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Prediction from Partial Information and Hindsight, with Application to Circuit Lower Bounds

Abstract:

Consider a random sequence of $n$ bits that has entropy at least $n-k$, where $k << n$. A commonly used observation is that an average coordinate of this random sequence is close to being uniformly distributed, that is, the coordinate "looks random". In this work, we prove a stronger result that says, roughly, that the average coordinate looks random to an adversary that is allowed to query about $n/k$ other coordinates of the sequence, even if the adversary is non-deterministic.

As an application of this result, we prove a new result on depth-3 circuits, which recovers as a direct corollary the known lower bounds for the parity and majority functions, as well as a lower bound on sensitive functions due to Boppana.