



# Algorithms and Datastructures

## Summer Term 2020

### Exercise Sheet 1

Due: Wednesday, 20th of May, 4 pm.

#### Exercise 1: Registration

(5 Points)

Register for the online course system [Daphne](#). You can also find the according link on the [Website](#) of this course. Make sure that your data is correct, specifically that you can be reached under the given email address. Then execute the *checkout* command on your SVN-repository.<sup>1</sup>

#### Exercise 2: Quicksort

(5 Points)

Implement the algorithm *QuickSort* from the lecture. A template `QuickSort.py` is provided on the website. Write a unit test both for the `quicksort_divide` and the `quicksort_recursive` method. The unit tests should check at least one non-trivial example. If there are critical cases that are easy to check (e.g., an empty input), you should make a unit test for these cases, too.

#### Exercise 3: Time Measurement

(5 Points)

Measure the runtime  $T(n)$  of the algorithms *SelectionSort*, *MergeSort*<sup>2</sup> and of your *QuickSort* implementation for different input sizes  $n$ . You should test *QuickSort* for two different variants of choosing the pivot: Choosing the first element as pivot and choosing a random element as pivot. Repeat the experiment for two different input types: Arrays with random integers and arrays with pairwise distinct integers in descending order.

Plot the runtimes of the *four* algorithms each with the *two* different input types with input sizes  $n \in \{100, 200, \dots, 5000\}$ .<sup>3</sup> Use your plots to compare the runtimes and write a short evaluation into the file `experience.txt` (c.f., Task 4).

#### Exercise 4: Submission

(5 Points)

Commit your code including the tests and the 8 plots into the SVN, into a subfolder `uebungsblatt-01` (German for exercise sheet 01). Make sure that there are no errors when you run your code (including style check and unit tests) on Jenkins. Commit a file `experience.txt` in which you describe your experiences with this exercise sheet and any problems that may have appeared.

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<sup>1</sup>Your SVN-repository will be created automatically after your registration to Daphne. The URL is <https://daphne.informatik.uni-freiburg.de/ss2020/AlgoDat/svn/your-rz-account-name>

<sup>2</sup>You can find the code for these algorithms in the public repository <https://daphne.informatik.uni-freiburg.de/ss2020/AlgoDat/svn/public>

<sup>3</sup>The differences in runtimes will be most distinct if they are plotted in a single chart with  $n$  on the  $x$ -axis and the runtime  $T(n)$  on a *logarithmic*  $y$ -axis.