Instructor: Dr. Sartaj Sahni
Summer, 2003

Advanced Data Structures
(COP 5536 /NTU AD 711R)
Exam 1

CLOSED BOOK
60 Minutes
Take one Week after Lecture 13 (Jun. 11th 2003)

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. (15)

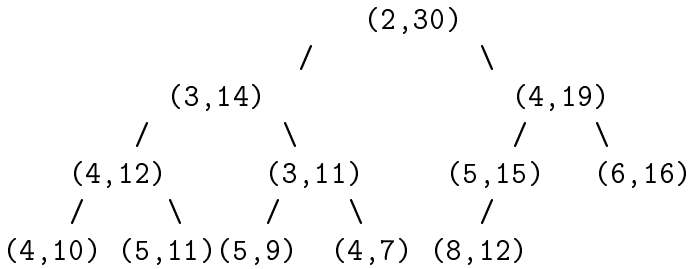
   (a) (10) In January, the CS department buys a computer which has a maintenance contract. The maintenance contract costs \$20 each month other than March, June, September, and December (this covers a basic routine check), \$40 every March, June, and September (this covers a basic routine check and a general inspection), and \$80 every December (this covers a complete inspection). Determine the lowest amortized cost of this maintenance contract as a function of the number of months.

   (b) (5) Using the amortized cost calculated in part(a), fill in the following table.

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Actual cost	20	20	40	20	20	40	20	20	40	20	20	80
Amortized cost												
Potential()												

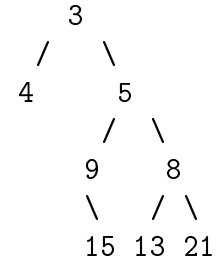
Table 1: Maintenance Contract

2. (12) Given the interval heap below, show the final interval heap produced by the following sequence of operations in this order: $insert(25)$, $removeMin()$. Show each step.

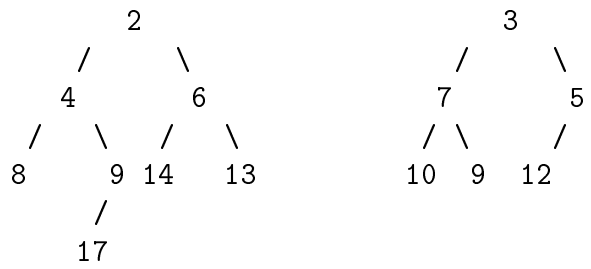


3. (13) Consider a height-biased min leftist tree:

   (a) (5) Convert the following min tree to a height-biased min leftist tree and label each node x with its shortest(x) value. Do this by swapping left and right subtrees as needed.



   (b) (8) Draw the min leftist tree that results from when the *combine* operation is performed on the two min leftist trees. Show each step.



4. (10) Start with an empty *min binomial heap*,

   (a) (4) *Insert* the following sequence of keys into the *min binomial heap*:

   $$7, 12, 4, 23, 3, 24, 13, 20, 19, 5$$

   Show the resulting structure.

   (b) (6) Perform a $RemoveMin$ operation on the heap of (a) (showing each step)
   (Note: For consistency in solution, if you have three binomial trees of the same size in the intermediate steps, please leave the binomial tree with the largest root, and combine the other binomial trees.)