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The Lovasz Local Lemma is tight for SAT

The Lovasz Local Lemma is a very powerful tool in combinatorics. At first glance it seems that due to its generality the Lovasz Local Lemma is unlikely to give asymptotically tight bounds for a specific application. We will, however, show that this is the case for Satisfiability of k -CNF formulas, improving on a previous result of Hoory and Szeider.

Concretely: By (k,s) -CNF we denote the set of CNF-formulas where every clause has exactly k distinct literals and each variable occurs in at most s clauses. Kratochvil, Savicky and Tuza showed by using the Lovasz Local Lemma that every $(k, 2^k/(ek))$ -CNF formula is satisfiable. From the other side Hoory and Szeider established unsatisfiable $(k, \log(k) * 2^k/k)$ -CNF formulas, implying that the bound of Kratochvil et al. is tight up to a logarithmic factor. We will show that the bound resulting from the Local Lemma is asymptotically tight.