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On the Complexity of Various Parameterizations of Common Induced Subgraph Isomorphism[☆]

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Abstract

In the Maximum Common Induced Subgraph problem (henceforth MCIS), given two graphs G_1 and G_2, one looks for a graph with the maximum number of vertices being both an induced subgraph of G_1 and G_2. MCIS is among the most studied classical NP-hard problems. It remains NP-hard on many graph classes including forests. In this paper, we study the parameterized complexity of MCIS. As a generalization of Clique, it is W[1]-hard parameterized by the size of the solution. Being NP-hard even on forests, most structural parameterizations are intractable. One has to go as far as parameterizing by the size of the minimum vertex cover to get some tractability. Indeed, when parameterized by $k := \mathrm{vc}(G_1) + \mathrm{vc}(G_2)$ the sum of the vertex cover number of the two input graphs, the problem was shown to be fixed-parameter tractable, with an algorithm running in time $2^{O(k \log k)}$. We complement this result by showing that, unless the ETH fails, it cannot be solved in time $2^{o(k \log k)}$. This kind of tight lower bound has been shown for a few problems and parameters but, to the best of our knowledge, not for the vertex cover number. We also show that MCIS does not have a polynomial kernel when parameterized by k, unless $\mathsf{NP} \subseteq \mathsf{coNP}/poly$. Finally, we study MCIS and its connected variant MCCIS on some special graph classes and with respect to other structural parameters.

Keywords: Induced Common Isomorphism, Parameterized Complexity, Kernelization, ETH based Lower Bounds

1. Introduction

A common induced subgraph of two graphs G_1 and G_2 is a graph that is isomorphic to an induced subgraph of both graphs. The problem of finding a common induced subgraph with the maximum number of vertices (or edges)

[☆] An extended abstract of this work appears in [1]

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