Expanders that beat the eigenvalue bound: explicit construction and applications

Avi Wigderson
David Zuckerman

Abstract
For every n and $0<\delta <1$, we construct graphs on n nodes such that every two sets of size n^{δ} share an edge, having essentially optimal maximum degree $n^{1-\delta+o(1)}$. Using known and new reductions from these graphs, we derive new explicit constructions of:

1. A k round sorting algorithm using $n^{1+1/k+o(1)}$ comparisons.
2. A k round selection algorithm using $n^{1+1/(2^k – 1)+o(1)}$ comparisons.
3. A depth 2 superconcentrator of size $n^{1+o(1)}$.
4. A depth k wide-sense nonblocking generalized connector of size $n^{1+1/k+o(1)}$.

All of these results improve on previous constructions by factors of $n^{\omega(1)}$, and are optimal to within factors of $n^{o(1)}$. These results are based on an improvement to the extractor construction of Nisan & Zuckerman: our algorithm extracts an asymptotically optimal number of random bits from a defective random source using a small additional number of truly random bits.