

Advanced Data Structures (COP 5536 /NTU AD 711R)
Exam 3 (Dec. 11, 2000)
CLOSED BOOK
120 Minutes

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. *For each problem you must use the relevant algorithm discussed in class or in the text or in the web readings.*

1. (6) What is the maximum number of disk accesses required for a *deletion* from a B-tree? Why? Assume that there is enough internal memory to hold all nodes accessed during this operation and h is the height of the B-tree.
2. (10) For Splay tree,
 - (a) (4) Construct an arbitrary splay tree with height 6 that has 10 elements. Your tree should have an element with value 7 at level 6.
 - (b) (6) Perform the *split* operation with respect to the element with value 7, showing each step.
3. (10) In a suffix tree,
 - (a) (5) Draw a clearly labeled suffix tree for the string *aaab*.
 - (b) (5) Describe how the longest repeating substring in a string can be determined. What is the longest repeating substring in the resulting tree of (a)?
4. (8) A min radix priority search tree (RPST) can be defined as a set of pairs $[x, y]$ over $[0..24]$ of integers. The RPST is a min-tree on y and a search tree on x .
Construct a min RPST by *inserting* the following pairs in the sequence shown below. Show each step.

$(23, 23), (4, 11), (5, 5), (8, 8), (3, 4).$

Delete (3,4) from the constructed tree, showing each step.

5. (10) Describe the 2-dimensional range tree data structure. Derive the formulas for the preprocessing time P , the space required S , and the query time Q .
6. (6) Let Q be a quad-tree that represents a digitized binary image of a region, where the pixels representing the water surface are black. Describe how the area of the water surface may be computed. Assume that each pixel represents one unit of area.