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Efficient and constructive algorithms for the pathwidth and treewidth of graphs. (English)

Zbl 0861.68036
J. Algorithms 21, No. 2, 358-402 (1996).

Summary: We give, for all constants k, ℓ, explicit algorithms that, given a graph $G = (V, E)$ with a tree-decomposition of G with treewidth at most ℓ, decide whether the treewidth (or pathwidth) of G is at most k, and, if so, find a tree-decomposition (or path-decomposition) of G of width at most k, and that use $O(|V|)$ time. In contrast with previous solutions, our algorithms do not rely on non-constructive reasoning and are single exponential in k and ℓ. This result can be combined with a result of *B. Reed* [in "Proceedings of the 24th Annual Symposium on Theory of Computing", 221-228 (1992)], yielding explicit $O(n \log n)$ algorithms for the problem, given a graph G, to determine whether the treewidth (or pathwidth) of G is at most k, and, if so, to find a tree- (or path-) decomposition of width at most k (k constant). Also, the author [in "Proceedings of the 25th Annual Symposium on Theory of Computing", 226-234 (1993)] has used the result of this paper to obtain linear time algorithms for these problems. We also show that for all constants k, there exists a polynomial time algorithm that, when given a graph $G = (V, E)$ with treewidth $\leq k$, computes the pathwidth of G and a path-decomposition of G of minimum width.

MSC:

68W10 Parallel algorithms in computer science
68R10 Graph theory (including graph drawing) in computer science

Keywords:

pathwidth

Full Text: DOI