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Major Research Interests: **Algorithmic Game Theory, Computational Social Choice, Algorithms and Complexity**

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Algorithmic game theory is an exciting research area at the intersection of game theory and computer science. It studies computational aspects of interaction between selfish agents, as well as incentive issues in algorithm design.

I have worked in several different subfields of this area, such as auction design, complexity of Nash equilibria in graphical games, and computational aspects of coalitional games. An example of a problem I have worked on is shortest path auctions: there is a network in which each edge is owned by a selfish agent, and a center that wants to route a unit of flow through this network. Routing the flow through a particular edge incurs a cost to the owner of this edge, who therefore needs to be compensated. However, the cost of an edge is known to its owner only, and it may lie about this cost if it is beneficial for him to do so. The center's goal is to purchase a path in this network without paying too much by means of a reverse auction. We show how to design an optimal auction for this setting where edges' cost distributions are known, and also demonstrate that every truthful mechanism will pay substantially more that the cost of the 2nd cheapest path, which is a natural measure of competition in this market. On the other hand, perhaps counterintuitively, the total payment can be reduced by deleting some edges from the graph.

In graphical games, players are located in the vertices of a bounded-degree graph, and each players' payoffs depend on his actions as well as the actions of his neighbors. In general, computing Nash equilibrium in such games is known to be computationally hard. However, prior to our work, it was believed that when the underlying graph is a tree, one can compute a Nash equilibrium in polynomial time. In our work, we refuted this conjecture, showing that the algorithm proposed for this problem does not always return a Nash equilibrium. We modified this algorithm so that it works correctly. However, the modified version is only guaranteed to run in polynomial time if the underlying graph is a path. We have also demonstrated that any algorithm based on similar ideas may produce an exponential-sized data structure even on very simple trees. It remains open whether Nash equilibria of graphical games on trees can be efficiently computed, perhaps using a completely different set of techniques.

In recent years, my research interests have shifted towards cooperative games, in which rational agents form teams and have to distribute the benefits of cooperation. I have worked on computing stability-related solution concepts in such games, as well as analysing if this solution concepts can be manipulated. Another issue I have looked at is the loss of efficiency that is caused by agents' selfishness.

Another research area I am actively working in is computational social choice. It deals with computational aspects of voting and, more generally, preference aggregation and elicitation. I have looked at computational aspects of various forms of dishonest behavior in voting, such as manipulation and bribery.

Selected Publications

E. Elkind & D. Pasechnik, Computing the nucleolus of weighted voting games. *Proceedings of the 20th Symposium on Discrete Algorithms (SODA), 2009*

G. Chalkiadakis, E. Elkind, V. Markakis & N. R. Jennings, Overlapping coalition formation. *Proceedings of the 4th Workshop on Internet and Network Economics (WINE), 2008*

M. Zuckerman, P. Faliszewski, Y. Bachrach & E. Elkind, Manipulating the quota in weighted voting games. *Proceedings of the 23rd AAAI Conference on Artificial Intelligence (AAAI), 2008*

E. Elkind, P. W. Goldberg, L. A. Goldberg & M. Wooldridge, Computational complexity of weighted threshold games. *Proceedings of the 22nd AAAI Conference on Artificial Intelligence (AAAI), 2007*

E. Elkind, P. W. Goldberg & L. A. Goldberg, Frugality ratios and improved truthful mechanisms for vertex cover. *Proceedings of the 8th ACM Conference on Electronic Commerce (ACM EC), 2007*

E. Elkind, Designing and learning optimal finite support auctions. *Proceedings of the 18th Symposium on Discrete Algorithms (SODA), 2007*

E. Elkind, P. W. Goldberg & L. A. Goldberg, Nash equilibria in graphical games on trees revisited. *Proceedings of the 7th ACM Conference on Electronic Commerce (ACM EC), 2006*

E. Elkind & H. Lipmaa, Hybrid voting protocols and hardness of manipulation, *Proceedings of the 16th International Symposium on Algorithms and Computation (ISAAC), 2005*

E. Elkind, True costs of cheap labor are hard to measure: edge deletion and VCG payments in graphs. *Proceedings of the 6th ACM Conference on Electronic Commerce (ACM EC), 2005*

E. Elkind, A. Sahai & K. Steiglitz, Frugality in path auctions. *Proceedings of the 15th Symposium on Discrete Algorithms (SODA), 2004*