Abstract

This thesis presents lower and upper bounds, which prove hardness of certain problems in algorithmics and combinatorics. It consists of a series of published papers, which explore two research directions: computational complexity and extremal combinatorics.

First, we study the computational complexity of problems related to calculating similarity between sequences, i.e. the Longest Common (Weakly) Increasing Subsequence problems. We prove that beating, by a polynomial factor, a simple quadratic time dynamic programming algorithms for these problems would require refuting the Strong Exponential Time Hypothesis.

The second direction of our research has an extremal combinatorics flavour. We consider a problem related to the Dushnik-Miller dimension of a partial order, and prove that it is impossible to guarantee finding a two-dimensional subposet of size asymptotically larger than $n^{2/3}$ in every poset of size n.

We extend our study to a third direction. In an unpublished manuscript, we prove lower bounds for a variant of the online graph coloring problem restricted to the class of intersection graphs of intervals with lengths in a fixed range.