Advanced Data Structures (COP 5536 /NTU AD 711R)
Exam 2 (Mar. 23, 2001)
CLOSED BOOK
50 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. In all problems, you must use the algorithms discussed in class or in the text.

1. (a) (2) Insert the following elements into an empty min Fibonacci-heap and show the result: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19

   (b) (4) Perform $DeleteMin$ operation on the constructed heap, clearly labelling $ChildCut$ value. Show each step.

   (c) (4) Perform $DecreaseKey$ operation to decrease 17 to 4 and draw the resulting tree.

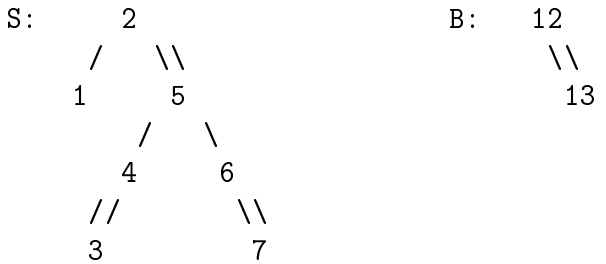
2. (8) Recall that an *Indexed Binary Search Tree ibst* has the field $leftSize$. For any node, the value of its $leftSize$ field is the number of nodes in its left subtree. Write a pesudo code $FindK_{th}(ibst, k)$ to locate the k_{th} smallest identifier m in *ibst*. The run time of your pseudo code should be $O(h)$, where h is the height of *ibst*.

3. (12) Recall that inserting a node into an AVL tree may require LL, LR, RL, or RR rotations. Draw AVL trees in which inserting a node requires an RL rotation. Remember that there are *three* cases for RL rotation. For each case, indicate a node to be inserted and draw the AVL tree following the insertion.

4. (a) (5) Insert keys 9, 8, 7, 2, 6, 1, 4 and 3 into an initially empty *2-3 tree* in the given order. Show each step.

   (b) (5) *Delete* the minimum key of the root node, showing each step.

5. (10) Consider the two red-black trees S and B shown below (single line denotes black pointer and double line red pointer):



   (a) (5) Perform *Join(S, 10, B)* operation, showing each step.

   (b) (5) For the red-black tree S above, perform *Split(3)*, showing each step.