Interdiction Game on Machine Scheduling under Budgeted Unavailability Patterns

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1 Introduction

Our problem is formalized as the strategic interaction between the scheduler and the interdictor in the framework of a deterministic Stackelberg game. In the interdiction game setting, the interdictor, acting as a leader, is allowed to freeze the machine subject to the interdiction budget B, which is the maximum downtime of a machine. With the assumption that the resource interdiction is preemptive, the interdictor is allowed to divide the total unavailable period of length B into smaller time patterns and distribute them throughout the scheduling horizon, with the goal of maximizing the makespan. It gives rise to solving *Single machine scheduling with multiple unavailability periods*.

2 Preliminary results and future research

Our ongoing research has derived the structure of the optimal strategy of the interdictor. Given the unavailability patterns assigned by the interdictor, we design a $\frac{3}{2}$-approximation to the Scheduler Best Response problem. Given the policy of the interdictor, the best response of the scheduler is NP-hard, which can be reduced from the Partition problem. However, when we study from the perspective of the interdictor, an interesting special case arises when $B = 1$, in which case the optimal strategy can be computed in polynomial time. Despite the complexity of the scheduler's best response problem, the optimal interdiction strategy can be computed in polynomial time. This finding is particularly interesting, as it suggests that the interdictor can efficiently determine the best policy to disrupt the scheduler, even though the scheduler's task of finding the optimal schedule under the given interdiction policy is computationally hard. For the case when $B = 2$, we also show the structure of the optimal strategy. Our future work aims to give an approximation algorithm for $B = 2$.

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