Data Structures and Algorithms Spring 2024 — Problem Sets

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Week 6. Problem set

1. Consider a modification of the randomized QUICK-SORT algorithm [Cormen, §7.3] that stops recursion when the size of subarray becomes less than or equal to k ($k \leq n$). For arrays of size $\leq k$, the modified algorithm performs BUBBLE-SORT. Answer the following questions about the modified algorithm:

   (a) What is the worst case time complexity in terms of n and k?

   (b) What is the best case time complexity in terms of n and k?

   (c) What is the average[1] case time complexity in terms of n and k?

   The answer should be given using Θ-notation.
   Provide a **brief** justification for each case (1–2 sentences).

2. Apply COUNTING-SORT to the following input array where each column corresponds to one item with its numeric key and single-character satellite data:

2	8	2	6	7	6	3	4	1	6	2	0
D	T	O	G	A	R	N	G	R	E	I	U

   You **must** demonstrate the final state of the auxiliary arrays used in the algorithm, as well as the output of the array.

References

[Cormen] T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein. *Introduction to Algorithms, Fourth Edition.* The MIT Press 2022

[1] assuming all elements in the input array are distinct and any initial order in the array is equally likely