

Instructor: Dr. Sartaj Sahni
Summer, 2002

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

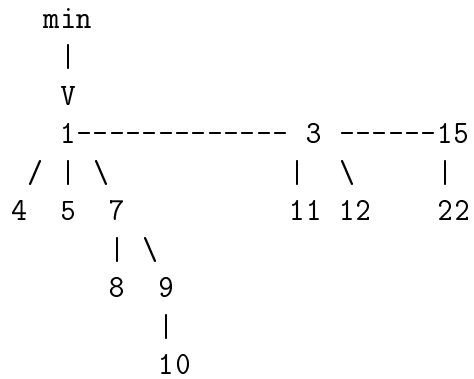
CLOSED BOOK
60 Minutes

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. (10) For the following three-tree min Fibonacci heap, assume that the *ChildCut* field of each node is TRUE.



- (a) (6) Perform a *DeleteMin* operation on the Fibonacci heap, clearly labelling ChildCut value. (Show each step)
- (b) (4) Perform a *DecreaseKey* operation by changing 15 to 2 on the resulting Fibonacci heap, clearly label *ChildCut* values (Draw the resulting *Fibonacci* heap.)

2. (8) Start with an empty *two-pass* max pairing heap.
 - (a) (4) *Insert* the following sequence of keys: 5, 3, 1, 15, 7, 8, 4, 12, and 2 in this order. Show the pairing heap after each insert.
 - (b) (4) Perform a *RemoveMax* operation on the resulting heap of (a), showing each step.

3. (10)

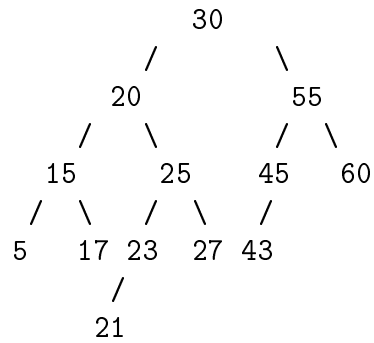


figure 3 AVL tree.

- (a) (4) Perform the result of inserting the sequence 2, 1, 3, 5, 4, 8, 7, 6 into an initially empty AVL tree (show each step and specify each rotation type).
- (b) (6) *Delete* 60 from the AVL tree of *figure 3*. Show each step and specify each rotation type.

4. (10) The following tree represents a 2-3-4 tree.

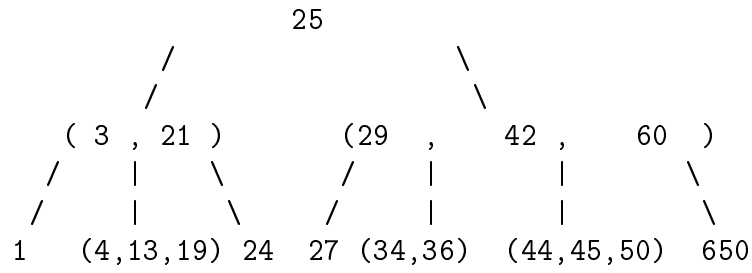


figure 4: 2-3-4 tree

- (a) (5) Convert the 2-3-4 tree into an equivalent red-black tree (show each step).
- (b) (5) Delete the key 25 from the original 2-3-4 tree of figure 4 (show each step).

5. (12) For red-black trees,

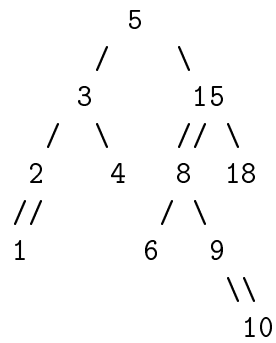


figure 5: red-black tree

- (a) (6) Delete the element 4 from the red-black tree shown in figure 5 and then insert the element 12 using the *bottom-up* (2-pass) algorithm (double lines indicate a red edge and single line a black one). Show each step.
- (b) (6) Perform the *split* operation for key value 8 in figure 5, showing each step.