Oberseminar Theoretische Informatik
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Incompressibility through Colors and IDs

Monday, January 12 at 2pm (c.t.)
in room 3319 (Ernst-Abbe-Platz 2, floor 3).

A parameterized problem is said to admit a *polynomial kernel* with respect to a parameter k if there are polynomial time preprocessing rules that reduce the input instance to an instance with size polynomial in k. Many problems have been shown to admit polynomial kernels, but it is only recently that a framework for showing the non-existence of polynomial kernels for specific problems has been developed by Bodlaender et al. and Fortnow and Santhanam. With few exceptions, all known kernelization lower bounds result have been obtained by directly applying this framework. In this paper we show how to combine these results with combinatorial reductions which use colors and IDs in order to prove kernelization lower bounds for a variety of basic problems. Below we give a summary of the results presented in the talk. All results are under the assumption that the polynomial hierarchy does not collapse to the third level.

- We show that the Steiner Tree problem parameterized by the number of terminals and solution size, and the problems Connected Vertex Cover and Capacitated Vertex Cover do not admit a polynomial kernel. The two latter results are surprising because the closely related Vertex Cover problem admits a kernel of size $2k$.
- The problems Hitting Set and Set Cover are among the most studied problems in algorithms. Both problems admit a kernel of size $k^{O(d)}$ when parameterized by solution size k and maximum set size d. We show that neither of them admits a polynomial kernel.

The existence of polynomial kernels for several of the problems mentioned above were open problems explicitly stated in the literature. Many of our results also rule out the existence of compression algorithms, a notion similar to kernelization defined by Harnik and Naor, for the problems in question.

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