

Regularity is a natural restriction on the propositional resolution proof system introduced by Tseitin [2]. A refutation is regular if every variable is eliminated at most once along every path in the refutation. E.g. resolution refutations produced as unsatisfiability witnesses by satisfiability testing algorithms are usually regular.

This paper gives a new separation of regular resolution from unrestricted resolution. A family of formulas is constructed having unrestricted resolution refutations of size $O(n(\log n)^5)$, for which regular resolution refutations require size $2^{\Omega(n/(\log n)^2 \log \log n)}$. This improves upon the previous best separation [1], which gave a lower bound of $2^{\Omega(n)}$ on the size of regular refutations of a family of formulas having unrestricted refutations of size $O(n^3)$. This new separation is optimal up to a polylogarithmic factor in the exponent.

References

- [1] M. Alekhnovich, J. Johannsen, T. Pitassi, and A. Urquhart. An exponential separation between regular and general resolution, *Theory Comput.* **3** (2007), 81–102. MR2322857 (2009j:03095)
- [2] G. Tseitin. On the complexity of derivation in propositional calculus. *Studies in Constructive Mathematics and Mathematical Logic, Part 2*, pages 115–125, 1968.