Approximating the 2-Machine Flow Shop Problem with Exact Delays Taking Two Values

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We study a special case of the 2-Machine Flow Shop problem with exact delays. An instance of the problem consists of n triples (a_j, l_j, b_j) of nonnegative integers where j is a job in the set of jobs $\{1, \ldots, n\}$. Each job j must be processed first on machine 1 and then on machine 2, a_j and b_j are the lengths of operations on machines 1 and 2, respectively. The operation of job j on machine 2 must start exactly l_j time units after the operation on machine 2 has been completed. The goal is to minimize makespan.

The approximability of the general case was studied by Ageev and Kononov in [1]. They proved that the existence of $(1.5-\varepsilon)$-approximation algorithm implies P=NP and constructed a 3-approximation algorithm. In this paper we consider the case when $l_j \in \{0, L\}$ for all $j \in \{1, \ldots, n\}$. In the standard three-field notation scheme this case can be written as $F2 \mid \text{exact } l_j \in \{0, L\} \mid C_{\max}$. The problem includes as a special case the classical no-wait 2-Machine Flow Shop problem which is known to be solvable in polynomial time [2]. Our results are the following: we prove that the existence of $(1.25-\varepsilon)$-approximation for $F2 \mid \text{exact } l_j \in \{0, L\} \mid C_{\max}$ implies P=NP and present a 2-approximation algorithm.

References

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