Announcement of Lecture

— Summer Semester 2023 —

Parameterized Algorithms

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Probably every prospective computer scientist has heard of the P vs NP problem. To put it simply, it follows from the assumption that problems solvable in polynomial time with non-deterministic Turing machines cannot always be solved with deterministic Turing machines in polynomial time: to solve NP-hard problems exactly, one needs superpolynomial time. However, many NP-hard problems arise in a variety of applications. For practitioners facing such problems, it is not helpful to know that their problem is NP-hard and that, there is no hope to solve it fast enough with a computer. On the contrary, many applications do solve NP-hard problems in practice, for example, dependency resolution is an NP-hard problem that package managers solve. This shows us that, by using an engineering approach, one can find exact solutions of NP-hard problem very quickly. Can this apparent contradiction be resolved? The framework of parameterized algorithms is one possible formal explanation for this apparent contradiction. In concrete terms, in parameterized algorithms, one characterizes the structure of typical instances and designs an algorithm that exploits this specific structure to solve an NP-hard problem efficiently.
More formally, we are trying to develop a two-dimensional view on the complexity of problems: besides the total size n of the input, a *parameter* k is used to bound parts of the input. We will practise techniques on numerous examples to find the best possible parameterized algorithms: besides search trees, so-called parameterized kernels, reparameterizations and graph parameters will be mentioned here. In addition, we will also get to know the "hard" sides of this theory.
Prerequisite: Knowledge equivalent to a bachelor's degree in computer science.

Date: Lecture: Tuesday 12:15–13:45 H13 Start: 18.04.
Exercise: To be decided during the first lecture