University of Nevada, Las Vegas Computer Science 477/677 Fall 2021

Assignment 4: Due Monday October 4, 2021 11:59 pm

Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet. Turn in the completed assignment on canvas, using instructions given to you by the grader, Mr. Heerdt, by 11:59 PM October 4.

1. (a) Name three kinds of priority queue.

   (b) The items in a priority queue always represent _____ _____ .

2. The asymptotic solution to the recurrence

   $F(n) = 2F(n-1)$

   is $F(n) = \Theta(2^n)$. The Fibonacci sequence, 1, 1, 2, 3, 5, 8, 13, 21, ... has the property that each term, after the second, is the sum of the two previous terms. If $F(n)$ is the n^{th} Fibonacci number we have the recurrence

   $F(n) = F(n-1) + F(n-2)$.

   If you work problem 0.3 on page 9 of your textbook, you will find that $F(n) = \Theta(\phi^n)$, where $\phi = \frac{1+\sqrt{5}}{2} \approx 1.619$, the so-called *golden ratio.*

   Give an asymptotic solution for the recurrence

   $F(n) = 2F(n-1) + 3F(n-2)$

3. Work problem 2.20 on page 74 of your textbook. Let $X[1 \ldots n]$ be an array of integers and let $M = \max_i X_i - \min_i X_i$. Find an $O(n + M)$ time algorithm for sorting X. For small M, this is linear time: why doesn't the $\Omega(n \log n)$ lower bound apply in this case?

4. The following array shows the steps of heapsort for the initial array of letters WIORGBNCVQ.

1	2	3	4	5	6	7	8	9	10	Notes.
W	I	O	R	G	B	N	C	V	Q	Initial array.
W	I	O	R	Q	B	N	C	V	G	Bubbledown(G).
W	I	O	V	Q	B	N	C	R	G	Bubbledown(R).
W	V	O	I	Q	B	N	C	R	G	Bubbledown(I).
W	V	O	R	Q	B	N	C	I	G	Bubbledown(I). Max-heap order, End Heapify.
G	V	O	R	Q	B	N	C	I	W	W swapped to final position.
V	G	O	R	Q	B	N	C	I	W	Bubbledown(G).
V	R	O	G	Q	B	N	C	I	W	Bubbledown(G).
V	R	O	I	Q	B	N	C	G	W	Bubbledown(G). Max-heap order restored. End Phase 1.
G	R	O	I	Q	B	N	C	V	W	V swapped to final position.
R	G	O	I	Q	B	N	C	V	W	Bubbledown(G).
R	Q	O	I	G	B	N	C	V	W	Bubbledown(G). Max-heap order restored. End Phase 2.
C	Q	O	I	G	B	N	R	V	W	R swapped to final position.
Q	C	O	I	G	B	N	R	V	W	Bubbledown(C).
Q	I	O	C	G	B	N	R	V	W	Bubbledown(C). Max-heap order restored. End Phase 3.
N	I	O	C	G	B	Q	R	V	W	Q swapped to final position.
O	I	N	C	G	B	Q	R	V	W	Bubbledown(N). Max-heap order restored. End Phase 4.
B	I	N	C	G	O	Q	R	V	W	O swapped to final position.
N	I	B	C	G	O	Q	R	V	W	Bubbledown(B). Max-heap order restored. End Phase 5.
G	I	B	C	N	O	Q	R	V	W	N swapped to final position.
I	G	B	C	N	O	Q	R	V	W	Bubbledown(G). Max-heap order restored. End Phase 6.
C	G	B	I	N	O	Q	R	V	W	I swapped to final position.
G	C	B	I	N	O	Q	R	V	W	Bubbledown(C). Max-heap order restored. End Phase 7.
B	C	G	I	N	O	Q	R	V	W	G swapped to final position.
C	B	G	I	N	O	Q	R	V	W	Bubbledown(B). Max-heap order restored. End Phase 8.
B	C	G	I	N	O	Q	R	V	W	C swapped to final position. End phase 9. Sorted.

5. Walk though heapsort with input array UBRYPQSVFMTX by filling in the array below and on the next page. Warning: the number of blank rows is not correct.

1	2	3	4	5	6	7	8	9	10	11	12
U	B	R	Y	P	Q	S	V	F	M	T	X

1	2	3	4	5	6	7	8	9	10	11	12

6. Walk through the steps of mergesort to sort the file YUEPGJQTBHZRWCNK.

7. Walk through the steps of polyphase mergesort to sort the file YUEPGJQTBHZRWCNK. **Remember!** Polyphase mergesort is not the same as mergesort.