

Referee Report for the Doctoral Thesis of Tomas Valla titled "Combinatorial Games Theory" submitted to Charles University.

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REPORT

The submitted Doctoral Thesis, by Mr. Tomas Valla, studies several antagonistic phenomena by using ideas from Game Theory, Complexity and Combinatorics.

The Thesis essentially contains three kinds of results:

- (a) The definition of a weighted vertex cover game and a proof of existence of Pure Nash Equilibria. The Thesis also shows that every such equilibrium is a 2-approximation to the optimal cover. In addition, the Thesis has a novel analysis of the fast convergence (to a pure Nash equilibrium) of a sequence of appropriate best responses.
- (b) Some complexity results on an extensive, full information game of 2 players, namely the Guarding Game introduced by Fomin et al in ref. [37] of the Thesis. The Thesis proves two new results:
 - (b1) The guarding game on directed graphs is Complete for exponential time, under log-space reductions.
 - (b2) The guarding game on undirected graphs, with prescribed starting positions, is Complete for exponential time, under log-space reductions.
- (c) A study of various Ramsey-type theorems and of the corresponding positional games.

All the results of the Thesis are correct. The techniques are clear, and some of them (especially the reductions and gadgets used for the Guarding Game) are quite elegant.

Overall, the Thesis of T. Valla is an interesting and original contribution to various aspects of the interaction of Game Theory and Complexity. The Thesis proves that the author is able to produce creative scientific work. The ideas of the Thesis can be applied to other problems in Optimization (such as facility location, hitting set etc).

Based on all the above, I propose that the Doctoral Thesis of T. Valla is approved by the Charles University.



The author may wish to comment on some published work on security games that resembles his covering and Guarding models (although in a different setting):

[1] M. Mavronicolas, V. Papadopoulou, A. Philippou, P. Spirakis "A Network Game with Attackers and a Defender", *Algorithmica* 51(3): 315-341 (2008).

[2] M. Mavronicolas, L. Michael, V. Papadopoulou, A. Philippou, P. Spirakis "The Price of Defense", *MFCs 2006*, 380-394.

[3] M. Mavronicolas, V. Papadopoulou, G. Persiano, A. Philippou, P. Spirakis "The Price of Defense and Fractional Matchings", *ICDCN 2006*:115-126.

