Advanced Data Structures (COP5536)

Exam 3, Sample 3

Note. All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality. The points assigned to each question are provided in parentheses.

1. For Splay tree,

   (a) (5) Construct an arbitrary splay tree with height 7. Your tree should have an element with key 10 at level 7.

   (b) (15) Perform split operation with respect to the element with 10. Show the splay tree following each substep of the splay operation as well as the final splay trees.

2. Consider B-tree with $m = 3$.

   (a) (5) Construct a B-tree with height 3 (level 1 at the root) with the keys: 1,2,3,4,5,6 and 7.

   (b) (15) Following the algorithm in the text, perform *delete 6* from the constructed tree showing each step.

3.

   (a) (10) Describe how the operation EnumerateRectangle (x_{left}, x_{right}, y_{top}) can be done on a radix priority search tree. The complexity of your method should be $O(logk+S)$. The x values are in the range 0 through $k-1$ and S is the number of points in the rectangle.

   (b) (5) Show that your method has the above complexity.

4. (a) (10) Describe the structure of a 3-range tree.

   (b) (5) Explain how you would find all records with $l_x <= x <= u_x$, $l_y <= y <= u_y$, $l_z <= z <= u_z$.

(c) (5) What are the preprocessing and query time for the 3-range tree? **Derive these**.

5. (15)

Explain how you would find the east neighbor block of a block X in a quadtree. The block X is a $2^k * 2^k$ region of an image and is represented by node X of the quadtree. The east neighbor of X is a region of size $2^j * 2^j$ with j being the smallest integer >= k such that the $2^j * 2^j$ region is adjacent to X on the east boundary of X. You are to describe in detail, how to locate the quadtree node that represents the east neighbor of the region X.

Solutions