Instructor: Dr. Sartaj Sahni
Fall, 2003

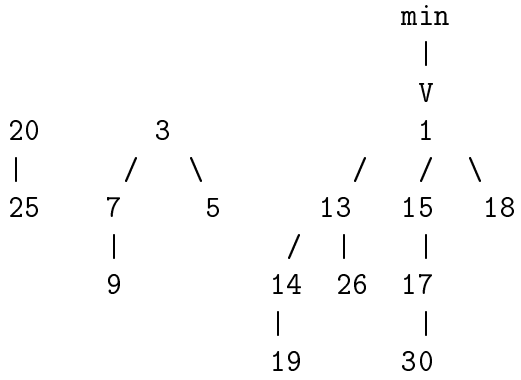
Advanced Data Structures
(COP 5536 /AD 711R)
Exam 2

CLOSED BOOK
60 Minutes

Name: _____

NOTE:
1. **For all problems, use only the algorithms discussed in class/text.**
2. All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality.
3. The points assigned to each question are provided in parentheses.

1. (17) For the following min Fibonacci heap, assume that the $ChildCut$ field of all node is TRUE (However, the ChildCut of a root node is undefined).



   (a) (9) *Delete* the *min* element. Show each step and clearly label $ChildCut$ values.

   (b) (8) Perform a $DecreaseKey$ operation by changing 19 to 6 on the resulting Fibobacci heap of (a), clearly label $ChildCut$ values (Draw the resulting *Fibonacci* heap.)

2. (13) For AVL trees,

   (a) (6) Construct an AVL tree with following keys: 2,3,4,5,6,7,9,10,11,12, and 13.
   The root node of the constructed AVL tree must have the key 5 and balance factor +1. All nodes other than the root node have the balance factor 0. (Note: Do not insert the keys in the given sequence.)

   (b) (7) *Insert* 8 and 1, in this order, into the AVL tree of Part (a). Show each result and clearly label balance factors and rotation types.

3. (20) For red-black trees, use the *bottom-up* algorithm for this problem.

   (a) (10) Construct a red-black tree by inserting the keys in the following sequence into an initially empty red-black tree:
   10, 8, 5, 1, 3, and 7

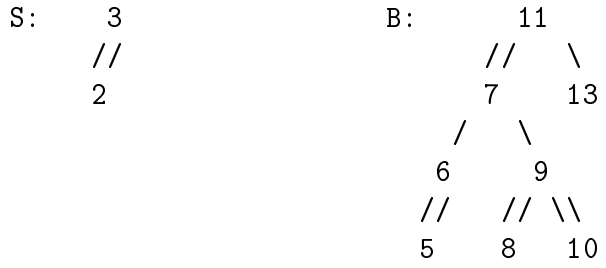


Figure. Red-black trees

   (b) (10) For the red-black trees S and B shown above, perform $Join(S, 4, B)$ operation, showing each step. Double edge indicates a red pointer and single edge indicates a black pointer.