

Homework Assignment 2

CS 430 Introduction to Algorithms
Spring Semester, 2018

Due: Thursday, February 1

1. (a) Let $\Pi = (\pi_1, \pi_2, \dots, \pi_n)$ be a random permutation of $\{1, 2, \dots, n\}$. What is the expected value of

$$\frac{1}{n} \sum_{i=1}^n |\pi_i - i|?$$

- (b) Explain why this value is the average distance that an item will move during sorting.
- (c) What can be concluded about a sorting algorithm (such as insertion) that performs only adjacent interchanges?
2. Problem 6.4-3 on page 160.
3. Problem 7-4 on page 188. Add a part (d), as follows: Determine the *average stack depth* for Tail-Recursive-Quicksort, assuming that all permutations are equally likely. (*Hint*: You need an analysis that is somewhat similar to that done in class on January 24.)
4. Problem 8-3(a) on page 206.
5. CLRS3 has code for RANDOMIZED-SELECTION on page 216. A careless CS 430 student implemented the code, but omitted the “−1” on line 8, typing q instead of $q - 1$.
- (a) Does the corrupted code still work (that is, correctly find the i th smallest element) always, sometimes, or never? Explain.
- (b) Analyze the worst-case running time of the corrupted code.
- (c) Analyze the best-case running time of the corrupted code.
- (d) Analyze the average-case running time of the corrupted code. (*Hint*: Be careful that you do not get snagged by the pitfall described in the middle of page 86 of CLRS3.)
- (e) There is (should be, if you did it correctly) something strange about your answer to the previous part; what is strange and how do you explain it?