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Selected Reading

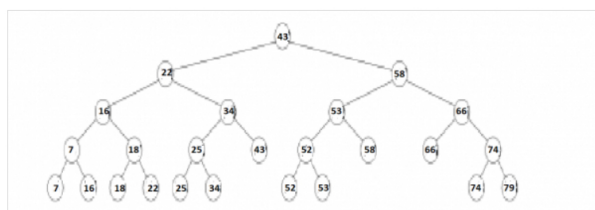
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Range Trees in Data Structure

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A range tree is defined as an ordered tree data structure to hold a list of points. It permits all points within a given range to be efficiently retrieved, and is typically implemented in two or higher dimensions. It is same to a kd-tree except with faster query times of $O(\log^d n + k)$ but worse storage of $O(n \log^{d-1} n)$, with d indicating the dimension of the space, n indicating the number of points in the tree, and k indicating the number of points retrieved for a given query. Range trees may be differentiated with interval trees: instead of storing points and allowing points in a given range to be retrieved efficiently, an interval tree stores intervals and allows the intervals containing a given point to be retrieved efficiently.

Data Structure



An example of a 1-dimensional range tree. Each node other than leaf stores the highest value in its left subtree.

A range tree on a set of 1-dimensional points is treated as a balanced binary search tree on those points. The points stored in the tree are stored in the leaves of the tree; each internal node stores the maximum value contained in its left subtree. A range tree on a set of points in d -dimensions is a recursively defined multi-level binary search tree. Each level of the data structure is treated as a binary search tree on one of the d -dimensions. The first level is a binary search tree on the first of the d -coordinates. Each vertex v of this tree consists of an associated structure that is a $(d-1)$ -dimensional range tree on the last $(d-1)$ -coordinates of the points stored in the subtree of v .

Operations

Construction

A 1-dimensional range tree on a set of n points is a binary search tree, which can be built in $O(n \log n)$ time. Range trees in higher dimensions are built recursively by constructing a balanced binary search tree on the first coordinate of the points, and after that, for each vertex v in this tree, building a $(d-1)$ -dimensional range tree on the points contained in the subtree of v . Building a range tree this way would require $O(n \log^d n)$ time.



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