Sharp Thresholds Imply Circuit Lower Bounds

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We show that sharp thresholds for Boolean functions imply circuit lower bounds. More formally we show that any Boolean function exhibiting a sharp enough threshold at an arbitrary threshold cannot be computed by Boolean circuits of bounded depth and polynomial size. This verifies a conjecture put forward earlier in the survey by Kalai and Safra. Our result is of particular interest in the sparse random graph setting where the main tool for bounding circuit depth, namely Linial-Mansour-Nisan (LMN) theorem does not apply. We redeem the power of LMN theorem by creating simple dense-to-sparse circuit gadgets. Our result will be illustrated using two models: independent sets in sparse random graphs and random 2-SAT model.

Joint work with Elchanan Mossel (MIT) and Ilias Zadik (Yale University).

References

[1] D.Gamarnik, E.Mossel, I. Zadik, Sharp Thresholds Imply Circuit Lower Bounds: from random 2-SAT to Planted Clique, *Israel Journal of Mathematics, to appear.* 2007 pp.145-161.