Regularizing data for practical randomness generation

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Non-local correlations that obey the no-signalling principle contain intrinsic randomness. In particular, for a specific Bell experiment, one can derive relations between the amount of randomness produced, as quantified by the min-entropy of the output data, and its associated violation of a Bell inequality. In practice, due to finite sampling, certifying randomness requires the development of statistical tools to lower-bound the min-entropy of the data as a function of the estimated Bell violation. The quality of such bounds relies on the choice of the certificate, i.e., the Bell inequality whose violation is estimated. In this work, we propose a method for choosing efficiently such a certificate. It requires sacrificing a part of the output data in order to estimate the underlying correlations. Regularizing this estimate then allows one to solve the related guessing probability problem, whose dual formulation provides a Bell inequality suitable for certifying practical randomness. In order to show the efficiency of our method, we carry out several numerical simulations of a Bell experiment: we nearly always obtain higher min-entropy rates than when we use a pre-established Bell inequality, namely the Clauser-Horne-Shimony-Holt inequality.

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[1] B. Bourdoncle, P.-S. Lin, D. Rosset, A. Acin, and Y.-C. Liang *Regularizing data for practical randomness generation*, arXiv:1802.04703 (2018).