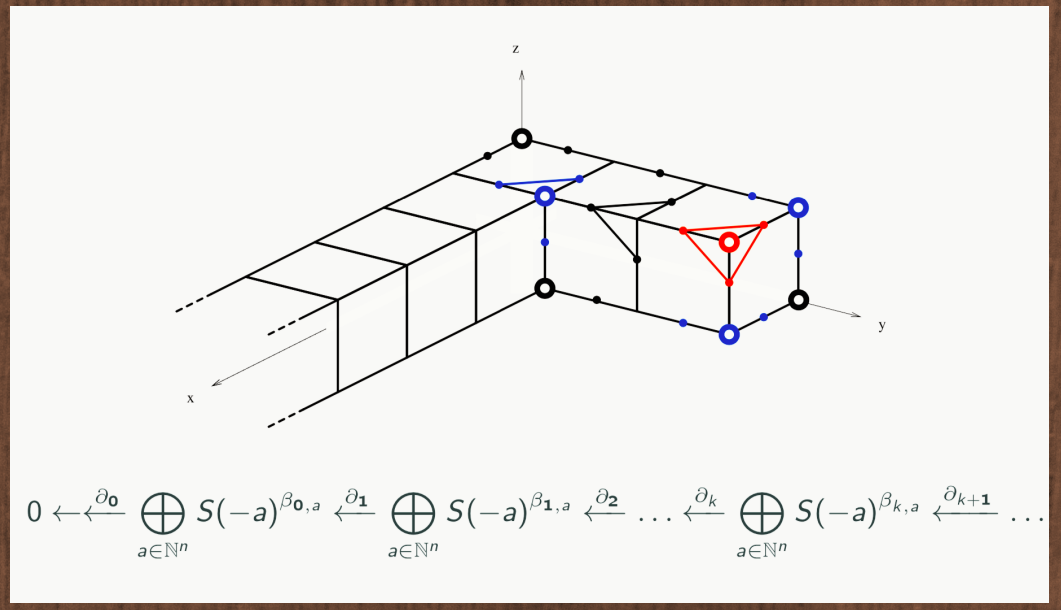
Senior Thesis

Implementing non-canonical Sylvan Resolutions

The problem of finding minimal free resolutions of monomial ideals in polynomial rings is central to the combinatorial side of commutative algebra. And while formulas for the Betti numbers, the ranks of the free modules in a minimal free resolution, have been known since the 1960s, it was only this past year that John Eagon, Ezra Miller, and Erika Ordog gave explicit and universal formulas for the differentials in the resolutions in their paper Minimal Resolutions of Monomial Ideals. This project's main goal is to design and implement an algorithm for computing minimal resolutions of arbitrary monomial ideals, using the novel method for computing boundary maps implied by their work.

More formally, given a monomial ideal, we have implemented software that constructs an N^n graded free resolution of the ideal. We compute the Betti numbers in the resolution by considering degrees in the lcm lattice of the ideal. We compute the boundary maps using the method implied by the recent work of Eagon, Miller, and Ordog. To be more specific, we leverage their explicit formula for the calculation of the differentials in the resolution. Splittings of the differentials are a key ingredient, and are in fact themselves differentials yielding a free resolution. We implement this method of computation in executable software, written in the language of Macaulay2.



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