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IMPROVED DYNAMIC PROGRAMMING METHOD FOR JOB SHOP SCHEDULING

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In the job shop scheduling problem a set of n jobs and a set of m machines are given. Each job has to visit all the machines following a specific order. The job consists of m task operations each of which is associated with a specific machine. Each machine can process only one job at the same time and each job can be processed by only one machine at the same time. The processing time $p(o)$ of each operation $o \in \mathcal{O}$ is assumed to be known. The goal is to schedule the jobs so as to minimize the makespan which is the maximum of their completition time.

Various approximation algorithms can be used for obtaining approximate solutions to the job shop scheduling problem (e.g., shifting bottleneck procedure [1], a genetic algorithm [2]), from which the upper bound C can be estimated. Gromicho et al. [3] gave the exact dynamic programming algorithm with complexity proven to be exponentially lower than exhaustive enumeration. We improve this algorithm by reducing the state space which consists of the set of sequences T of operations. Let

$$\eta(o_i) = \{o_k \in \mathcal{O} \colon j(o_i) = j(o_k) \land k \geq i\},$$

where $j(o)$ is the corresponding job for operation $o \in \mathcal{O}$. We add additional restriction for the sequence T which should be satisfied to include it in the state space:

$$\psi(T, o) + \sum_{o^* \in \eta(o)} p(o^*) \leq C \text{ for all } o \in \varepsilon(S), \tag{1}$$

where $S \subset \mathcal{O}$ is the set of operations corresponding to T, $\varepsilon(S)$ denotes the set of all operations that can be used to obtain an expansion of S and $\psi(T, o)$ denotes the earliest starting time for operation o if this operation is added to the end of the partial sequence T. We describe how the restriction (1) can be incorporated in the algorithm [3].

REFERENCES

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