

Project Proposal for Team#6

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1 TOPIC: GENERALIZED DISTRIBUTED AUCTION ON SOCIAL NETWORKS

Our research topic lies in the field of auction mechanism design on social networks. A seller tries to sell one or more items through the network, and all the agents are potential buyers. Each agent is connected to a subset of other agents, and, if the agent has participated in the auction, it can invite its neighbors to the auction. With more agents, the seller will be more likely to sell the item with a higher price. However, agents are also competitors, so we have to design proper incentives for them to invite their neighbors.

Many centralized mechanisms have been proposed, but distributed mechanisms are still rare. Our study will be based on Haoxin Liu's work, which lays the foundation for distributed mechanism design on social networks. Our work will be focused on generalizing Haoxin's work or exploring more properties of the proposed algorithms.

2 MOTIVATION

Previously designed mechanisms on social network require a centralized trustworthy executor to implement, exposing the privacy of agents to perilous situation. To provide privacy security guarantee, the mechanism needs to be decentralized, eliminating the need of trusted authority or a reliable third-party.

Research in decentralized mechanisms is still in a primitive phase where various issues are not settled.

The first fully distributed mechanism [3] has been proposed, however it only solves single item auction. Extension for general cases such as selling homogeneous items or combinatorial auction remains to be tackled. Properties of the proposed mechanism are also not fully explored yet.

Sybil-proofness [4] is another concern in social network-based mechanism design. It means avoiding buyers from creating fake nodes in social networks to improve their utilities, which determines whether a mechanism can be effectively applied in reality. Whether the first fully distributed mechanism is sybil-proofness, and if not, how to design a sybil-proofness distributed mechanism, are still questions to be answered.

3 RESEARCH QUESTIONS

There are several appealing research directions:

- (1) Current works only consider auctions with single item. It may be a simple extension that homogeneous items are sold with single-unit demand for each buyer. Models in which buyers with diminishing valuation can also be considered.
- (2) In reality, the participants are likely to suffer from some penalty when spreading the information and reselling the item, which brings about a diffusion cost. We may add this constraint to the existing distributed mechanism to see if we can reveal some interesting features.
- (3) Sybil attack is a common problem faced by most of the distributed system. We can evaluate the vulnerability to the newly proposed distributed mechanism and, if possible, give a sybil-proof modification.

More specifically, the following questions need to be addressed:

- (1) How to design completely decentralized mechanisms for selling homogeneous items?

- (2) What extension to the existing mechanisms can compensate the diffusion cost so that agents are willing to invite their neighbours?
- (3) Whether or not an agent has an incentive to create fake identities? If it has, how to design a sybil-proof mechanism?

4 PLAN

The primary research methods for this study is literature review, mathematical modeling and theoretical analysis. We will first review various literatures related to the above three directions, which will allow us to choose one direction and define a more specific research question. By the end of week 9, we will write a comprehensive literature review on our selected topic. In the next stage, a formal model will be devised based on the review. By the end of week 13, we will finish our milestone report where some preliminary solutions to the research questions will be proposed. We may carry out a simulation to verify it if an applicable result is derived before week 16. The final report will be finished before the semester ends.

REFERENCES

- [1] Bin Li et al. "Diffusion and Auction on Graphs". In: *CoRR* abs/1905.09604 (2019). arXiv: 1905.09604. URL: <http://arxiv.org/abs/1905.09604>.
- [2] Bin Li et al. "Mechanism Design in Social Networks". In: *CoRR* abs/1702.03627 (2017). arXiv: 1702.03627. URL: <http://arxiv.org/abs/1702.03627>.
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- [4] Alexander Stannat et al. "Achieving Sybil-Proofness in Distributed Work Systems." In: *AAMAS*. 2021, pp. 1263–1271.
- [5] Dengji Zhao et al. "Selling multiple items via social networks". In: *arXiv preprint arXiv:1903.02703* (2019).