CS/SS/Ec 149 Introduction to Algorithmic Economics

- Instructors: Federico Echenique and Luciano Pomatto
  Lectures: MWF 10-11am
  Class homepage:
  `http://www.hss.caltech.edu/~fede/csssec149/`

- Readings.

  The required texts are: "A course in game theory," by Martin J. Osborne and Ariel Rubinstein (MIT press, 1994; you can download this book from `http://books.osborne.economics.utoronto.ca/`), and "An introduction to the theory of mechanism design," by Tilman Börgers (Oxford University Press, 2015). You may also find the following useful: "Game Theory," by M. Maschler, E. Solan, S. Zamir (Cambridge University Press, 2013), and "Algorithmic Game Theory" by Noam Nisan, Tim Roughgarden, Eva Tardös, and Vijay Vazirani (Cambridge University Press, 2007).

- Grading.

  There will be one midterm and one final exam. The midterm covers the first half of the course material, and the final the second half. Each of the tests is worth 40% of the grade. There will also be weekly or bi-weekly homework, in all counting for 20% of the grade. To receive a passing grade, students must attempt and hand in all the homework, and obtain at least 10% of the points in the midterm and in the final. Students should form groups of three or four students to work on problem sets.

  We expect each student to first attempt all the problems individually, and then meet as a group to discuss and arrive at a consensus solution for each problem. Finally, each group should hand in a single common solution to the problem set.

- Course Outline.

  1. Fundamentals: Strategic-form games, mixed strategies, dominance and iterated dominance, applications to price competition and second-price auctions.

2. Games and Solutions: Nash Equilibrium (existence, properties and interpretation), correlated Equilibrium, min-max and zero-sum games.
3. Dynamics: Best-response dynamics and potential games. Congestion games. Applications.
4. Approachability and Blackwell's Theorem, calibration and no-regret dynamics. Convergence to Correlated Equilibrium. Applications.
5. Mechanism design: Implementation and the revelation principle.
6. Dominant strategy implementation. The Gibbard-Satterthwaite theorem. Quasi-linear environments. Monotonicity and cyclic monotonicity. Welfare maximization: the VCG mechanism and Roberts' theorem.
7. Bayesian mechanism design. Virtual valuations.
8. Auctions. Internet ad auctions and the generalized second price auction. Revenue equivalence. Myerson optimal auctions.
9. Combinatorial auctions. Fractional assignments via linear programming.
10. Communication complexity of economic mechanism.
11. Price of anarchy and the quantification of inefficiency. Network games.
12. Two-sided matching markets. Linear programming and the TU assignment game. The NTU matching markets. Applications: school choice.