Single machine scheduling with non-availability interval and job rejection - First Report

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Abstract

Introduction: This project delves into a pair of scheduling problems presented in the article by Kellerer and Strusevich[1] that deals with their connection to the knapsack problems, and proposes approximate FPTAS solutions.

Problem Description: Given a single machine and n tasks, each with known processing times p_j and weights w_j, $1 \leq j \leq n$, and a time interval $[s,t]$ in which the machine is disabled from work, the goal is to minimize $\sum_{i=1}^{n} w_j C_j$, where C_j is the completion time of job j.

Two different methods are defined for processing jobs in a machine with a non-availability interval:

1. **Non-resumable scenario** $(1|h(1), N-res|\sum w_j C_j)$: if a particular task is ceased in the middle, the same task should restart right after the break.
2. **Resumable scenario** $(1|h(1), Res|\sum w_j C_j)$: if the ceased task could continue, right after the break, from the point at which it had stopped.

In our project we intend to implement the dynamic programming solutions presented by Kellerer et al. [1] for both paradigms. We will design pseudo-polynomial solutions to the same problems where it is also possible to reject some tasks, given a limit on the amount of deferral costs that can be incurred, i.e, in the case where each task has an (additional) rejection cost e_j, $1 \leq j \leq n$ and there is a total upper bound rejection cost U. Our goal is to minimized the target function within the restriction that the total sum of rejections is less than or equal to U.

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[1] Kellerer, H.,& Strusevich,V.A.(2010). Fully polynomial approximation schemes for a symmetric quadratic knapsack problem and its scheduling applications. Algorithmica, 57(4), 769-795.