Khovanov Homology and Legendrian Simple Knots

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Abstract

Knot theory is a challenging subject when it comes to computation, several invariants are known to have NP-Hard complexities. One such invariant, Khovanov homology, has been increasingly important in the past few decades, in particular for its ability to uniquely distinguish certain knots such as the unknot, left and right handed trefoils, the figure-eight, and the cinquefoil. Another subject that has been intruding into knot theory is contact topology, the odd dimensional analogue of symplectic topology, both of which have their roots in Hamiltonian mechanics. The aforementioned knots are the simplest of the Legendrian simple knots, a particular family of knots that have nice contact properties, leading one to conjecture that Khovanov homology may detect all such knots. By examining all prime knots up to 19 crossings we are able to provide strong numerical support that this conjecture may be true. In the process of doing so we've tabulated the Khovanov homology of all prime knots up to 17 crossings and the Jones and HOMFLY-PT polynomials of all prime knots up to 19 crossings. We'll discuss some of the algorithms and implementations used to tackle these hard computations.