

**Instructor: Dr. Sartaj Sahni
Spring, 2004**

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

CLOSED BOOK
50 Minutes
Feb. 18th 2004

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.

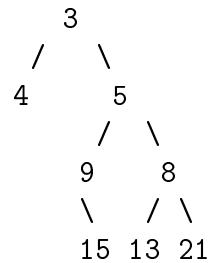
1. (10) Suppose that a sequence of n operations is performed on a data structure. The k th operation has a cost of $2\sqrt{k}$ whenever k is a perfect square ($k = 1, 4, 9, 16, 25$, etc), and otherwise it has a cost of 1. Use any one of the following methods of analysis to determine the amortized cost per operation: aggregate, accounting, or potential method. Please specify which method you are using. (notice that, find the smallest integer amortized cost)

2. (10) You are given 8 runs with 100, 200, 300, 400, 500, 600, 700, and 800 equal-length records. The block size is 100 records. The runs are to be merged using either an optimal 4-way or 8-way merge scheme. Assume that each merge is done using a loser tree.

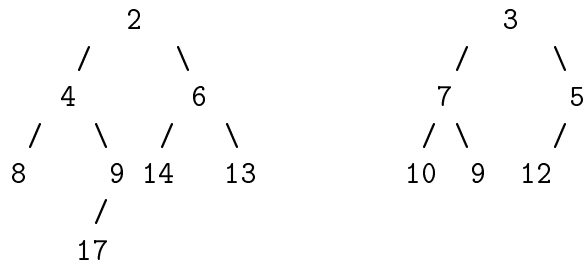
Determine the number of comparisons and the number of disk I/Os for both merge schemes. Which scheme do you recommend when all input, output, and CPU processing are sequential?

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

- (a) (4) Convert the following min tree to a height-biased min leftist tree and label each node x with its $\text{shortest}(x)$ value. Do this by swapping left and right subtrees as needed.



- (b) (6) 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) (3) *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) (7) 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.)