



Coalition formation games – preface

Judy Goldsmith¹ · Jörg Rothe²

© The Author(s) 2024

Mathematics Subject Classification (2010) 91-XX · 91Axx · 91A12

This special issue is devoted to *coalition formation games*, a central part of cooperative game theory with many real-world applications. Indeed, there are many situations in which individuals may choose to act as a group, or coalition, including social clubs, political parties, partnership formation, and legislative voting. The goal of coalition formation games is to partition a set of agents into coalitions, according to certain criteria, such as coalitional stability or maximization of social welfare. Especially interesting is a subclass of coalition formation games, hedonic games, which were first proposed by Drèze and Greenberg (1980) and later formalized by Banerjee et al. (2001) and Bogomolnaia and Jackson (2002). What makes hedonic games special within general coalition formation games is the requirement that each agent’s utility must be entirely determined by the members of their own coalition.

Preliminary versions of many of the papers in this special issue were presented in the special session on coalition formation games at the *17th International Symposium on Artificial Intelligence and Mathematics (ISAIM 2022)*, which in January 2022 (instead of taking place in Fort Lauderdale, USA, as in previous years) was done online via zoom sessions, because of the pandemic. However, this special issue is not a comprehensive proceedings of the ISAIM 2022 special session on coalition formation games, but rather consists of a selection of the best contributions presented at the conference, plus some carefully selected papers that fit the special issue theme. All papers accepted for publication here have run through the regular reviewing process of The Annals of Mathematics and Artificial Intelligence, with at least two reviewers for each submission and up to three rounds of reviews per paper. The reviews have been particularly detailed and helpful, and the editors are very grateful to all the reviewers for their time and invaluable effort to improve the submissions.

This special issue covers a broad variety of topics related to coalition formation games, ranging from hedonic expertise games and hedonic games with common ranking property

✉ Jörg Rothe
rothe@hhu.de

Judy Goldsmith
goldsmi@cs.uky.edu

¹ Department of Computer Science, University of Kentucky, Lexington, Kentucky 40506, USA

² Institut für Informatik, MNF, Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf, Germany

to altruism in coalition formation games to socially conscious stability for tiered coalition formation games to control of weighted voting games by deleting or adding players:

- In “*Socially Conscious Stability for Tiered Coalition Formation Games*,” Nathan Arnold, Sarah Snider, and Judy Goldsmith study tiered coalition formation games that are inspired by the stratification of Pokémon on the fan website, Smogon. They prove that for tier lists under match-up oriented preferences, socially conscious stability is equivalent to Nash stability and to core stability, but in k -tier lists, the three stability notions are distinct. They also study the robustness of these games and validate their findings experimentally.
- In their study “*On Hedonic Games with Common Ranking Property*,” Bugra Caskurlu and Fatih Erdem Kizilkaya model coalition formation of general partnerships where all affiliates are assigned the same utility. They strengthen previous results for them by showing that these games admit a solution that is Pareto-optimal, core-stable, and individually stable. Recognizing such solutions is polynomial-time solvable for size-two coalitions but NP-hard for size-three coalitions. They further study socially optimal solutions for these games and establish related inapproximability results.
- In “*Altruism in Coalition Formation Games*,” Anna Maria Kerkmann, Simon Cramer, and Jörg Rothe extend the previously known notion of altruistic hedonic games to coalition formation games in general: Based on friend-oriented preferences, players consider not only their own but also their friends’ preferences, be they in their own or in other coalitions. Comparing this model to altruistic hedonic games, it is argued that excluding some friends from the players’ altruistic behavior just because they are members of other coalitions is a major disadvantage that comes with the restriction to hedonic games. They study some common stability notions for these games and examine the associated verification and existence problems in terms of their computational complexity.
- In “*Controlling Weighted Voting Games by Deleting or Adding Players with or without Changing the Quota*,” Joanna Kaczmarek and Jörg Rothe expand previous results on how a distinguished player’s power (measured by the Shapley–Shubik or the probabilistic Penrose–Banzhaf power index) can be changed or maintained by deleting players from or adding them to a weighted voting game. In addition, they modify the previous model of controlling weighted voting games to a more realistic setting in which the quota is implicitly changed by the addition or deletion of players, and they study the corresponding problems in terms of their computational complexity.
- In “*Hedonic Expertise Games*,” Bugra Caskurlu, Fatih Erdem Kizilkaya, and Berkehan Ozen model as hedonic games a variety of settings where agents with complementary qualities would like to form coalitions to fulfill certain tasks as well as possible together. These games have the common ranking property mentioned above, and a monotonic coalitional utility function. They study the existence or nonexistence of stable and efficient partitions in such games.

We thank all the authors for their wonderful contributions to this special issue, and wish the readers to take much pleasure in reading them.

Judy Goldsmith and Jörg Rothe
January, 2024

Funding Open Access funding enabled and organized by Projekt DEAL.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence,

and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.