Title: Parameterized Complexity

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Abstract: This thesis deals with the parameterized complexity of NP-hard graph problems. We explore the complexity of the problems in various scenarios, with respect to miscellaneous parameters and their combinations. Our aim is rather to classify in this multivariate manner whether the particular parameters make the problem fixed-parameter tractable or intractable than to present the algorithm achieving the best running time. In the questions we study typically the first-choice parameter is unsuccessful, in which case we propose to use less standard ones.

The first family of problems investigated provides a common generalization of many well known and studied domination and independence problems. Here we suggest using the dual parameterization and show that, in contrast to the standard solution-size, it can confine the inevitable combinatorial explosion. Further studied problems are analogues of the Steiner problem in directed graphs. Here the parameterization by the number of terminals to be connected seems to be previously unexplored in the directed setting. Unfortunately, the problems are shown to be intractable with respect to this parameter. Finally, the problems of partitioning the graph into classes of the same size, satisfying some further constraints, are considered. The problems turn out to be one of a few which are polynomial-time solvable on graphs of bounded treewidth, but not fixed-parameter tractable. More fine-grained structural parameterizations are then employed and proved to be successful.

Keywords: parameterized complexity, graph, Steiner problem, generalized domination, equitable partitions