Instructor: Dr. Sartaj Sahni
Spring, 2005

Advanced Data Structures
(COP5536)
Exam 01

CLOSED BOOK
50 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 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. (15)

   (a) (10) In January, the CS department purchased 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

Name:

Continue work here if necessary.

Name:

2. (10) You are given n=1000 records to be sorted on a computer with a memory capacity of S=180 records. Assume that the entire S-record capacity may be used for input/output buffers, i.e., you have extra memory for a k-way loser tree. The input is on disk and consists of m runs. Assume that you use $2k$ buffers for input and 2 for output. Also assume that each time a disk access is made, the seek time is t_s=6ms and the latency time is t_l=4ms. The transmission time is t_t =0.1ms per record transmitted.

   What is the buffer size, b , and the total input time for k=8?

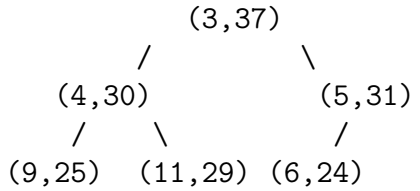
Name:

Continue work here if necessary.

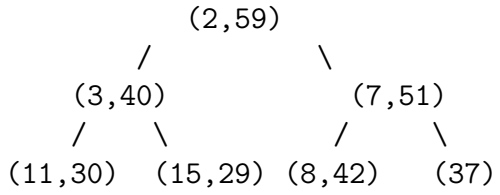
Name:

3. *(5)* For the *interval heap*,

   (a) (3) Show the final interval heap produced by *insert(40)* to the interval heap below:



   (b) (5) Perform *RemoveMin* operation from the interval heap below, showing each step.

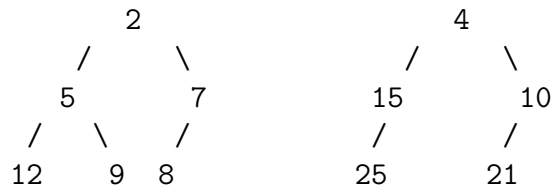


Name:

Continue work here if necessary.

Name:

4. *(5) Meld* the following height-biased min leftist trees, showing each step.



Name:

Continue work here if necessary.

Name:

5. *(12)* Consider a min binomial heap.

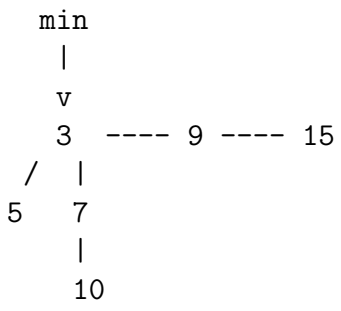


Figure 5. Min binomial heap

(a) (2) Draw the final min binomial heap produced by operations *insert(8)*

(b) (4) Perform $RemoveMin$ from the above min binomial heap (figure 5).

(c) (6) What is the overall complexity of $RemoveMin$ operation. Provide this complexity as a function of $MaxDegree(n)$ (the maximum possible degree for a tree in a binomial heap that has n elements) and t (the number of top–level trees in the binomial heap just prior to the remove min operation). Assume the binomial heap has n elements prior to the *RemoveMin*. (justify your answer)?

Name:

Continue work here if necessary.