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Scheduling under energy constraints ⋆

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Abstract

In this paper we present a scheduling problem dealing with energy constraints (typically electrical energy). Mainly we propose an extension of specific resource constraint propagation techniques (known as "energy reasoning") to efficiently prune the search space and then to facilitate its resolution. We also present dominance rules and a branching scheme to solve the problem via tree search. Finally, computational results are provided.

Key words: Production scheduling, energy constraints, constraint propagation, energy reasoning

1 Introduction

Since the last two decades, hard combinatorial problems, mainly in scheduling, have been the target of many approaches combining Operations Research and Artificial Intelligence techniques. These approaches are generally focussed on constraint satisfaction as a general paradigm for representing and solving efficiently such problems. At the heart of these approaches, a panel of consistency enforcing techniques is used to dramatically prune the search space.

Therefore propagation techniques dedicated to resource and time constrained scheduling problems, viewed as special instances of Constraint Satisfaction Problems (CSP), have been developed to speed up the search for a feasible schedule or to detect early an inconsistency. For instance the energy reasoning [3] has enabled the joint integration of both resource and time constraints in order to prevent the combinatorics of solving conflicts between activities in competition for limited resources.

Furthermore, it is still of interest to search for propagating novel types of constraints according to real world problems. The new environmental constraints, but also the increase of the energy cost, should prompt us to consider as a crucial and promising issue to look into the problem of the power consumption optimization in production scheduling. Real-time (processor) scheduling theory has often addressed energy constraints. However, the consideration of energy constraints in production scheduling, and particularly focussed on constraint propagation techniques, has been relatively unexplored.

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