Tutorial Proposal: Computational Social Choice

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1 Description

Social choice theory is a traditional discipline that studies representation and aggregation of individual preferences. It dates back to the 4th century B.C., and prospered since the 18th century. In the past few decades, rapid developments in computer science and internet technologies have brought fresh air to social choice by introducing not only many new applications, but also a computational point of view on preference representation and aggregation. As a result, an interdisciplinary area called *computational social choice* emerged and have attracted much attention of researchers in artificial intelligence, economics, and theory of computation. In particular, computational social choice has found its place in many multi-agent system settings where the agents have conflicting preferences but they must make a joint decision.

In this tutorial, we will give an overview of computational social choice from two different viewpoints: the first views social choice systems as methods that compromises agents' preferences, and the second views social choice systems as methods that reveal the true status of the world. We will discuss objectives and principles of design, with more emphasis on computational considerations. More precisely, we will mainly focus on the first viewpoint by discussing the rationale and possibility of using computational complexity as a barrier against strategic behavior, and preference representation and aggregation when the set of alternatives is exponentially large and has a combinatorial structure. For the second viewpoint we plan to discuss a maximum likelihood approach. We will also discuss connections between some promising future directions.

2 Outline (length: half day)

1. Introduction to social choice theory. (30 min)
   (a) Common voting rules.
   (b) Desired properties for "good" voting rules.
   (c) Game-theoretic aspects and Gibbard-Satterthewaite theorem.

2. Using computational complexity to prevent strategic behavior. (1 hour)
   (a) Voting games where strategic behavior leads to extremely undesirable outcomes.
   (b) Worst-case hardness results (positive).
   (c) Typical-case easiness results (negative).
   (d) Using information constraints to prevent manipulation.
3. Preference representation and aggregation in combinatorial domains. (45 min)
   (a) Combinatorial domains.
   (b) Paradoxes of multiple elections.
   (c) CP-nets and sequential voting rules.
   (d) Strategic behavior in combinatorial voting.
4. Maximum likelihood estimators. (45 min)
   (a) Common voting rules as MLEs.
   (b) Using MLEs to aggregate partial preferences.

3 Target audience

Our target audience is researchers who are interested in multiagent systems, electronic commerce, game theory, mechanism design, and computational complexity. No background is needed beyond graduate knowledge of computer science, including computational complexity and basic probability theory. We feel that this tutorial will be of interest to both theoretical and applied researchers who work on building effective and computationally efficient preference aggregation systems. Specifically, some of Part 2 (b) and (c) were presented in an EC-10 tutorial titled "Computational Voting Theory" by Vincent Conitzer and Ariel Procaccia. Other parts were not presented before.

4 Short bio of the presenter

Lirong Xia is a CRCS fellow and NSF CIFellow at Harvard's School of Engineering and Applied Sciences. He got a Ph.D. in Computer Science in 2011 and an M.A. in Economics in 2010, both from Duke University. His research focuses on the intersection of computer science and microeconomics, in particular computational social choice, game theory, and mechanism design. He has published more than 30 papers in some of the most prestigious conferences and journals in AI and Theory, including AAAI, AAMAS, ACM EC, IJCAI, SODA, UAI, AIJ, and JAIR. His Ph.D. dissertaiton "Computational Voting Theory: Game-Theoretic and Combinatorial Aspects" won 2011 Duke CS outstanding Ph.D. dissertation award.

Example of work: Computational Voting Theory: Game-Theoretic and Combinatorial

Aspects. (http://people.seas.harvard.edu/~lxia/Files/dissertation_Lirong.pdf)
A shorter version titled "Computational Social Choice: Strategic and Combinatorial Aspects" was published in AAAI-10 Doctoral Consortium (http://people.seas.harvard.edu/~lxia/Files/XiaAAAI10DC.pdf).

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