

COP 5536

Advanced Data Structures Spring 2021

Exam 1

CLOSED BOOK

9:00 am – 10:30 am

(60 Minutes + Extra 30 Minutes for scanning & submission)

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. For all problems, use only the algorithms discussed in class/text.
2. Write your answers directly on your own white blank paper. You may use extra scratch paper for calculation, but these will not be submitted.
3. All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality.
4. You may use only a pen or a pencil. No calculators allowed.

Note. All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality. The points assigned to each question are provided in parentheses.

Last Name: _____

First Name: _____

UFID: _____

Q. 1 (10)	Q. 2 (12)	Q. 3 (14)	Q. 4 (14)	Total (50)

Question 1 (10):

An ordered stack is a data structure that stores a sequence of items and supports the following operations.

- **OrderedPush**(x) removes all items smaller than x from the beginning of the sequence and then adds x to the beginning of the sequence.
- **Pop** deletes and returns the first item in the sequence (or Null if the sequence is empty).

Suppose we implement an ordered stack with a simple linked list, using the obvious OrderedPush and Pop algorithms. The actual cost of each operation equals the actual number of items it removes or adds. Suppose we start with an empty data structure, what is the smallest integer amortized cost for the OrderedPush and Pop operations? Specify the method you used and show how you arrive at this.

Note that if (x,y) denotes (amortized cost of OrderedPush, amortized cost of Pop), then $(x_1, y_1) \leq (x_2, y_2)$ iff $x_1 < x_2$ or $(x_1 = x_2$ and $y_1 \leq y_2)$.

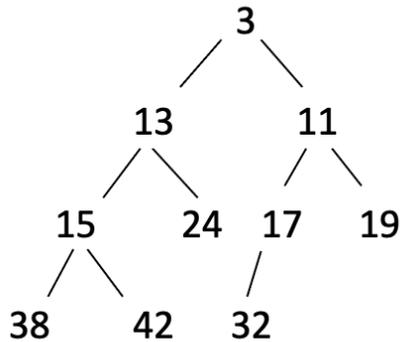
Question 2 (12):

You are given a disk with m runs that has a total of $n = 1000$ records. These m runs are to be merged into one using a k -way merge and a computer with memory capacity of $S = 180$ records. Assume that the entire S -record capacity may be used for I/O buffers (you have extra memory for a k -way loser tree and any other needed support structures). Assume that the merge is done using the $2k+2$ buffer strategy ($2k$ input buffers and 2 output buffers) and that the size of a disk block $B = S/(2k+2)$. Also assume the seek time is $t_s = 6ms$ and latency time is $t_l = 4ms$ for disk access. The transmission time is $t_t = 0.1ms$ per record transmitted.

What is the **buffer size** b , and the **total input time** in terms of m when $k=8$?

Question 3 (14):

For the following height biased min leftist tree:



- (6) Perform insert (9). Show the steps.
- (6) Perform delete Min from the original tree. Show the steps.
- (2) Mention the complexity for the insert, delete and meld operations in a min leftist tree with n elements.

Question 4 (14):

- (4) Insert 7, 31, 12, 11, 8, 13, 22, 9, 2, 19 in the given order into an initially empty binomial heap. Show the resulting min binomial heap.
- (6) Perform one Remove min operation on the resulting binomial heap of part a.
- (4) Insert 23, 44, 58, in this order, into the resulting heap of part b.