The Parallel Complexity of Element Distinctness is $\Omega(\sqrt{log n})$

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Abstract

We consider the problem of element distinctness. Here n synchronized processors, each given an integer input, must decide whether these integers are pairwise distinct, while communicating via an infinitely large shared memory.

If simultaneous write access to a memory cell is forbidden, then a lower bound of $\Omega(log n)$ on the number of steps easily follows (from S. Cook, C. Dwork, and R. Reischuk, SIAM J. Comput., 15 (1986), pp. 87-97) When several (different) values can be written simultaneously to any cell, then there is a simple algorithm requiring O(1) steps.

We consider the intermediate model, in which simultaneous writes to a single cell are allowed only if all values written are equal. We prove a lower bound of $\Omega((log n)^{1/2})$ steps, improving the previous lower bound of $\Omega(log log log n)$ steps (F. E. Fich, F Meyer auf der Heide, and A. Wigderson, Adv. In Comput., 4(1987), pp. 1—15).

The proof uses Ramsey-theoretic and combinatorical arguments. The result implies a separation between the powers of some variants of the PRAM model of parallel computation.