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Scheduling Jobs with Equal-Processing-Time on Parallel Machines with Non-identical Capacities to Minimize Makespan

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Abstract: We consider the problem of scheduling a set of equal-processing-time jobs with arbitrary job sizes on a set of batch machines with different capacities. A job can only be assigned to a machine whose capacity is not smaller than the size of the job. Our goal is to minimize the schedule length (makespan). We show that there is no polynomial-time approximation algorithm with an absolute worst-case ratio less than 2, unless $P = NP$. We then give a polynomial-time approximation algorithm with an absolute worst-case ratio exactly 2. Moreover, we give a polynomial-time approximation algorithm with asymptotic worst-case ratio of 3/2. Finally, we perform a computational experiment and show that our approximation algorithm performs very well in practice.

Keywords: Batch machines; makespan; NP-hard; approximation algorithm; absolute worst-case ratio; asymptotic worst-case ratio.

1. Introduction

In a parallel batch machine, several jobs can be processed simultaneously as a batch. Parallel batch machines are encountered in many industries such as semiconductor industry, metal industry, pharmaceutical industry, etc., see [16] for more information. As an example, consider the burn-in operations in a semiconductor company, in which integrated circuits are put into