

Homework 2
CSE 246 Analysis of Algorithms, Spring 2017
Due 20.04.2017 Thursday 23:59

Design an experiment to compare different versions of Quick-sort algorithm. Initial Quick-sort algorithm is a recursive algorithm, where pivot is always selected as the first element. Several modifications may improve the performance of Quick-sort.

1. Apply median-of-three pivot selection¹,
2. Switch to insertion-sort in small subarrays,
3. Elimination of recursion.

In this experiment, you are asked to analyze amount of improvement satisfied by the above modifications. First apply all the modifications one by one, then apply various combination of these modifications. For the second modification, you may consider two different selection of the size of small subarrays for which switch to insertion sort is triggered (You have to decide on these sizes). Your input should be an array of n elements. You should design your experiment in your own. You may implement each version of Quick-sort in any programming language. You have to decide on some sample inputs (large lists with different characteristics) to best clarify the effect of the modifications. While doing your empirical analysis, use physical unit of time, but also count actual number of basic operation's executions. You are also expected to compare your findings with theoretical complexity values. You should provide extensive comments on your results.

This homework has three main steps:

Step 1: Designing the Experiment: This step includes deciding on reasonable inputs and/or generating reasonable sample inputs². For second modification, you have to decide on the size of subarrays (for switching from Quick-sort to insertion sort). You should clearly describe your decisions and reasons behind these decisions in your detailed report.

Step 2: Coding and Running: All algorithms should be implemented in any programming language and experiments should be performed for decided input lists, and results should be evaluated in terms of decided metrics.

Step 3: Illustrating and Analyzing Results: This step includes:

- (a) Providing some plots or tables to illustrate performance of the algorithms.
- (b) Comparing the performance of different versions of Quick-sort for different kind of inputs, and on average.
- (c) Comparing the empirical results with the theoretical results.

You should provide detailed comments for your findings in these comparisons.

Each of the above three steps will be graded separately.

¹ **Note 1:** In quick-sort with median-of-three partitioning the pivot item is selected as the median between the first element, the last element, and the middle element.

² **Note 2:** Inputs should reflect best and worst cases. Also you need to use enough (as many as possible) sample inputs to find a reasonable average case time complexity. Also use different inputs with different sizes.

Note 3: You may do this homework in groups of two.

Note 4: Read chapter 2.6 in order to learn guidelines for performing a timing experiment.

Note 5: Input generation time should not be included in the timing experiment.

Note 6: Please submit your commented source codes, input files and detailed report in a zip file that includes both your name(s) and surname by email to cse246submit@gmail.com.

Note 7: Do not forget that your grade will mostly determined by quality of your REPORT!