

Econ 472: Economics of Artificial Intelligence and Innovation

Yale University, Department of Economics

Fall 2018

Tuesday, 1:30 - 3:20 pm

Office hours: Monday, 2:30 - 3:30pm

& Tuesday, 3:30 - 4:30pm

(or by appointment)

Evangelia Chalioti

Office: 30 Hillhouse, Room 35

Email: evangelia.chalioti@yale.edu

Tel.: (203) 432 - 8320

Course Description

It used to be common to speak of the "high-tech sector" of the economy, but increasingly information technology is transforming how almost every market works: finance has been transformed by algorithmic trading and bitcoin, ridesharing is changing the nature of public transportation, Amazon is revolutionizing logistics and Airbnb is now the most valuable accommodation provider in the world. This transformation, which has been led by a series of start-ups and newly-dominant technology companies, inherently combines technical and economic aspects, as entrepreneurs take advantage of the potential of technology to facilitate exchanges that were previously infeasible.

This course intends to provide students with a solid understanding of the economics of innovation and the effects of artificial intelligence on different industries. Topics include economics of the intellectual property (IP) protection system; strategic choices in innovation & competition; patent races; measurement and big data; the sharing and digitalized economy; collective intelligence and decisions; online auctions; venture capital; legal and social infrastructure.

This course will often motivate the analysis of economic concepts using case studies and empirical facts. The academic objective of this course is to elaborate students' skills in using theoretical tools to formulate and solve economic problems. The goal is for the students gain a deep understanding of the economic aspects of innovative activity and artificial intelligence.

Course website

This course uses **Yale Canvas** as the course website. Students registered for the course may log in at <http://canvas.yale.edu/>. This website will be used to post announcements, copies of all lecture notes, class handouts, problem sets, answer keys, and most readings. A sample of (next day's) lecture notes will also be available on Canvas before each class.

Prerequisite

Basic and intermediate-level microeconomics (ECON 115 or equivalent; ECON 121) are the prerequisites for this class. You should also be familiar with basic calculus such as derivatives as well as with optimization problems such as profits and utility maximization. Prior knowledge of basic game theory - Nash equilibrium, subgame perfect Nash equilibrium, backward induction - is strongly recommended.

Readings

The lecture notes will be posted over the course on the homepage to reflect the current lectures.

Main textbooks:

- Scotchmer, Suzanne, 2004, *Innovation and Incentives*, MIT Press
- Church, Jeffrey and Roger Ware, 2000, *Industrial Organization: A Strategic Approach*, Irwin McGraw-Hill. Available in PDF format at http://works.bepress.com/jeffrey_church/23
- Agrawal, Ajay, Gans, Joshua, and Avi Goldfarb, 2018, *Prediction Machines, The Simple Economics of Artificial Intelligence*, Harvard Business Review Press.

Selected readings from recent research and case studies will also be assigned.

Supplementary books.

Industrial organization:

- Belleflamme, Paul and Martin Peitz, *Industrial Organization: Markets and Strategies*, Cambridge University Press, (4th printing 2012)
- Tirole, Jean, *The Theory of Industrial Organization*, MIT Press, 1992
- Shy, Oz, *Industrial Organization. Theory and Applications*. MIT Press. 1995.

Artificial Intelligence and innovation:

- *Who Gets What - and Why: The New Economics of Matchmaking and Market Design* by Alvin E. Roth.
- *Computers Ltd.: What They Really Can't Do* By David Harel.
- *Who Owns the Future* by Jaron Lanier.
- *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies* by Erik Brynjolfsson.
- *Oracles: How Prediction Markets Turn Employees into Visionaries* by Donald N. Thompson.

Problem Sets

Problem sets will be assigned. They must be uploaded on Canvas the day is due.

Working through the problem sets (solving or at least trying to solve them) is the key to understanding the course material (and preparing for the midterm and final exam). Some exercises will

also be discussed in class. We will not be granting extensions to problem sets, unless you have a letter from your college Dean. However, if no problem sets are missed, the lowest grade will be dropped.

Team work is encouraged in homework assignments. However, problem set solutions should be written up individually. To receive credit, you must clearly write your name as well as the names of the students you worked with. Identical write-ups will not be counted. You also need to show how you arrived at the mathematical solution and explain your steps.¹

Attendance policy

Attendance to class is mandatory. It will help in mastering the course material and getting prepared for the exams, since presentation slides will be used as a text, problems will be solved and case studies will be discussed. An attendance sheet will be circulated in every class.

Grading

There will be a midterm exam. Details about the exam will be announced in class as well as on Canvas. The course grade will be the weighted average of the following:

Problem sets: 20%

Class presentation/attendance/participation: 20%

Report: 30%

Midterm exam (Tuesday, October 16, 2018): 30%

- You will present a case study on a topic related to the course (length: 20 minutes including questions and answers). The content is either your own research or discussion of published research papers and newspaper articles. A joint presentation by up to two students is allowed, but in that case, the length should be 40 minutes.

- The report will be on the same topic as the student's presentation. Suggested length of the report is between 7 to 10 pages but it can vary within a reasonable limit. A joint report by up to two students is allowed, but in that case the suggested length is 15-20 pages.

- The midterm exam will be based on lectures, class discussions, problem sets and readings assigned during the course. There will be no final exam.

- You are required to inform me of any known conflict as soon as possible but no later than two weeks before the date of examination.

¹To submit your assignment, you need to scan your assignment and save it in PDF format. Click the Assignments link in Course Navigation. Click the name of the assignment, and then the "Submit Assignment" button. To upload a file from your computer, select the File Upload tab. When you are ready to submit your assignment, click the Submit Assignment button. After you have submitted your work, you will see information in the Sidebar about your submission. The Sidebar provides a link to your submission to download if necessary. You can also resubmit another version of your assignment using the Re-submit Assignment button. You will only be able to view the details of your most recent submission in the Sidebar, but the grader and I will be able to see all of your submissions.

- If you need to miss an exam or assignment, please obtain a "Dean's excuse" and email me before the assignment is due or the exam date. Otherwise, the missed assignment or exam will result in a failing grade.

⇒ Help me prioritize your emails by including in the subject line the course code "Econ 482".

Remarks

- Lectures are not self-contained. It is not expected that you will be able to follow a lecture if you have gaps in your knowledge from prior lectures.

- It is not expected that understanding the lecture notes will prepare you to perform well in the exams. Successfully completing the problem sets *and* reading the covered sections of the textbooks are necessary components for such preparation.

- Academic Integrity: Violations of academic integrity as given in "Undergraduate Regulations" will be taken seriously. See <http://yalecollege.yale.edu/campus-life/undergraduate-regulations>.

Students assistance

If you receive services through the Resource Office on Disabilities and require accommodations for this class (note taking assistance, extended time for tests, etc.), please, make an appointment with me as soon as possible to discuss your approved accommodation needs. I will hold any information you share with me in the strictest confidence.

If you need help with your writing skills, you can contact the Yale College Writing Center. See <http://writing.yalecollege.yale.edu/writing-yale>.

Lectures

The lectures are the core elements of the course. Following is a sketch of topics we are likely to cover (some modifications are likely along the way).

⇒ The required readings for each class will be listed in the last slide of the lecture notes.

Recommended readings:

Intellectual property

* Scotchmer: CH 3, 4.6

* Besen, S. and L. Raskind (1991), "An Introduction to the Law and Economics of Intellectual Property", *The Journal of Economic Perspectives* 5(1), pp. 3-27.

* Gallini, N. and S. Scotchmer (2002), "Intellectual Property: When is it the Best Incentive Mechanism?", in: Jaffe, A., J. Lerner and S. Stern (Eds), *Innovation Policy and the Economy* (2), MIT Press, pp. 51-78.

* Maurer, S. M. and S. Scotchmer (2006), "Open source software: the new intellectual property paradigm", NBER Working Paper 12148.

Innovation & market structure

* Scotchmer: CH 2, 8.4

* Church and Ware, CH 2.4, CH 18.1 - 18.2.1

* Dosi, G. (1988), "Sources, procedures and microeconomic effects of innovation", *Journal of Economic Literature* 26 (3), pp. 1120-1171.

* Fagerberg, J. (2004), "Innovation: a guide to the literature", working paper

* Gilbert, R. and D. Newbery (1982), "Preemptive patenting and the persistence of monopoly", *American Economic Review* 72 (3), pp. 514-526.

Strategic investment in R&D

* Church and Ware, CH 15 (*CH 8)

* Afuah, A. (2009), "Strategic innovation: New game strategies for competitive advantage", Routledge, Part V, Cases 3, 9, 11, 12.

Mechanism and market design

* William Cronon (1992), *Nature's Metropolis: Chicago and the Great West*, W. W. Norton & Company, Inc., CH 3.

* Jeremy, B. and J. Roberts (1989), "The Simple Economics of Optimal Auctions", *Journal of Political Economy*, Vol. 97, No. 5, pp. 1060-1090.

* Tideman, T. N., and G. Tullock (1976), "A New and Superior Process for Making Social Choices", *Journal of Political Economy*, Vol. 84, No. 6, pp. 1145-1159.

* Vijay Krishna (2010), *Auction Theory*, Academic Press.

The sharing economy

* Hall, J., Kendrick, C., and C. Nosko (2015), "The Effects of Uber's Surge Pricing Algorithm: A Case Study".

* Einav, L., Farronato, C., and J. Levin (2015), "Peer-to-Peer Markets", NBER Working Paper No. 21496.

Collective intelligence and decisions

* Posner, E. A., and E. G. Weyl (2014), "Voting Squared: Quadratic Voting in Democratic Politics", Chicago, Coase-Sandor Institute for Law and Economics Working Paper No. 657.

Online auctions

* Hal Varian, "Insights on the AdWords Auction", <https://www.youtube.com/watch?v=PjOHTFRaBWA>

* Lewis, R. A., and J. M. Rao (2015), "The Unfavorable Economics of Measuring the Returns to Advertising", *Quarterly Journal of Economics*, Vol. 130 (4), pp. 1941-1973.

* Einav, L., Farronato, C., Levin, J., and N. Sundaresan (2018), "Auctions versus Posted Prices in Online Markets", *Journal of Political Economy*, Vol. 126 (1), pp. 178–215.

* Nosko, C., and S. Tadelis (2015), "The Limits of Reputation in Platform Markets: An Empirical Analysis and Field Experiment", NBER Working Paper No. 20830.