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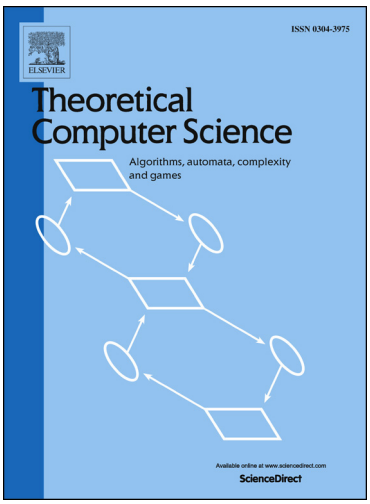

Mean-payoff Games with Partial Observation

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Mean-payoff Games with Partial Observation[☆]

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Abstract

Mean-payoff games are important quantitative models for open reactive systems. They have been widely studied as games of full observation. In this paper we investigate the algorithmic properties of several sub-classes of mean-payoff games where the players have asymmetric information about the state of the game. These games are in general undecidable and not determined according to the classical definition. We show that such games are determined under a more general notion of winning strategy. We also consider mean-payoff games where the winner can be determined by the winner of a finite cycle-forming game. This yields several decidable classes of mean-payoff games of asymmetric information that require only finite-memory strategies, including a generalization of full-observation games where positional strategies are sufficient. We give an exponential time algorithm for determining the winner of the latter.

Keywords: Quantitative games, Partial observation, Verification, Synthesis, Game theory

1. Introduction

Mean-payoff games (MPGs) are two-player, infinite duration, turn-based games played on finite edge-weighted graphs. The two players alternately move a token around the graph; and one of the players (Eve) tries to maximize the (limit) average weight of the edges traversed, whilst the other player (Adam) attempts to minimize the average weight. Such games are particularly useful in the field of verification of models of reactive systems, and the full-observation versions of these games have been extensively studied [1, 2, 3, 4]. One of the major open questions in the field of verification is whether the following decision problem, known to be in the intersection of the classes NP and coNP [1][1], can be solved in polynomial time: Given a threshold ν, does Eve have a strategy to ensure a mean-payoff value of at least ν?

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[1]From results in [5] and [6] it follows that the problem is also in UP ∩ coUP.