Instructor: Dr. Sartaj Sahni
Summer, 2005

Advanced Data Structures
(AD 711R)
Exam 02

CLOSED BOOK
60 Minutes

Name: _____

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. **For all problems, use only the algorithms discussed in class/text.**
2. **Write your name at the top of every exam sheet.**
3. **Write your answers directly on the exam question sheet.** You may use scrap paper (supplied by your proctor) for work, but these will not be graded.
4. All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality.
5. The points assigned to each question are provided in parentheses.
6. You may use only a pen or a pencil. No calculators allowed.
7. Do not write on the reverse side of the exam sheet.
8. Do not write close to the margins since those areas do not always make it through when faxed.

Name:

1. (60) For the following min Fibonacci heap. (The ChildCut of field shown in parentheses; ChildCut is undefined for the root.)

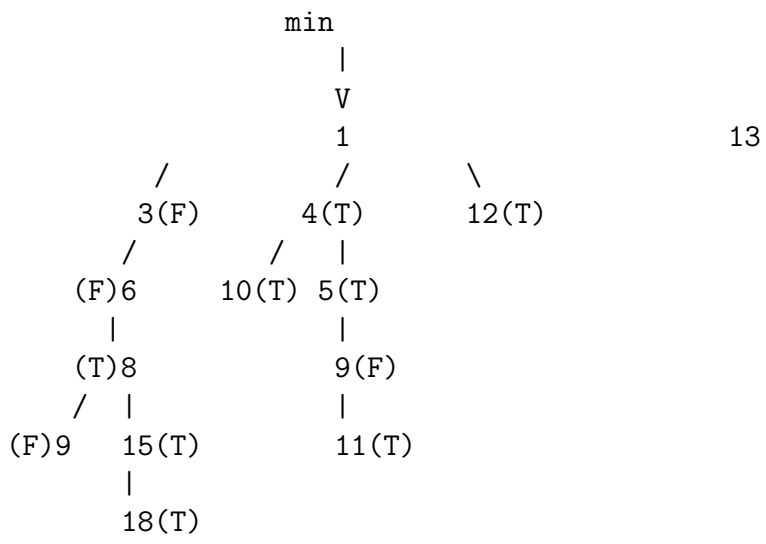


Figure 1. Min Fibonacci heap

   (a) (30) For the min Fibonacci heap of figure 1, perform a *DecreaseKey* operation by changing 15 to 2. Draw the resulting *min Fibonacci* heap, clearly label *ChildCut* value.

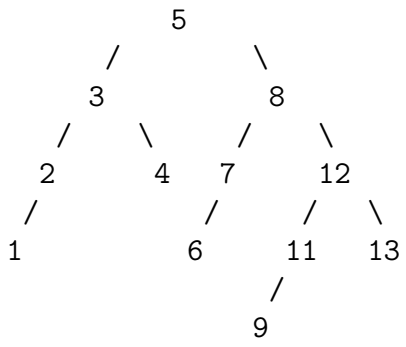
   (b) (30) For the min Fibonacci heap of figure 1, perform a *Delete* the *min* element. Draw the resulting *min Fibonacci* heap, clearly label *ChildCut* value.

Name:

Continue work here if necessary.

Name:

2. (6) Consider the following AVL tree.



The two operations are independent. Each of them starts from the above tree

(a) (4) Perform *Insert(10)*.

(b) (4) Perform *delete(5)*.

Name:

Continue work here if necessary.

Name:

3. (60) Start with an empty *two-pass max* pairing heap,

   (a) (20) Insert the following sequence of keys: 3, 7, 1, 2, 8, 9, 12 and 10 in this order. Draw the resulting max pairing heap.

   (b) (20) Perform a IncreaseKey(7,10) operation, which increase the 7 to 17, on the resulting max pairing heap of (a). Show the resulting max pairing heap.

   (c) (20) For the *max* pairing heap of figure 3 below, perform a $RemoveMax$ operation using *two-pass* scheme and show each step.

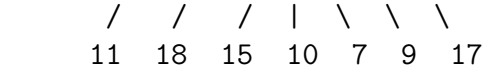


Figure 3. max pairing heap

Name:

Continue work here if necessary.

Name:

4. (14) For *red-black* trees, use the *bottom-up* algorithm for this problem. Double lines indicate a red edge and single line a black edge.

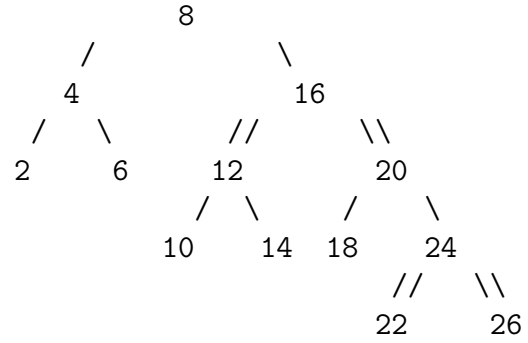


Figure 4. Red-black tree

(a) (8) Perform the following sequence of operations on the red-black tree shown in Figure 4 in this order:
Insert(21), Insert(25), Delete(2)
Show each step and specify rotation type/color flip/rebalancing strategy if applied.

(b) (6) Consider the red-black tree shown in Figure 5. Perform *Split(3)* operation, showing each step.

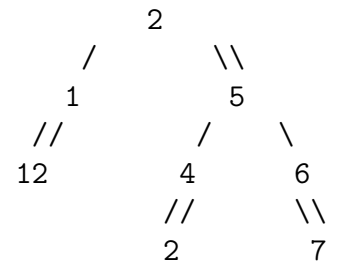


Figure 5. Red-black tree

Name:

Continue work here if necessary.