

ALGORITHMS, FALL 2018, HOMEWORK 3

Due Thursday, September 27 at 11:59pm.

Worth 2% of the final grade.

Submit each problem on a separate page. Subproblems can be on the same page.

1. Suppose that you have n real numbers, placed in groups of size k . The groups are already in “sorted” order in the sense that every number from one group is smaller than every number from the next. However within each group nothing is sorted. You must return all numbers in sorted order.
 - (a) How many possible outputs (permutations of the input) are there?
 - (b) Provide a lower bound on the worst case time complexity of fully sorting the input, using your answer from (a). Do this without Θ -notation.
 - (c) Convert the answer that you get in (b) to an expression that is more “user-friendly”, using Θ -notation.
 - (d) Briefly confirm that the bound in (c) can be matched: what would you do to sort this input, and what would the cost be?

2. You work at the emergency room at a hospital. Patients come in and you evaluate the severity of their injury by assigning a **real** number from 1 to 100. Whoever has the highest number (and in case of ties, whoever arrived first) sees the doctors first. When a doctor is available, no time should be wasted; you want to identify the person who goes next as quickly as possible (minimize the worst case).
 - (a) How will you handle the data, to automate this process?
 - (b) How much time will it take to send the next patient to the doctors, assuming you’ve had time to set up properly?
 - (c) How long will it take to reorganize after a patient is sent through to the doctors?
 - (d) How long will it take to reorganize after a new patient arrives and you have evaluated their injury?
 - (e) Someone in the wait room gets worse, and you assign a new number for them. How do you reorganize and how long does it take?
 - (f) Someone miraculously gets all better and leaves (after letting you know). How do you reorganize and how long does it take?
 - (g) Now suppose that all of the assessment numbers are values that get rounded to the first decimal (e.g., 23.6, 63.9, 44.1, etc). How do you handle the data and how does it affect the time complexity of the above situations?