
MR1082137 (91k:68044) 68Q05 68Q10 68Q20 68Q25

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Improved upper and lower time bounds for parallel random access machines without simultaneous writes.

SIAM J. Comput. **20** (1991), *no.* 1, 88–99.

A PRAM or parallel random access machine consists of an infinite number of processors that operate in parallel and share an infinite memory. At each time step each processor reads a value from the shared memory, changes to a new state, and writes this new state back into the shared memory. Simultaneous read operations of a single shared-memory cell by many processors are allowed but simultaneous write operations into a single cell are not. An input to a PRAM M consists of a finite sequence $I=(x_0,x_1,\cdots,x_{n-1})$ of natural numbers, of which x_i is placed in cell i of the shared memory at the start of the computation of M. When the processors have terminated, the contents of cell 0 constitute the output computed by M. The time required by M is the maximum over all inputs of size n of the number of steps needed to process that input, considered as a function of n.

Using a communication argument, the authors improve by a constant factor known lower and upper bounds on the running time for PRAMs. More precisely, they show that any PRAM that computes a so-called critical function—i.e., a Boolean function for which there exists an input I with the property that changing a single bit x_i from I changes its output—requires at least time $0.5\log_2 n-O(1)$, and that there exists a critical function which can be computed in time $0.57\log_2 n-O(1)$.

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