

The Design of Online Marketplaces

ORIE 6180: Syllabus

Spring 2016

Essential Course information:

Lectures and Recitations

Class time: MW 10:10-11:25am

Class location: Hollister 320

Website: <http://people.orie.cornell.edu/sbanerjee/ORIE6180/orie6180s16.html>

Instructor

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Catalog course description:

New online marketplaces are profoundly altering our social and economic interactions. They enable unprecedented levels of monitoring and control over their participants; the complexity of their underlying functions results in the platforms and their participants interacting in intricate and subtle ways; finally, many online marketplaces are reaching scales where small design changes can have a huge impact on their performance. In this course, we will: (i) look at several important online marketplaces, and highlight their unique economic and operational challenges, and (ii) develop stochastic models that provide a principled way to reason about their operations.

Detailed Course description:

Markets are an ancient institution for matching supply and demand; in recent years, are being transformed by the digital revolution. Many of today's most interesting marketplaces are online: for example, ad-auctions at the heart of Google and Facebook; Amazon, eBay and Etsy (for goods); Netflix (for entertainment); Lyft and Uber (for transportation); Upwork (previously Elance-oDesk, for online freelance work); Taskrabbit and Postmates (for physical freelance work); Airbnb (for lodging); okCupid and Match.com (for dating); etc.

Online marketplaces enable fine-grained monitoring of participants, and provide a variety of 'control-levers' such as pricing, terms of trade, liquidity, visibility, information revelation, etc. The decisions made by the platform and the market participants interact, sometimes in intricate and subtle ways, to determine market outcomes. Finally, every aspect of an online market platform can be altered within days, hours, or even minutes, allowing unprecedented levels of intervention in. These factors have made the design of these marketplaces an exciting and challenging place to work in. Small changes to such basic infrastructure can radically alter the behavior of the market itself – the goal in this class is to develop a conceptual understanding of these market design challenges.

This course is geared towards preparing students for research on online and platform markets. It will be taught using a mix of lecture format and seminar-style guided discussion, and has a significant project component. Much of what we will discuss is active research, with reading material drawn from recent literature. The focus will be on encouraging discussion of both open theoretical questions and modeling issues. This is particularly important since the course content draws from a range of disciplines (operations research, computer science, economics, etc.).

Course Goals

This course has three main goals:

1. **Research Problems:** The main goal of this course is to identify open problems arising from the task of designing online platforms. This is an exciting time for market design, with great interest in the fundamentals, and a rich set of applications that motivate research directions, and provide data and testbeds for validation.
2. **Tools and Models:** The second goal is to provide students access to a set of tools from microeconomics, game theory and revenue management, which are useful for reasoning about online markets. In particular, we will focus on large-scale stochastic models of these systems.
3. **Applications to online marketplaces:** Along the way, we will try to see how the research questions we identify and the tools we learn are relevant to real-world marketplaces. This will be through exposure to a host of interesting platforms, and empirical research and anecdotal evidence for the use of market design in these platforms.

Tentative Course Structure

The course will be taught using a mix of lecture format and seminar-style discussions. The course content is drawn from a range of disciplines (operations research, computer science, economics), and hopefully should provide a unique forum for a lively exchange of ideas across these boundaries. The focus will be on encouraging discussion of both open theoretical questions and modeling issues. Much of what we will discuss is active research, so the reading material will be drawn from relevant papers in the literature; this material will be available from the course website.

The course will comprise of three units:

1. **Basic tools for studying online marketplaces**
 - Introduction to mechanism design and auctions
 - Price theory of two-sided platforms
2. **Operational details of platform marketplaces:**
 - Search and visibility
 - Pricing
 - Reputation and Feedback
3. **Additional topics:**
 - Platform competition
 - Learning with strategic agents
 - Experimentation and A/B testing in platform markets

Prerequisites:

I will assume knowledge of basic probability and optimization (at the level of ORIE 6500 and ORIE 6300, or equivalent). Prior exposure to microeconomics and game theory would be helpful, but is not necessary. Send me a mail if you are concerned about having the appropriate prerequisites.

Grading:

Your grade will be based on a project (50%), two assignments (20%) and class participation (30%) – the latter is further divided into scribing (subject to class strength) and paper summaries. The two assignments will be cover the earlier units, and will be spread over roughly 3 weeks each. Subsequently, we will cover more recent papers – these will be announced beforehand, and the students will be expected to read and briefly summarize the papers before class. Finally, for the project, students need to submit a 2-3 page proposal, and give a brief presentation on their chosen topic on **Wednesday, March 23, 2016** (the week before spring break). Subsequently, the last two classes (May 9 and 11) will be kept aside for longer student presentations, after which a final report is due during the finals period. The proposal and intro presentation are worth 10%, the final presentation is worth 15%, and the remaining 25% is for the report.

Textbooks:

There is no required textbook; a lot of what we discuss will be drawn from research papers, which will be posted on the website. However, you may find some of the following books helpful:

- General references for microeconomics and game theory:
 - *Game Theory for Applied Economists*, Gibbons – This is a basic undergraduate level text in game theory, which gives an elementary treatment of most of the major topics.
 - *Game Theory*, Fudenberg and Tirole – An excellent and rigorous treatment of Game Theory, but not necessarily the easiest introductory reference.
 - *Algorithmic Game Theory*, Nisan et al. – An excellent reference for the CS theory viewpoint on game theory and economics.
 - *Microeconomic Theory*, Mas-Colell, Whinston, and Green – A definitive reference on all topics in microeconomics.
- For auction theory and mechanism design:
 - *Putting Auction Theory to Work*, Milgrom – A beautiful book by one of the giants of the field. Has a great mix of theory and practice.
 - *Mechanism Design and Approximation*, Hartline – Covers the CS approach to mechanism design. Available at <http://jasonhartline.com/MDnA/>. Another great resource is Tim Roughgarden's lecture notes (<http://theory.stanford.edu/~tim/notes.html>).
- For Operations Management:
 - *The Theory and Practice of Revenue Management*, Talluri and van Ryzin – An excellent introduction to the topic; covers a lot of the theory and practical aspects.

Academic integrity:

You are expected to abide by the Cornell University Code of Academic Integrity. Any work submitted by you in this course for academic credit should be your own. The complete code is available at <http://cuinfo.cornell.edu/Academic/AIC.html>.