**Accepted Papers:**

**Peihua Li, Jiong Guo. Possible and Necessary Winner Problems in Iterative Elections with Multiple Rules**

Abstract:

An iterative election eliminates some candidates in each round until the remaining candidates have the same score according to a given voting rule. Prominent iterative voting rules include Hare, Coombs, Baldwin, and Nanson. The Hare/Coombs/Baldwin rules eliminate in each round the candidates with the least plurality/veto/Borda scores, while the Nanson rule eliminates the candidates with below-average Borda scores. Recently, it has been demonstrated that iterative elections admit some desirable properties such as polynomial-time winner determination and NP-hard control/manipulation/bribery.

We study new aspects of iterative elections. We suppose that a set R of iterative voting rules is given and each round of the iterative election can choose one rule in R to apply. The question is whether there is a combination of rules, such that a specific candidate p becomes the unique winner (the Possible Winner problem), or whether a specific candidate p wins under all rule combinations (the Necessary Winner problem). The Possible Winner problem can be considered as a special control problem for iterative elections. We prove that for all subsets R of {Hare, Coombs, Baldwin, Nanson} with |R| ≥ 2, both Possible and Necessary Winner problems are hard to solve, with the only exception of R = {Baldwin, Nanson}. We further provide special cases of the Necessary Winner problem with R = {Baldwin, Nanson}, which are polynomial-time solvable. We also discuss the parameterized complexity of the Possible Winner problems with respect to the number of candidates and the number of votes, and achieve fixed-parameter tractable (FPT) results.

**Mengjing Chen, Yang Liu, Weiran Shen, Yiheng Shen, Pingzhong Tang, Qiang Yang. A Mechanism Design Approach for Multi-Party Machine Learning**

Abstract:

In a multi-party machine learning system, different parties cooperate on optimizing towards better models by sharing data in a privacy-preserving way. A major challenge in learning is the incentive issue. For example, if there is competition among the parties, one may strategically hide his data to prevent other parties from getting better models.

In this paper, we study the problem through the lens of mechanism design and incorporate the features of multi-party learning in our setting. First, each agent’s valuation has externalities that depend on others’ types and actions. Second, each agent can only misreport a type lower than his true type, but not the other way round. We call this setting interdependent value with type-dependent action spaces. We provide the optimal truthful mechanism in the quasi-monotone utility setting. We also provide necessary and sufficient conditions for truthful mechanisms in the most general case. We show the existence of such mechanisms is highly affected by the market growth rate. Finally, we devise an algorithm to find the desirable mechanism that is truthful, individually rational, efficient and weakly budget-balance.

**Xiang Liu, Weiwei Wu, Wanyuan Wang, Yuhang Xu, Xiumin Wang, Helei Cui. Budget-Feasible Sybil-Proof Mechanisms for Crowdsensing**

Abstract:

The rapid use of smartphones and devices leads to the development of crowdsensing (CS) systems where a large crowd of participants can take part in performing data collecting tasks in large-scale distributed networks. Participants/users in such systems are usually selfish and have private information, such as costs and identities. Budget-feasible mechanism design, as a sub-field of auction theory, is a useful paradigm for crowdsensing, which naturally formulates the procurement scenario with buyers’ budgets being considered and allows the users to bid their private costs. Although the bidding behavior is well-regulated, budget-feasible mechanisms are still vulnerable to the Sybil attack where users may generate multiple fake identities to manipulate the system. Thus, it is vital to provide Sybil-proof budget-feasible mechanisms for crowdsensing. In this paper, we design a budget-feasible incentive mechanism which can guarantee truthfulness and deter Sybil attack. We prove that the proposed mechanism achieves individual rationality, truthfulness, budget feasibility, and Sybil-proofness. Extensive simulation results further validate the efficiency of the proposed mechanism.

**Invited Talks:**

**Xinhang Lu. Truthful Cake Sharing**

Abstract:

The classic cake cutting problem concerns the fair allocation of a heterogeneous resource among interested agents. In this paper, we study a public goods variant of the problem, where instead of competing with one another for the cake, the agents all share the same subset of the cake which must be chosen subject to a length constraint. We focus on the design of truthful and fair mechanisms in the presence of strategic agents who have piecewise uniform utilities over the cake. On the one hand, we show that the leximin solution is truthful and moreover maximizes an egalitarian welfare measure among all truthful and position oblivious mechanisms. On the other hand, we demonstrate that the maximum Nash welfare solution is truthful for two agents but not in general. Our results assume that mechanisms can block each agent from accessing parts that the agent does not claim to desire; we provide an impossibility result when blocking is not allowed.

Joint work with Xiaohui Bei and Warut Suksompong

Bio:

Xinhang is currently a postdoc hosted by Toby Walsh at the University of New South Wales, Australia. Prior to this, she was a postdoc with Warut Suksompong at the National University of Singapore, a PhD student under the supervision of Xiaohui Bei at Nanyang Technological University, and an undergraduate at Southeast University. She is broadly interested in problems at the interface between computer science and economics. Recently, her work has focused on resource allocation and mechanism design.

**Ying Wen. An Efficient Algorithm for Approximating Nash Equilibrium in Zero-sum Imperfect-information Games**

Abstract:

Policy Space Response Oracle methods (PSRO) provide a general solution to learn Nash equilibrium in two-player zero-sum games but suffer from two drawbacks: (1) the computation inefficiency due to the need for consistent meta-game evaluation via simulations, and (2) the exploration inefficiency due to finding the best response against a fixed meta-strategy at every epoch. In this work, we propose Efficient PSRO (EPSRO) that largely improves the efficiency of the above two steps. Central to our development is the newly-introduced subroutine of no-regret optimization on the unrestricted-restricted (URR) game. By solving URR at each epoch, one can evaluate the current game and compute the best response in one forward pass without the need for meta-game simulations. Theoretically, we prove that the solution procedures of EPSRO offer a monotonic improvement on the exploitability, which none of existing PSRO methods possess. A desirable property of EPSRO is that it is parallelizable, this allows for highly efficient exploration in the policy space that induces behavioral diversity. We test EPSRO on three classes of games, and report a 50x speedup in wall-time and 10x data efficiency while maintaining similar exploitability as existing PSRO methods on Kuhn and Leduc Poker games.

Bio:

Ying Wen is a tenure-track Assistant Professor in John Hopcroft Center for Computer Science at Shanghai Jiao Tong University. His research interests include machine learning, multi-agent systems and human-centered interactive systems etc. He has published over 20 research papers about machine learning on top-tier international conferences(ICML, NeurIPS, ICLR, IJCAI, and AAMAS). He has been serving as a PC member at ICML, NeurIPS, ICLR, AAAI, IJCAI, ICAPS and a reviewer at TIFS，Operational Research etc. He was granted Best Paper Award in AAMAS 2021 Blue Sky Track and the Best System Paper Award in CoRL 2020.

**Fang-Yi Yu. Escaping Saddle Points: from Agent-based Models to Stochastic Gradient Descent**

Abstract:

We study a large family of stochastic processes that update a limited amount in each step. One family of such examples is agent-based modeling, where one agent at a time updates, so the state has small changes in each step. A key question is how this family of stochastic processes is approximated by their mean-field approximations. Prior work shows that the stochastic processes escape repelling fixed points and saddle points in polynomial time.

We provide a tight analysis of the above question. Additionally, We show

the power of our results by applying them to several settings:

- Evolutionary game theory

- Opinion formation dynamics on social networks

- Stochastic gradient descent in a finite-dimensional space

Bio:

Fang-Yi is an assistant professor in the Computer Science Department at George Mason University. He was a Postdoctoral fellow at Harvard School of Engineering and Applied Sciences and received a Ph.D. in Computer Science from the University of Michigan. His research is broadly situated at the interface between machine learning, artificial intelligence, and economics. His recent work focuses on machine learning with strategic agents.