Student Name: ______________________________ J#: ________________

CSC 228 Data Structures and Algorithms, Fall 2019

Instructor: Dr. Natarajan Meghanathan

Quiz 5 and Quiz 6 (Take Home) Max. Points: 50 each

Due on: Nov. 19th @ 11.30 AM. **<u>Late submissions will NOT be accepted.</u>**

Print all the pages and answer in the space provided. Staple everything together and submit in class at the above time.

Clear label your answers for each of the sub parts (a) - (n), in the space provided.

Given an array of integers, do the following (SHOW ALL THE STEPS; just writing the final answer will get only ZERO).

Quiz 5

(a - 11 pts) Construct a max heap of the array. Show the initial essentially complete binary tree and the transformation of the binary tree to a max heap via the reheapify operations at the indices of the internal nodes (as shown in the slides).

(b - 11 pts) Sort the max heap version of the array obtained from (a) to obtain a sorted array of integers. Show the structural changes of the max heap in each iteration.

(c - 7 pts) Transform the max heap of (a) to a binary search tree.

(d - 7 pts) For the binary search tree obtained in (c), considering both its structure and data together, determine the average number of comparisons for a successful search and the average number of comparisons for an unsuccessful search.

(e - 7 pts) Use the sorted array of (b) to construct a binary search tree.

(f - 7 pts) For the binary search tree obtained in (e), considering both its structure and data together, determine the average number of comparisons for a successful search and the average number of comparisons for an unsuccessful search.

Quiz 6

(g - 6 pts) Construct a hash table of the given array using a hash function H(K) = K mod 5.

(h - 6 pts) For the hash table of (g), determine the average number of comparisons for a successful search and the worst case number of comparisons for an unsuccessful search.

(i - 9 pts) Consider the elements of the array assigned to you are known only one at a time. Construct a sequence of priority queues (as max heaps) with the insertion (enqueue) of one element at a time, as shown in the slides.

(j - 7 pts) Transform the binary search tree of (c) to a min heap.

(k - 6 pts) Transform the max heap of (a) to a min heap via reheapify operations at the internal nodes.

(l - 3 pts) Are the min heaps of (j) and (k) the same or not? What can you say about the distribution of the data in the min heaps of (j) and (k)?

(m - 7 pts) Determine whether the binary search trees of (c) and (e) are height-balanced or not?

(n - 6 pts) Write the pre-order, in-order and post-order traversal of the vertices in the binary search tree of (c).

Student Name: ______________________________ J#: ________________

1	Oluwaseun Akintade	24	44	31	29	19	45	47	36	41	42	25	35
2	Abdullah Alharbi	26	37	45	6	46	29	48	6	37	20	32	29
3	Abdulmajeed Alharbi	26	13	46	47	10	41	18	27	16	10	24	38
4	Kenneth Allen	12	47	44	7	33	43	30	25	46	6	39	38
5	Zatavia Allen	41	5	27	19	4	37	30	46	8	26	10	16
6	Tara Amos	41	13	15	5	9	42	2	17	31	40	10	30
7	Dakarai Armstead	20	47	23	1	31	45	38	37	8	2	47	44
8	Nayaa Atkins	39	10	49	46	12	38	11	2	50	41	39	34
9	Isaiah Barnett	9	36	33	21	35	33	4	28	22	35	48	44
10	Ronnal Boyd	38	15	22	45	14	9	11	41	43	16	33	50
11	Justin Bridges	36	5	12	47	13	19	37	44	19	47	21	34
12	Surruaku Cathey	34	10	26	37	41	36	6	10	41	18	39	39
13	Deunta Collins	40	28	1	38	33	20	2	22	31	50	5	13
14	Korderrick Davis	21	33	28	46	32	5	3	39	36	4	40	47
15	Kobe Dixon	42	42	41	10	46	27	18	43	11	24	13	47
16	Keilah Drake	1	36	29	38	29	43	19	48	17	42	47	28
17	Enoma Ereyimwen	24	28	38	29	10	34	37	28	35	19	19	45
18	Angel Foster	14	17	16	45	9	42	47	34	33	45	49	42
19	Kenjeffery Harmon	44	10	46	10	10	12	22	24	33	26	44	47
20	Taylor Hayes	29	48	19	10	43	1	37	14	18	30	8	5
21	Qaylin Holliman	17	6	43	20	31	4	45	33	15	15	30	38
22	Shaquan Holmes	36	7	28	45	44	50	48	6	26	9	49	32
23	Atayliya Irving	39	2	1	16	31	21	1	27	13	10	20	37
24	Shamia Johnson	7	1	12	39	34	7	5	26	19	22	5	20
25	Camrin Jones	7	6	16	33	29	8	39	36	16	5	34	28
26	Trave'Elle Knotts	37	5	6	12	7	8	24	12	23	39	3	7
27	Jorian Lenard	26	4	48	28	15	15	22	1	2	50	29	49
28	Clairice Magee	16	13	22	42	17	3	22	32	30	18	12	38
29	Jeremy McFadden	4	8	16	6	6	35	11	40	38	16	33	42
30	Bria McGee	30	44	21	41	8	35	33	20	46	29	16	32
31	Getnet Mekuriyaw	25	42	35	11	25	41	45	21	10	25	27	23
32	Montey Moran Jr.	8	41	13	21	2	44	3	1	18	45	49	14
33	Patrick Pei	48	19	9	1	44	25	48	14	19	9	11	46
34	Janaurius Porter	17	39	41	35	48	29	43	46	34	32	14	49
35	Justice Prelow	50	14	34	1	34	21	29	30	38	8	31	35
36	Simeon Rankin	43	50	45	44	20	9	8	36	50	5	13	24
37	Eliza Samuels	35	49	15	19	23	1	18	22	42	13	30	45
38	Shomari Smith	44	21	16	26	34	41	33	10	7	18	38	35
39	William Smith	19	41	36	8	24	23	50	38	14	25	4	16
40	Jasmine Stubbs	49	45	6	5	21	13	48	14	21	14	33	8
41	Shaurya Swami	15	4	37	23	10	36	46	23	44	29	49	14
42	Landrie Tchakoua	39	35	7	36	26	29	40	17	21	48	26	20
43	Nahom Teshome	12	48	10	5	38	34	3	25	15	3	47	37
44	DiQuonte Thomas	13	1	10	2	2	37	17	19	39	29	32	30
45	Da Johne' Thompson	20	4	21	6	49	35	45	17	45	46	1	47
46	Marzell Triplett	45	46	15	24	39	9	13	1	35	43	15	32
47	Kenneth Varnell	2	37	9	2	22	32	6	34	42	4	21	14

48	Justin Walls	15	19	31	39	36	17	33	40	39	39	12	18
49	Kayla Wilkes	46	10	41	22	20	29	6	19	41	24	7	24
50	Henri Williams	41	20	28	10	44	33	50	19	13	22	19	22
51	Nicholas Williams	35	24	20	13	24	39	41	18	45	34	1	43
52	Branden Willis	6	19	42	18	19	24	32	50	19	29	43	22
53	Cleveland Yancovitz	42	41	13	22	27	3	10	45	31	11	10	6
54		20	4	15	4	9	25	7	19	38	30	6	39
55		38	47	46	38	6	50	23	37	40	16	19	22

(a - 11 pts) Construct a max heap of the array. Show the initial essentially complete binary tree and the transformation of the binary tree to a max heap via the reheapify operations at the indices of the internal nodes (as shown in the slides).

(b - 11 pts) Sort the max heap version of the array obtained from (a) to obtain a sorted array of integers. Show the structural changes of the max heap in each iteration.

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(c - 7 pts) Transform the max heap of (a) to a binary search tree.

(d - 7 pts) For the binary search tree obtained in (c), considering both its structure and data together, determine the average number of comparisons for a successful search and the average number of comparisons for an unsuccessful search.

(e - 7 pts) Use the sorted array of (b) to construct a binary search tree.

(f - 7 pts) For the binary search tree obtained in (e), considering both its structure and data together, determine the average number of comparisons for a successful search and the average number of comparisons for an unsuccessful search.

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(g - 7 pts) Construct a hash table of the given array using a hash function H(K) = K mod 5.

(h - 7 pts) For the hash table of (g), determine the average number of comparisons for a successful search and the worst case number of comparisons for an unsuccessful search.

(i - 14 pts) Consider the elements of the array assigned to you are known only one at a time. Construct a sequence of priority queues (as max heaps) with the insertion (enqueue) of one element at a time, as shown in the slides.

(j - 7 pts) Transform the binary search tree of (c) to a min heap.

(k - 7 pts) Transform the max heap of (a) to a min heap via reheapify operations at the internal nodes.

(l - 4 pts) Are the min heaps of (j) and (k) the same or not? What can you say about the distribution of the data in the min heaps of (j) and (k)?

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(m - 7 pts) Determine whether the binary search trees of (c) and (e) are height-balanced or not? Show all the work.

(n - 6 pts) Write the pre-order, in-order and post-order traversal of the vertices in the binary search tree of (c).