

Being Stubborn: Developing Optimal Solution Strategies for a Scheduling Problem Despite its NP-Hardness

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Abstract:

Many NP-hard problems are so difficult that even for small problem instances heuristics are employed. Scheduling task graphs with communication delays on a set of processors ($P|prec, c_{ij}|C_{max}$ in $\alpha|\beta|\gamma$ notation) is such a problem. But the presenter is stubborn and insisted on solving this problem optimally (OK, for small problem instances), so this talk is a study of optimal solution strategies for a hard problem. First, Integer Linear Programming (ILP) based approaches are discussed. Crucial for meaningful performance of such ILPs is the efficient conversion of the bilinear constraints that arise from the consideration of the communication delays. Different formulations are developed and the relation between the formulation components and performance is all but trivial. Second, we look at exhaustive search techniques based on DFS (Depth First Search), branch-and-bound, A* and the like. We investigate how to construct the search space, while trying to avoid duplicate states. Problem specific pruning techniques are then studied to reduce the search space efficiently.