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On a sublinear time parallel construction of optimal binary search trees. (English)


Summary: We design an efficient sublinear time parallel construction of optimal binary search trees. The efficiency of the parallel algorithm corresponds to its total work (the product time × processors). Our algorithm works in O(n1−ω log n) time with the total work O(n2−ω), for an arbitrarily small constant 0 < ϵ ≤ 1/2. This is optimal within a factor n2ϵ with respect to the best known sequential algorithm given by Knuth, which needs only O(n2) time due to a monotonicity property of optimal binary search trees, see [D. E. Knuth, Acta Inf. 1, 14–25 (1971; Zbl 0233.68010)]. It is unknown how to explore this property in an efficient NC construction of binary search trees. Here we show that it can be effectively used in sublinear time parallel computation. Our improvement also relies on the use (in independently processed small subcomputations) of the parallelism present in Knuth’s algorithm. The best known sublinear time algorithms for the construction of binary search trees (as an instance of a more general problem) have O(n3) work for time larger than n3/4, see [Z. Galil and K. Park, J. Parallel Distrib. Comput. 21, No. 2, 213–222 (1994; Zbl 0820.90122); L. L. Larmore and W. Rytter, Lect. Notes Comput. Sci. 577, 121–132 (1992; Zbl 1493.68394)]. For time √n these algorithms need n4 work, while our algorithm needs for this time only n3 work, thus improving the known algorithms by a linear factor. Also if time is O(n1−λ/2) and ϵ is very small our improvement is close to O(n). Such improvement is similar to the one implied by the monotonicity property in sequential computations (from n2 sequential time for a more general dynamic programming problem to n2 time for the special case of optimal binary search trees).

For the entire collection see [Zbl 0825.68120].

MSC:
68P05 Data structures
68W10 Parallel algorithms in computer science
68W40 Analysis of algorithms

Full Text: DOI

References:

[3] Z. Galil, K. Park, "Parallel algorithms for dynamic programming recurrences with more than O(1) dependency", Manuscript. · Zbl 0820.90122

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