The (Sequential) Price of Anarchy for Throughput Scheduling

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Abstract

Motivated by the organization of distributed service systems, we study models for throughput scheduling in a decentralized setting. In throughput scheduling, a set of jobs j with values w_j, processing times p_{ij} on machine i, release dates r_j and deadlines d_j, is to be processed non-preemptively on a set of unrelated machines. The goal is to maximize the total value of jobs scheduled within their time window $[r_j, d_j]$. While approximation algorithms with different performance guarantees exist for this and related models, we are interested in the situation where subsets of machines are governed by selfish players. We give a universal result that bounds the price of decentralization: Any local α-approximation algorithm, $\alpha \geq 1$, yields Nash equilibria that are at most a factor $\alpha + 1$ away from the global optimum, and this bound is tight. For identical machines, we improve this bound to approximately $\alpha + \frac{1}{2}$, which is shown to be tight, too. The latter result is obtained by considering subgame perfect equilibria of a corresponding sequential game. We also address some variations of the problem.