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Succinct representations of weighted trees supporting path queries. (English) Zbl 1268.68069

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Summary: We consider the problem of succinctly representing a given vertex-weighted tree of n vertices, whose vertices are labeled by integer weights from $\{1, 2, \ldots, \sigma\}$ and supporting the following path queries efficiently: (1) path median query: given two vertices i, j, return the median weight on the path from i to j, (2) path selection query: given two vertices i, j and a positive integer k, return the kth smallest weight on the path from i to j, (3) path counting/reporting query: given two vertices i, j and a range $[a, b]$, count/report the vertices on the path from i to j whose weights are in this range.

The previous best data structure supporting these queries takes $O(n \log n)$ bits space and can perform path median/selection/counting in $O(\log \sigma)$ time and path reporting in $O(\log \sigma + occ \log \sigma)$ time, where occ represents the number of outputs [*M. He* et al., Lect. Notes Comput. Sci. 7074, 140–149 (2011; Zbl 1350.68073)].

We present a succinct data structure taking $n \log \sigma + 6n + o(n \log \sigma)$ bits space that can perform the above mentioned queries in $O(\log \sigma \log n)$ and $O(\log \sigma \log n + occ \log \sigma)$ time respectively.

MSC:

68P05 Data structures
68R10 Graph theory (including graph drawing) in computer science
05C05 Trees

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