Instructor: Dr. Sartaj Sahni
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Advanced Data Structures
(COP 5536 /NTU AD 711R)

Exam 2

CLOSED BOOK
70 Minutes
Take One Week after Lecture 26

Name: ______________________________

SSN: ______________________________

Site Number: ______________________________

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. (10) For the following two-tree min Fibonacci heap, assume that the *ChildCut* field of all nodes is TRUE.

```
 min
   1                 15
 / | \               |
3  5  7              16
      | \
      9  11
         |
         13
```

   (a) (4) Perform *DecreaseKey* operation by changing 11 to 2.

   (b) (6) Perform DeleteMin operation on the resulting Fibobacci heap, clearly labelling ChildCut value. (Show each step)

2. (10) 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.

   (a) (5) Write a pseudo code Find-Kth(ibst, k) to locate the Kth smallest identifier m in ibst.

   (b) (5) The run time of your psedo code should be O(h), where h is the height of ibst. Justify your answer.

3. (10) Consider an AVL tree.

   (a) (4) Construct an AVL tree with the keys: 1,3,4,5,6,7,9,10,11,12,13. The root node of the constructed AVL tree must have the key value 10 and balance factor 1. All nodes other than the root node must have the balance factor 0.

   (b) (8) Into the constructed tree above, *insert 8* and 2 in sequence, showing each result. Clearly label the balance factor on each node.

4. (10) Draw a 2-3 tree with 11 elements (1 to 11) and height 3, where all nodes at levels are 2-nodes (the root is at level 1). Delete the element in the leftmost node at level 2 and draw the resulting 2-3 tree. Delete again the max element and draw the resulting 2-3 tree.

5. (10) Following the algorithm in the text/lecture, consider the two red-black trees S and B below (single line denotes black pointer and double line red pointer).

```
S:          3                B:     13
          /   \\                     \\
         1     7                      14
             /  \
            5    9
          //\\     \\
         4   6      10
```

(a) (8) Perform $Join(S, 12, B)$ operation, showing each step.

(b) (8) For the red-black tree S above, perform the *split* operation for key value 5, showing each step.