Game Theory with CS Applications - Spring 2024

Final Project

1. Overview

In the final project, you are required to **form a group** with **no more than 3 students**, to survey a specific topic in game theory. The group members need to collaborate and investigate **different aspects** for the chosen topic. Each group needs to prepare a **15-min group presentation** on the chosen topic (in week 15 and week 16 class) combining the aspects surveyed by each member. Moreover, each student needs to submit an **individual report** on the content he/she is responsible for. The students in a same group could share the overview introduction that organizes the content surveyed by different members, but **the main body of the report should be finished independently** and avoid overlapping. Some examples on how to divide the work between group members are: divide by time of publication, divide by work of different researchers, divide by variants of model, etc.

2. Requirement on Group Presentation

In the 15-min group presentation, each group needs to present **a general overview of the chosen topic** through introducing the work surveyed by the group members. Due to the limitation of time, you are **not required to explain the details** of the work. The major objective of your presentation is to provide the audience with a guidance on the development of this topic in literature. Nevertheless, it would be important to clearly introduce the basics of the chosen topic, where you may expand the mathematical details if you feel it necessary.

3. Requirement on Individual Report

Ideally speaking, it is expected that combining the individual reports from members of a group could constitute a survey paper on the chosen topic.

- Each report should be **no less than 10 pages and no more than 20 pages,** using the **LaTeX template same as the scribing note** (please change the titles correspondingly). The page limit includes figures, tables, appendices, references, and any other material. If you really need more pages, please ask for the permission from the professor or TA. Please note that more content does not necessarily gain more credits, and we mainly judge your report based on its quality.
- Please **clearly indicate which parts are referenced** from existing literature, and cite the articles you referenced.
- At least **one fifth (1/5)** of the contents should be **analysis done by yourself**, which needs to **be highlighted** using boldface (or other formats you like). We encourage you to propose your own thoughts on the development of the literature or potential future direction.
- Please clearly **describe the relation and differences** between the major content of your report and those of your teammates.

4. Tentative Topics

The topics include but not limited to the following:

1. The Complexity of Finding Nash Equilibria
2. Equilibrium Computation for Two-Player Games in Strategic and Extensive Form
3. Learning, Regret Minimization, and Equilibria
4. Combinatorial Algorithms for Market Equilibria
5. Computation of Market Equilibria by Convex Programming
6. Graphical Games
7. Cryptography and Game Theory
8. Mechanism Design without Money
9. Combinatorial Auctions
10. Computationally Efficient Approximation Mechanisms
11. Profit Maximization in Mechanism Design
12. Distributed Algorithmic Mechanism Design
13. Cost Sharing
14. Online Mechanisms
15. Routing Games
16. Network Formation Games and the Potential Function Method
17. Selfish Load Balancing
18. The Price of Anarchy and the Design of Scalable Resource Allocation Mechanisms
19. Incentives and Pricing in Communications Networks
20. Incentives in Peer-to-Peer Systems
21. Computational Aspects of Prediction Markets
22. Manipulation-Resistant Reputation Systems
23. Sponsored Search Auction
24. Information Design
25. Matching Market
26. Incentives in Blockchain system
27. Game theory in Adversarial Machine Learning
28. GAN and game theory
29. Mean-field Game
30. **Any potential topic you are interested in** (please ask for permission from the professor or TA to ensure it is within the context of game theory)

The topics 1-23 are from the chapters of book "Algorithmic Game Theory", which is a classical book written by experts in different topics (you could find in the canvas file). While you may refer to the book to obtain basic knowledge of the topic, since this book is published in 2007, some of its content has been outdated, and you need to additionally survey the latest work for your final project. The topics 24-29 are some of the hot topics in game theory and EconCS community in the last decade, where you may find more intersections with other topics in computer science. Please also feel free to choose any other potential topic you are interested in. You may also **rename the topic (within an appropriate range) to emphasize your focus** within the broad literature on this topic. To avoid plagiarism, we **do not encourage two groups to choose an**

exactly same topic. We would carefully inspect whether there exists collusion between groups if you choose the same topic.

5. Timeline (Year 2024)

4.30 – Project description released, fill in the link below to announce your group and topic

https://docs.qq.com/sheet/DV2dCWFNhUkduTEhj?tab=BB08J2

5.14 – Group member and chosen topic finalized

Before 5.21 – Presentation schedule released (deciding when you would present by random draw)

5.28 and 6.4 – Presentation in class

6.11 – Individual report deadline

Since the final project accounts for 40% of your final grade, please make sure to follow the above timeline to get a satisfying (passing) grade in this course. You may utilize the WeChat group to find your teammates. If you have any question on the project, please contact the professor or TA.