Programming Project

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Computational Geometry

April 23, 2018

Problem . Orthogonal Range Searching - Given n points, process and store it in a data structure. For any rectangle given (specified by opposite corners) report all points in the rectangle

Solution As explained in book I have used KD-tree method for the problem stated above.

In that first the program will form a KD-tree by dividing the plane through medians of x and y co-ordinates of given points alternatively on alternate level of tree. As the problem stated is a 2d case of KD-tree.

For dividing the unsorted point at each level QuickSelect median method is used to find median of the given points in $\mathcal{O}(n)$.

After forming the KD-tree for querying following cases are considered.

1. If the current node is a leaf then program will check if that point at leaf lies inside the rectangle or not and report that leaf accordingly.
2. If the region at that node lies completely inside the given rectangle then the program will report all the leaves for that subtree.
3. If there is no intersection of region at that node and rectangle then recursion will not further go ahead that node.
4. If the rectangle lies completely at the left of the divider of that node then recursion will go to the left of that node.
5. If the rectangle lies completely at the right of the divider of that node then recursion will go to the right of that node.
6. otherwise it will recurse on both left and right of the current node.

Storage:- As at each node a single value denoting the median is stored so overall storage will be of $\mathcal{O}(n)$.

Running Time:- Forming KD-tree will take $\mathcal{O}(nlogn)$ and querying will take $\mathcal{O}(\sqrt{n}+k)$ where k is the number of reported points.