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REPORT

By a member of the dissertation committee of the dissertation of CHIRKOVA Julia Vasilevna on the theme: "Networking Games: Equilibrium and Optimal Behavior", submitted in conformity with requirements for the degree of Doctor of Physico-Mathematical Sciences in Speciality 1.2.3 — Theoretical Computer Science, Cybernetics.

The thesis of Julia Chirkova is dedicated to game theoretic and optimization models on networks of agents. This is a very contemporary topic with numerous important applications such as telecommunication (in particular, wireless) networks, cloud providers and transportation networks just to name a few.

The thesis of Julia Chirkova consists of 14 technical chapters as well as of Introduction, Conclusions and Bibliography. In the Introduction, the candidate carefully described the relation of the work with the state of the art, the main contributions of the thesis and the main methodological tools.

The first three chapters of the thesis are devoted to strategic queueing models, when the agents choose the arrival moments. Specifically, the first chapter analyses a two-server queueing system with random access. The second chapter is devoted to a model with a choice of arrival moments in a preemptive queueing system. And, the third chapter, a model of a queuing system with retrials is analysed. I particularly appreciate this part of the thesis and found it quite original as up to the present not so many works have been carried out in this domain. The model of retrial queueing is particularly difficult and it is great to see that the candidate obtains insightful results for this queueing discipline.

In the fourth chapter, the candidate studies a one-dimensional problem of choosing a base station by wireless network agents based on the SINR value. Two cases are considered: when the agents know and do not know the location of the other agents.

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Nice analytical results have been obtained with useful practical implications for the design of wireless networks.

The fifth chapter is dedicated to the game-theoretic model of competing cloud operators' behavior in the two-sided telecommunications market, which also results in useful practical recommendations. Then, the sixth chapter presents the analysis of the KP-model of data transmission with unsplittable traffic.

The seventh and the eighth chapters are mostly devoted to the analysis of the price of anarchy in the load balancing problem with and without externalities. The addition of externalities makes a valuable, original contribution. Also, in the case of two processors with externalities a Nash equilibrium in pure strategies has been established.

The ninth and tenth chapters are devoted to the analysis of the price of anarchy in the cover game for a system of several processors with and without externalities. The eleventh chapter contains some generalizations and numerical procedures for both load balancing and cover games.

In the last three chapters of the thesis, the candidate studies the Wardrop equilibria in transportation networks. The original contributions here are: new delay functions, the formulation of the Bayesian Wardrop equilibrium for the case of incomplete information, and the analysis of the transportation model with externalities. The latter two contributions are particularly important, since in reality the agents often do not have an access to the complete information and different parts of the transportation system are strongly correlated.

The amount of research results presented by Julia Chirkova is truly impressive and significantly advances the topic of networking games. The results of the thesis have been presented in important conferences on games and optimization (such as *GTM*, *NGM*, *MOTOR*) and in high-level journals (such as Automation and Remote Control, Mathematical Game Theory and its Applications, Optimization Letters, Mathematics). Many publications are indexed by Scopus and Web of Science. Finally, I would like to mention the book "Networking Games: Network Forming Games and Games on Networks" co-authored by the candidate. This book is a very valuable reference for the up-to-date results in the domain of networking games.

For all the above reasons, I conclude that the dissertation of Julia Chirkova on the theme "Networking Games: Equilibrium and Optimal Behavior" meets the requirements established by Order No. 11181/1 of 19 November 2021, "On the procedure for awarding academic degrees at Saint Petersburg State University", and the candidate CHIRKOVA Julia Vasilevna deserves the award of the degree of Doctor of Physico-Mathematical Sciences in the Speciality 1.2.3 — Theoretical Computer Science, Cybernetics. Clauses 9 and 11 of the aforementioned Order by the author of the thesis is not broken.

Member of the Dissertation Council,
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12 June 2023.