Quiz

CSCI-4470 Algorithms

Quiz 1 and Quiz 2

Quiz-1

1. (2 points) (True/False) Heap sort is $O(n)$ If the data is already sorted.

2. (2 points) (True or false) `Build-Max-Heap` would still be correct If the loop went from 1 to $\frac{n}{2}$ instead of $\frac{n}{2}$ downto 1.

3. (2 points) $f(n) = 3n^2 - 4n + 10$ and $h(n) = n^3 + 10$ which of the following is correct.
   (a) $f(n)$ and $h(n) \in o(n^3)$
   (b) $f(n) \in O(n^3)$ and $h(n) \in \omega(n^3)$
   (c) $f(n) \in o(n^3)$ and $h(n) \in \Omega(n^3)$
   (d) $f(n) \in \Omega(n^3)$ and $h(n) \in O(n^3)$

4. (2 points) Consider the `Hire-Assistant` problem discussed in the class. What is the probability that exactly 1 candidate is hired?
   (a) $\frac{1}{\log(n)}$
   (b) $\frac{1}{n!}$
   (c) $\frac{1}{n}$
   (d) None of the above

5. (2 points) What is the Big O of the function $f(n) = 75(1 - \frac{1}{n})$.

6. (2 points) Assume you have a heap of height `h` What is the minimum number of elements that can be in the heap? Your answer should be in terms of height `h` .

7. Consider the following array, which represents a priority queue.

   A<39, 37, 25, 20, 36, 22, 19, 15, 17, 30, 26>

   (2 points each) Answer the following question after dequeue operation in performed on this queue.
   (a) what is the root of the heap?
   (b) List all the leaf nodes.
   (c) (True/False) 26 is the right child of node 30.

8. (6 points) A class has 8 woman and 5 men. A committee of 4 is chosen at random. What is the expected number of women in this committee.

9. (6 points) Use the substitution method to solve the following recurrence relation $T(n) = 4T(\frac{n}{2}) + n^2$

Quiz-2

1. (2 points) (`True` /False) Quick sort is a stable sorting algorithm.

2. (4 points) Consider the array A = [10, 23, 5, 18, 12, 20, 13, 15]. Show how the array `A` is going to look after calling `Partition(A, 1, 8)`.

3. (2 points) If `Quicksort` is executed on the array given in problem 2, how many times will partition be called?

    (a) 5

    (b) 7

    (c) 6

    (d) 4

4. (2 points) Assume that after the third loop in `Counting-Sort` (the one that accumulates C), you have `C = [2, 5, 7, 8, 11]`. Which of the following arrays might have been the input to be sorted?

    (a) [0, 4, 1, 2, 3, 0, 1, 2, 1, 4, 4, 3]

    (b) [1, 0, 4, 3, 0, 1, 1, 2, 0, 2, 4]

    (c) [1, 0, 4, 3, 1, 2, 1, 0, 4, 2, 4]

    (d) None of the above

5. (4 points) Assume the list `125, 245, 881, 671, 583, 792, 672, 422` is sorted using `Radix-Sort`. Consider the following pairs of numbers `X` and `Y`. For which of these pairs `X` was placed (or ordered) before `Y` during the iterations of `Radix-sort`? Select all that apply.

    (a) X = 422, Y = 125

    (b) X = 792, Y = 671

    (c) X = 881, Y = 671

    (d) X = 422, Y = 245

    (e) X = 245, Y = 125

6. (2 points) We use `Counting-Sort` as a secondary sorting algorithm used in `Radix-Sort`. Suggest an algorithm that can replace a `Counting-Sort` algorithm. Give justification to your choice.

    Note: For this problem, the focus is only on correctness. Runtime is not an issue here so the complexity of `Radix-sort` can go up.

7. (3 points) Consider the input values `8, 2, 15, 11, 20, 13, 7, 31, 25`. In what case or cases `Randomized-Select` algorithm (finding ith order statistics) will have worst performance for the given input.

8. (6 points) Consider the array `A = [6, 4, 2, 0, 3, 5, 1, 4, 2, 1, 6, 3, 4, 3, 2]`. Assume `Counting-Sort(A, B, 6)` is executed. The last loop in the Counting-Sort algorithm goes from $j : n$ downto 1. Draw the array B and array C when $j = 10$.