Title: Computing Exact Solutions for Intractable Optimization Problems with Tree Decomposition

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Abstract: In computer and information science, a large number of optimization problems can be formulated on graphs and many of them are computationally intractable. Algorithms that can efficiently compute exact solutions for these problems are thus highly desirable in practice. In this talk, I will present an algorithmic framework that is useful for efficiently computing the exact solutions of these problems in practice. Specifically, given an optimization problem, a graph model can often be constructed to formulate the problem. Based on a tree decomposition of the graph model, an exact solution for the optimization problem can often be efficiently computed by a dynamic programming algorithm. As an example，I will discuss a dynamic programming algorithm that can compute a maximum independent set in a graph with bounded tree width in linear time. I will then present a large number of intractable problems from different areas in computer science and show that they can be efficiently solved based on this framework when the underlying graph model has a bounded tree width. In addition, I will also present a class of optimization problems whose exact solutions can be efficiently computed with this framework and a heuristic algorithm that can efficiently generate a tree decomposition of a given graph.