Course Form for PKU Summer School International 2018

Course Title	**Economics and Computation**
	经济与计算
Teacher	XIA Lirong
First day of classes	July 16, 2018
Last day of classes	July 25, 2018
Course Credit	2 credits

Course Description

Objective

Economics and Computation is an emerging multi-disciplinary field of Economics, Theoretical Computer Science, and Artificial Intelligence. It brings together principles and methodologies in these fields to tackle challenges in the internet era. This course offers a comprehensive in-depth introduction to key subjects in Economics and Computation. It will cover great ideas in Economics, including key contributions of more than 10 Nobel laureates in economics, as well as computational techniques and computational thinking in new topics such as Algorithmic Game Theory and Computational Social Choice, which were recognized one of the eleven "*fundamental methods and application areas*" of AI, according to The One Hundred Year Study on Artificial Intelligence at Stanford University.

Students will learn (1) key applications of Economics and Computation, including social choice, auctions, matching and resource allocation; (2) important conceptual contributions, including Nash Equilibrium and their refinements, implementation theory, incentive analysis, discrete choice models; (3) technical breakthroughs and algorithms, such as the VCG mechanism, deferred acceptance algorithm, top-trading-cycles, generalized method-of-moments; (4) modern topics such as security games, crowdsourcing, bitcoins.

This course is based on a highly-rated course taught by Lirong for four times at RPI.

Pre-requisites /Target audience

The course only requires basic knowledge in algorithms. No background in Economics is necessary.

Proceeding of the Course

None

Assignments (essay or other forms)

Reading and written assignment

Evaluation Details

Attendance and Reading: 30%
Written assignment: 40%
Exam: 30%

Text Books and Reading Materials

1. D. Parkes and S. Seuken. Economics and Computation (in progress).
2. L. Xia. Learning and Decision-Making from Rank Data (in progress).
3. F. Brandt, V. Coniter, U. Endriss, J. Lang, A. Procaccia. Handbook of Computational Social Choice, 2016
4. Y. Shoham and K. Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, 2009.
5. N. Nisan, T. Roughgarden, E. Tardos and V. Vazirani, Algorithmic Game Theory, 2007

Academic Integrity (If necessary)

Students are encouraged to work in groups, but they must acknowledge helps and discussions with other students.

CLASS SCHEDULE
(Subject to adjustment)

Session 1： *Introduction to the course, basic game theory*	Date:7/16

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)
Overview of the course, examples of EconCS systems. Basic game theory, pure Nash Equilibrium. Mixed-strategy equilibrium, Nash's proof of existence.

【Questions】

【Readings, Websites or Video Clips】

【Assignments for this session (if any)】

Session 2： *Sequential-Move games and Bayesian games*	Date:7/17

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.) Extensive-form games, subgame perfect equilibrium. Bayesian games, Bayes-Nash Equilibrium.
【Questions】
【Readings, Websites or Video Clips】
【Assignments for this session (if any)】

Session 3： *Algorithmic Game Theory: Equilibrium Computation*	Date:7/18

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.) Algorithms for computing mixed-strategy NE, correlated equilibrium, complexity of NE
【Questions】
【Readings, Websites or Video Clips】
【Assignments for this session (if any)】

Session 4： *Mechanism design*	Date:7/19

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.) Fundamental theory of mechanism design, implementation, revelation principle. Various auction mechanisms, VCG mechanisms
【Questions】
【Readings, Websites or Video Clips】

【Assignments for this session (if any)】

Session 5： Matching and resource allocation	Date:7/20
【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.) Deferred acceptance algorithm, top-trading-cycles algorithm, serial dictatorships. Complexity and normative properties	
【Questions】	
【Readings, Websites or Video Clips】	
【Assignments for this session (if any)】	
Session 6： *Voting*	Date:7/21
【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.) Definition and algorithms for voting rules. Axiomatic properties of voting rules, Arrow's impossibility theorem.	
【Questions】	
【Readings, Websites or Video Clips】	
【Assignments for this session (if any)】	
Session 7： Computational Social Choice	Date:7/22
【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.) Computational complexity and algorithms for winner determination. Using complexity to protect elections. Strategic behavior and manipulation in social choice. Gibbard-Satterthwaite theorem.	

【Questions】
【Readings, Websites or Video Clips】
【Assignments for this session (if any)】

Session 8： *Wisdom of the crowd*	Date:7/23

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.) Condorcet Jury theorem and truthful elicitation, proper scoring rules.
【Questions】
【Readings, Websites or Video Clips】
【Assignments for this session (if any)】

Session 9： *Discrete Choice Models*	Date:7/24

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.) Discrete choice models, Plackett-Luce models, Random Utility Models, and generalized method-of-moments algorithms for computing them.
【Questions】
【Readings, Websites or Video Clips】
【Assignments for this session (if any)】

Session 10： *Crowdsourcing, Blockchain and bitcoin*	Date:7/25
【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.) Applications and challenges in crowdsourcing. Principles, protocols and strategic issues in blockchain technology, illustrated in the context of bitcoin.	
【Questions】	
【Readings, Websites or Video Clips】	
【Assignments for this session (if any)】	