

HOMEWORK-4

Total Points: 70

1. [15 points] What would be the time complexity of the quick sort implementation discussed in class for the case when all the elements of the array have the same value? Justify your answer.
2. [20 points] Modify the randomized quicksort algorithm discussed in class to find the median of n array elements without always sorting the entire array. You will lose marks if your algorithm does unnecessary computation. What is the worst-case time complexity of your algorithm?
3. [5 points] Give an algorithm with the worst-case complexity of $O(n * \log(n))$ to find the median of n elements.
4. [10 points] How many times will the merge procedure be called to sort the following sequence of integer elements using merge sort?

28 43 72 79 23 70 55 39 68 1 41 40 5 25 95 4 42 54 79 55

What would be the contents of the array every time the merge procedure returns? If the merge procedure is called k times, you need to write the contents of the whole array k times.

5. [10 points] Let's say the partition algorithm always picks the first element as the pivot. How many times will the partition algorithm be called to sort the following sequence of integer elements using quick sort?

28 43 72 79 23 70 55 39 68 1 41 40 5 25 95 4 42 54 79 55

What would be the contents of the array every time the partition procedure returns? If the partition algorithm is called k times, you need to write the contents of the whole array k times.

6. [10 points] Solve the following recurrence relation using the expansion method.

$$T(n) = T(n - 1) + (c * n^2)$$

$$T(1) = c_1$$