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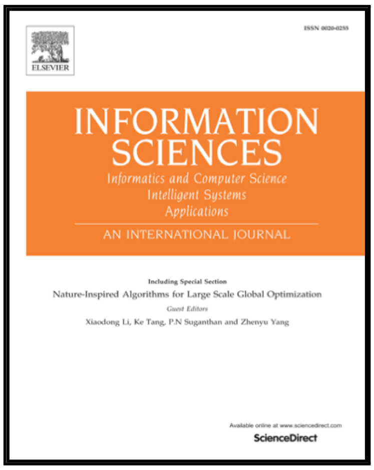

A Shapley distance in graphs

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A Shapley distance in graphs

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Abstract

A new distance in finite graphs is defined through a game-theoretic approach. This distance arises when solving the problem about the fair cost, for a node in a graph, of attaining access to another node. The distance indicates the level of difficulty in the communication between any pair of nodes, on the understanding that the fewer paths there are between two nodes and the more nodes there are that form those paths, the greater the distance is.

Keywords: game theory, graph, distance, cooperative TU game, Shapley value.

1. Introduction

Myerson [6] studied cooperative games in situations in which there are limitations on the communication among the players. He used the best-known value for cooperative transferable utility (TU) games, the Shapley value, to define and characterize a value for games with communication restrictions. These restrictions were modeled through graphs. Since then, many studies in game theory have been carried out to deal with situations in which there is a cooperative game and a graph that delimits the communication among the players. This has led several game theorists to consider the study of graphs by using game-theoretic tools. The basic idea is the following. Given a graph, whose nodes will be identified with players, we can consider, instead of an exogenous game, a game determined by the graph itself. If the game is properly chosen, we can obtain useful information about the graph by applying a value to the game. Notable examples of this are the studies on centrality in graphs that have been carried out by means of game-theoretic tools. The first of these studies was carried out by Grofman and Owen [4]. They used one of the most important values studied in cooperative game theory, the Banzhaf value, to study power in social networks, and gave other graph-theoretic applications of this value. Later on, Gómez *et al.* [3], following the approaches considered by Myerson [6] and Owen [7], studied centrality in graphs by means

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