Algorithms and Data Structures
Jacobs University Bremen
Dr. Kinga Lipskoch

Course: CH08-320201
February 14th, 2019

Homework 2

- Submit one ZIP file per homework sheet which contains one PDF file (including pictures, computations, formulas, explanations, etc.) and your source code file(s) with one makefile and without adding executable, object or temporary files.
- The implementations of algorithms has to be done using C, C++, Python or Java.
- The TAs are grading solutions to the problems according to the following criteria: https://grader.eecs.jacobs-university.de/courses/320201/2019_1/Grading_Criteria_ADS.pdf

Problem 2.1 *Merge Sort* (16 points)

(a) (7 points) Implement a variant of Merge Sort that does not divide the problem all the way down to subproblems of size 1. Instead, when reaching subsequences of length k it applies Insertion Sort on these n/k subsequences.

(b) (3 points) Apply it to the different sequences from Problem 1.2 (from Homework 1) for different numbers of k. Add the computation times to the plots you had generated in Problem 1.2.

(c) (4 points) How do the different values of k change the best-, average-, and worst-case asymptotic time complexities for this variant? Explain/prove your answer.

(d) (2 points) Based on the results from (b) and (c), how would you choose k in practice? Briefly explain.

Problem 2.2 *Recurrences* (10 points)

Use the substitution method, the recursion tree, or the master method to derive upper and lower bounds for $T(n)$ in each of the following recurrences. Make the bounds as tight as possible. Assume that $T(n)$ is constant for $n \leq 2$.

(a) (2 points) $T(n) = 36T(n/6) + 2n$,

(b) (2 points) $T(n) = 5T(n/3) + 17n^{1.2}$,

(c) (2 points) $T(n) = 12T(n/2) + n^2 \lg n$,

(d) (2 points) $T(n) = 3T(n/5) + T(n/2) + 2^n$,

(e) (2 points) $T(n) = T(2n/5) + T(3n/5) + \Theta(n)$.

How to submit your solutions

You can submit your solutions via *Grader* at **`https://grader.eecs.jacobs-university.de`** as a generated PDF file and/or source code files.
If there are problems with *Grader* (but only then), you can submit the file by sending mail to `k.lipskoch@jacobs-university.de` **with a subject line that starts with CH08-320201**.

Please note, that after the deadline it will not be possible to submit solutions. It is useless to send solutions by mail, because they will not be graded.

This homework is due by Friday, February 22nd, 23:00.