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SHORT COMMUNICATION

On the complexity of proportionate open shop and job shop problems

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Abstract
In this paper, we present $\mathcal{NP}$-hardness proofs and exhibit linear-time algorithms for proportionate two-machine open shop and job shop problems with respect to the maximum lateness, the makespan with release dates, the total weighted completion times and the number of just-in-time jobs.

Keywords Proportionate shop · Complexity · Scheduling · Makespan · Maximum lateness · Mean finish time · Just-in-time

1 Introduction

The classical shop problems may be defined as follows. There are n jobs and m machines. Each job, $J_j; j = 1, \ldots, n$, has to be processed on each machine and thus comprises m operations, $O_{1j}, \ldots, O_{mj}$. For each operation, O_{ij}, there is an associated number $p_{ij} \in \mathbb{Z}^+$, denoting the time taken by machine M_i to process that operation. If the processing route of the jobs throughout the machines is not given in advance, the corresponding model is known as an open shop. If it is the same for all the jobs, we have a flow shop, and finally, if each job has its own processing route, then the corresponding model is known as a job shop. We seek a schedule that minimizes a given criterion. The criteria we considered are the

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