The Complexity Landscape of Fixed-Parameter Directed Steiner Network Problems

Dániel Marx

Institute for Computer Science and Control, Hungarian Academy of Sciences (MTA SZTAKI), Budapest, Hungary
dmarx@cs.bme.hu

Abstract

Given a directed graph G and a list $(s_1, t_1), \ldots, (s_k, t_k)$ of terminal pairs, the Directed Steiner Network problem asks for a minimum-cost subgraph of G that contains a directed $s_i \to t_i$ path for every $1 \leq i \leq k$. Feldman and Ruhl presented an $n^{O(k)}$ time algorithm for the problem, which shows that it is polynomial-time solvable for every fixed number k of demands. There are special cases of the problem that can be solved much more efficiently: for example, the special case Directed Steiner Tree (when we ask for paths from a root r to terminals t_1, $\ldots$, t_k) is known to be fixed-parameter tractable parameterized by the number of terminals, that is, algorithms with running time of the form $f(k) \cdot n^{O(1)}$ exist for the problem. On the other hand, the special case Strongly Connected Steiner Subgraph (when we ask for a path from every t_i to every other t_j) is known to be W[1]-hard parameterized by the number of terminals, hence it is unlikely to be fixed-parameter tractable. In the talk, we survey results on parameterized algorithms for special cases of Directed Steiner Network, including a recent complete classification result (joint work with Andreas Feldmann) that systematically explores the complexity landscape of directed Steiner problems to fully understand which special cases are FPT or W[1]-hard.

1998 ACM Subject Classification F2.2 Nonnumerical Algorithms and Problems, G.2.2 Graph Theory

Keywords and phrases Directed Steiner Tree, Directed Steiner Network, fixed-parameter tractability, dichotomy

Digital Object Identifier 10.4230/LIPIcs.SWAT.2016.32

Category Invited Talk

15th Scandinavian Symposium and Workshops on Algorithm Theory (SWAT 2016).
Editor: Rasmus Pagh; Article No. 32; pp. 32:1–32:1

Leibniz International Proceedings in Informatics
Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany