University of Pennsylvania, Wharton School

Department of Operations, Information, and Decisions
OIDD 469 – Advanced Information Strategy and Economics (1.0 CU)
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Course Overview

This course is devoted to the study of the strategic use of information and the related role of information technology. It is designed for students who want to manage and compete in technology-intensive businesses. The topics of the course vary year to year, but generally include current issues in selling digital products, data science, intermediation and disintermediation, competing in online markets, emerging technologies, managing artificial intelligence and data science for business, and technology project management. Heavy emphasis is placed on utilizing information economics to analyze businesses in information-intensive industries. Technology skills are not required, although a background in information technology management, strategic management or managerial economics is helpful. The course is designed to complement OIDD 210, OIDD 215, OIDD 245, and OIDD 255.

If "software is eating the world", then a new view of economics is needed to understand how pricing, competition, and markets will change as more of the economy is digitized.[1] We will study information-based industries like digital media, social networks, financial services, and online retail as well as traditional businesses that are being changed by new digital capabilities. There are four broad themes for the course: the economics of information goods and services, search and consumer information, markets and market design, and implementations. Each day we will discuss a core topic in one or more of these themes, with an emphasis on bridging theoretical ideas to real world applications. Application topics might include applying artificial intelligence, platform economics, and cryptocurrencies.

The course is likely to be especially useful for students interested in working in the information economy. For those interested in becoming consultants, business technologists and analysts (e.g. product managers or technology management roles), analysts of various types, and entrepreneurs this course will introduce critical frameworks for understanding the economics of competing in digital business. A basic understanding of strategy and microeconomics (including basic game theory) is useful, but all necessary strategic or economic concepts will be discussed as part of the course. There are also two analytics-focused individual assignments. Students may use their programming language of choice to complete these assignments, but R and Python are

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[1] https://www.wsj.com/articles/SB10001424053111903480904576512250915629460

recommended. Additional office hours to assist students in completing these assignments will be available as well.

Course Structure and Grading

Preparation and Readings: Much of the work in the course is preparing by doing the readings and coming to class ready to discuss the ideas in the readings. For each session there will be a reading guide posted on Canvas listing required (and in some cases, optional) readings from academic, trade, and popular sources. There will also be a couple guest speakers and exercises derived from the readings. There is no required textbook. The readings are often lengthy and, in many cases, contain extensive technical material. When reading, try not to be as worried about understanding technical details and focus instead on the arguments made in the material. We will sometimes go through technical details in class. In-class discussions will be more relevant for exercises and the exam. Of course, if you'd like to study the technical content more, it's there for you!

To guide some of the discussion, each "topic"-based session (most sessions except for the first and last days of class) will have a short, graded memo assignment due the evening before the start of class. Each student's two lowest memo assignment grades will be dropped. Details on these short memos can be found below.

Grading: There are four main class activities that will be graded:

- Exam (25%): We will have an open-note exam scheduled during the allotted final exam period. Students are not allowed to work together on the exam or access materials other than notes and readings. We will have an optional review session prior to the exam to be scheduled closer to the date.

Memos and Assignments (25%): Memos will consist of between one and four open-ended questions based on the readings for the session. In total, memo responses should typically not exceed three double-spaced pages with typical margins. There is no minimum length for a response to a particular question. Memos will be due by 12:01pm on the day prior to class unless otherwise noted on the course calendar, which is adjusted to reflect holidays. We will use Canvas for submission and grading. Memos are graded between 1 and 10 (10 is the highest possible score). Students may drop their three lowest memo scores. This is intended to build in flexibility. Late memos will be penalized, as the exercises are meant to prepare for class. These memos should reflect original thinking for each student. That is, group work on the memos is NOT permitted. Of course, discussion of the conceptual material is strongly encouraged. The memos will be 12.5% of the grade (half the homework grade).

There are two quantitative data analysis assignments required for this course, both of which will require programming. Prior experience programming will not be necessary but is helpful. The assignments will be 12.5% of the grade (half the homework grade).

- Class Participation (20%): Contributing insight to the class and helping the entire group engage with the subject matter is highly valued in this course. This of course requires adequate preparation, both in the explicitly required exercises as well as with each student's best efforts to go beyond the basics from the readings and materials. Participation is therefore both about frequency and quality. The goal is to help everyone (including the

instructor!) to learn. We know that taking a risk to express a perspective in a group can be challenging, but it is a critical skill to develop at Wharton and beyond. On the other hand, inappropriate behavior that distracts from the day's discussion or makes it more difficult for us to engage with the course content can negatively affect a participation grade.

- Final Project (30%): The final project can be done in groups (no more than 3 people per group) or individually and is meant as an opportunity for you to explore a question related to digital economics that you find particularly interesting. The project is largely unconstrained. The only prompt is to 1) define a question that you think merits deeper inquiry and 2) answer it with rigor. Your answers, however, they are formulated, should consider alternative perspectives. We will spend a day in the middle of the semester for everyone to present their initial ideas with group feedback. On the last day of class teams will present their work (following previous years, each team will get approximately 15 min*$\sqrt{GroupSize}$). Additionally, a report detailing the results and findings will be due the same day. This report should be 6-10 pages double-spaced, not including references, figures, and tables. Both the report and the presentation should clearly state and motivate the question to be addressed, explain the methods applied, and analyze the findings.

Since the answers to the memos are inherently subjective, there will be no re-grade requests permitted for those assignments. For all other assignments, points will be deducted at a penalty rate of 20% for each day the submission is late.

Office Hours and Course Support

We will be using Canvas for dissemination of readings and submission of assignments, as well as course announcements. We will also have a class Slack for interested students to have ongoing discussions and share materials of interest.

Office hours will be by appointment. There may also be "open channel" office hours where Professor Rock is available via zoom. Any student can drop in for these sessions (timing to be approximately weekly, posted on Canvas). These office hours are your time! Feel free to discuss anything of interest.

Course Calendar

The tentative agenda for the quarter is as follows (subject to change):

- **1/11: Course Introduction**
  Information Goods
    – *Required Readings: None (First day of class)*
    – *Optional Readings: None (First day of class)*
    – *Assignment: None (First day of class)*
- **1/18: Information Goods and Versioning***
    – *Required Readings:*
        - Varian, Hal R. *Markets for information goods*. Vol. 99. Institute for Monetary and Economic Studies, Bank of Japan, 1999. (Read sections 1-6)
        - Varian, Hal R. *Versioning information goods*. working paper, 1997. (Read all)
        - *Information Rules* (Shapiro and Varian), Chapter 1

- *Optional Readings:*
  - Waldfogel, Joel. "How digitization has created a golden age of music, movies, books, and television." *Journal of economic perspectives* 31, no. 3 (2017): 195-214.
  - Ellison, Glenn. "A model of add-on pricing." *The Quarterly Journal of Economics* 120, no. 2 (2005): 585-637.

- *Assignment: Memo*

- **1/23: Bundling and Information Goods Pricing***
  - *Required Readings:*
    - *Information Rules* (Varian), Chapter 2-3
    - *The Second Machine Age* (Brynjolfsson and McAfee), Chapter 4
    - Bakos, Yannis, and Erik Brynjolfsson. "Bundling information goods: Pricing, profits, and efficiency." *Management science* 45, no. 12 (1999): 1613-1630.
  - *Optional Readings:*
    - Bakos, Yannis, and Erik Brynjolfsson. "Bundling and Competition on the Internet." *Marketing science* 19, no. 1 (2000): 63-82.
    - Kumar, Madhav, Dean Eckles, and Sinan Aral. "Scalable bundling via dense product embeddings." *arXiv preprint arXiv:2002.00100* (2020).
    - Shiller, Ben, and Joel Waldfogel. "Music for a song: an empirical look at uniform pricing and its alternatives." *The Journal of Industrial Economics* 59, no. 4 (2011): 630-660.

  - *Assignment: Memo*

Markets

- **1/25: Markets***
  - *Required Readings:*
    - Hayek, Friedrich August. "The use of knowledge in society." *The American economic review* 35, no. 4 (1945): 519-530.
    - Lee, Ho Geun, and Theodore H. Clark. "Impacts of the electronic marketplace on transaction cost and market structure." *International journal of electronic commerce* 1, no. 1 (1996): 127-149.

  - *Optional Readings:*
    - Hirshleifer, Jack. "The private and social value of information and the reward to inventive activity." In *Uncertainty in Economics*, pp. 541-556. Academic Press, 1978.
    - "In Soviet Union, Optimization Problem Solves *You*" (blog by Cosma Shalizi): https://crookedtimber.org/2012/05/30/in-soviet-union-optimization-problem-solves-you/
    - Hurwicz, Leonid. "The design of mechanisms for resource allocation." *The American Economic Review* 63, no. 2 (1973): 1-30.

- Kyle, Albert S. "Continuous auctions and insider trading." *Econometrica: Journal of the Econometric Society* (1985): 1315-1335. [note: only for the **bold**!]
- Roth, Alvin E. *Who gets what—and why: The new economics of matchmaking and market design*. Houghton Mifflin Harcourt, 2015.

  – *Assignment: Memo*
- **1/30: Information Asymmetries and Information Risks***
  – *Required Readings:*
    - Stiglitz, Joseph E. "The contributions of the economics of information to twentieth century economics." *The quarterly journal of economics* 115, no. 4 (2000): 1441-1478.
    - Akerlof, George A. "The market for "lemons": Quality uncertainty and the market mechanism." In *Uncertainty in economics*, pp. 235-251. Academic Press, 1978.
    - Kahn, M. E., B. Casey, and N. Jones. "How the insurance industry can push us to prepare for climate change." *Harvard Business Review* (2017).

  – *Optional Readings:*
    - Rothschild, Michael, and Joseph Stiglitz. "Equilibrium in competitive insurance markets: An essay on the economics of imperfect information." In *Uncertainty in economics*, pp. 257-280. Academic Press, 1978.
    - Hölmstrom, Bengt. "Moral hazard and observability." *The Bell journal of economics* (1979): 74-91.

  – *Assignment: Bundling Programming Assignment based on class preferences due*

Networks and Platforms
- **2/1: Network Effects and Social Networks***
  – *Required Readings:*
    - *Information Rules* (Shapiro and Varian) – Chapter 7
    - Varian, Hal R. "High-technology industries and market structure." *University of California, Berkeley* 33 (2001). (Read sections 6 to 9 only)
    - Benzell, Seth, and Avinash Collis. "How to Govern Facebook: A Structural Model for Taxing and Regulating Big Tech." *Available at SSRN 3619535* (2020).
    - This thread: https://twitter.com/emollick/status/1350826211975553025?s=20

  – *Optional Readings:*
    - Godinho de Matos, Miguel, Pedro Ferreira, Michael D. Smith, and Rahul Telang. "Culling the herd: Using real-world randomized experiments to measure social bias with known costly goods." *Management Science* 62, no. 9 (2016): 2563-2580.
    - Hall, Jonathan V., John J. Horton, and Daniel T. Knoepfle. "Labor market equilibration: Evidence from uber." *URL http://john-joseph-horton. com/papers/uber_price. pdf, working paper* (2017).

  – *Assignment: Memo*

- **2/6: Platforms***
  - *Required Readings:*
    - Parker, Geoffrey G., and Marshall W. Van Alstyne. "Two-sided network effects: A theory of information product design." *Management science* 51, no. 10 (2005): 1494-1504.
    - Rochet, Jean-Charles, and Jean Tirole. "Platform competition in two-sided markets." *Journal of the european economic association* 1, no. 4 (2003): 990-1029.
    - Eisenmann, Thomas, Geoffrey Parker, and Marshall W. Van Alstyne. "Strategies for two-sided markets." *Harvard business review* 84, no. 10 (2006): 92.

  - *Optional Readings:*
    - Fradkin, Andrey, Elena Grewal, and David Holtz. *Reciprocity in two-sided reputation systems: Evidence from an experiment on Airbnb*. Working paper, 2020.
    - Seamans, Robert, and Feng Zhu. "Responses to entry in multi-sided markets: The impact of Craigslist on local newspapers." *Management Science* 60, no. 2 (2014): 476-493.
    - Corts, Kenneth S., and Mara Lederman. "Software exclusivity and the scope of indirect network effects in the US home video game market." *international Journal of industrial Organization* 27, no. 2 (2009): 121-136.

  - *Assignment: Memo*
- **2/8: Auctions and Mechanisms***
  - *Required Readings:*
    - Edelman, Benjamin, Michael Ostrovsky, and Michael Schwarz. "Internet advertising and the generalized second-price auction: Selling billions of dollars worth of keywords." *American economic review* 97, no. 1 (2007): 242-259.

    - Muñoz-García, Félix. "An Introduction to Auction Theory for Undergraduate Students". Available: https://faculty.ses.wsu.edu/Munoz/Research/Auction_Theory_for_Undergrads_Sept_2012.pdf
    - This Wired article: *https://www.wired.com/2015/09/facebook-doesnt-make-much-money-couldon-purpose/*
  - *Optional Readings:*
    - Agarwal, Nikhil, Itai Ashlagi, Eduardo Azevedo, Clayton R. Featherstone, and Ömer Karaduman. "Market failure in kidney exchange." *American Economic Review* 109, no. 11 (2019): 4026-70.
    - Malmendier, Ulrike, and Young Han Lee. "The bidder's curse." *American Economic Review* 101, no. 2 (2011): 749-87.

  - *Assignment: Memo*

Applications and Technologies
- **2/13: Intangible capital and cloud computing***
  – *Required Readings:*
    - Brynjolfsson, Erik, Lorin M. Hitt, and Shinkyu Yang. "Intangible assets: Computers and organizational capital." *Brookings papers on economic activity* 2002, no. 1 (2002): 137-181.
    - Tambe, Prasanna, Lorin Hitt, Daniel Rock, and Erik Brynjolfsson. *Digital Capital and Superstar Firms*. No. w28285. National Bureau of Economic Research, 2020.
    - Ewens, Michael, Ramana Nanda, and Matthew Rhodes-Kropf. "Cost of experimentation and the evolution of venture capital." *Journal of Financial Economics* 128, no. 3 (2018): 422-442.
    - Jin, Wang, and Kristina McElheran. "Economies before scale: survival and performance of young plants in the age of cloud computing." *Rotman School of Management Working Paper* 3112901 (2017).

  – *Optional Readings:*
    - Hall, R. E., Cummins, J. G., & Lamont, O. A. (2000). E-capital: The link between the stock market and the labor market in the 1990s. *Brookings Papers on Economic Activity*, *2000*(2), 73-118.
    - Hall, Robert E. "The stock market and capital accumulation." *American Economic Review* 91, no. 5 (2001): 1185-1202.
    - Zolas, Nikolas, Zachary Kroff, Erik Brynjolfsson, Kristina McElheran, David N. Beede, Cathy Buffington, Nathan Goldschlag, Lucia Foster, and Emin Dinlersoz. *Advanced Technologies Adoption and Use by US Firms: Evidence from the Annual Business Survey*. No. w28290. National Bureau of Economic Research, 2020.

  – *Assignment: Memo*
- **2/15: Artificial Intelligence and automation***
  – *Required Readings:*
    - Brynjolfsson, Erik, Daniel Rock, and Chad Syverson. "Artificial intelligence and the modern productivity paradox: A clash of expectations and statistics." In *The economics of artificial intelligence: An agenda*, pp. 23-57. University of Chicago Press, 2018.
    - Agrawal, Ajay, Joshua S. Gans, and Avi Goldfarb. "Artificial intelligence: the ambiguous labor market impact of automating prediction." *Journal of Economic Perspectives* 33, no. 2 (2019): 31-50.
    - Brynjolfsson, Erik, and Andrew McAfee. "The business of artificial intelligence." *Harvard Business Review* (2017): 1-20.

  – *Optional Readings:*
    - Acemoglu, Daron, and Pascual Restrepo. "The race between man and machine: Implications of technology for growth, factor shares, and employment." *American Economic Review* 108, no. 6 (2018): 1488-1542.

- Brynjolfsson, Erik, Daniel Rock, and Chad Syverson. "The productivity J-curve: How intangibles complement general purpose technologies." *American Economic Journal: Macroeconomics* 13, no. 1 (2021): 333-72.
- Taddy, Matt. *The technological elements of artificial intelligence*. No. w24301. National Bureau of Economic Research, 2018.
- Autor, David H., Frank Levy, and Richard J. Murnane. "The skill content of recent technological change: An empirical exploration." *The Quarterly journal of economics* 118, no. 4 (2003): 1279-1333.

- – *Assignment: Memo*

- **2/20: Guest speaker***
  - – *Required Readings:* TBD
  - – *Optional Readings:* TBD
  Assignment: Information Economics Analytics Assignment due

- **2/22: The Future of Work**
  - – *Required Readings:*
    - Brynjolfsson, Erik, Tom Mitchell, and Daniel Rock. "What can machines learn, and what does it mean for occupations and the economy?." In *AEA Papers and Proceedings*, vol. 108, pp. 43-47. 2018.
    - Autor, David H. "Why are there still so many jobs? The history and future of workplace automation." *Journal of economic perspectives* 29, no. 3 (2015): 3-30.
    - Deming, David J. "The growing importance of social skills in the labor market." *The Quarterly Journal of Economics* 132, no. 4 (2017): 1593-1640.

  - – *Optional Readings:*
    - Frank, Morgan R., David Autor, James E. Bessen, Erik Brynjolfsson, Manuel Cebrian, David J. Deming, Maryann Feldman et al. "Toward understanding the impact of artificial intelligence on labor." *Proceedings of the National Academy of Sciences* 116, no. 14 (2019): 6531-6539.

    - Altman, Elizabeth J., Robin Jones, David Kiron, and Jeff Schwartz. "Driving the future of work with workforce ecosystems". *Deloitte Insights Report*. 2021. Link: https://www2.deloitte.com/us/en/insights/focus/technology-and-the-future-of-work/future-of-work-workforce-ecosystem.html
  - – *Assignment: Memo*

- **2/27: Macroeconomics and Technology**
  - – *Required Readings:* TBD
  - – *Optional Readings:* TBD
  - – *Assignment: TBD*

- **3/1: Project Proposal Day**
  - *Required Readings:* None
  - *Optional Readings:* None
  - *Assignment: Project Proposal Presentation and 2-page description due*

- **3/13: Tech Week Day 1: Python Basics**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **3/15: Tech Week Day 2: Scraping the Web**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **3/20: Guest Lecture (Zoom)**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **3/22: Statistical Learning 1: Machine Learning and Prediction**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **3/27: Business Impact of Machine Learning**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **3/29: Technology in Financial Markets**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **4/3: Digital Entrepreneurship**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **4/5: Statistical Learning 2: Causal Inference**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **4/10: Review Session for Exam**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: Analytics Assignment for Data Analysis due*

- **4/12: Expert Panel on Platforms and Data**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **4/17: Antitrust/Flex**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **4/19: Economics of Privacy/Flex**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **4/24: Final Project Presentations Day 1**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

- **4/26: Final Project Presentations Day 2**
  - *Required Readings:* TBD
  - *Optional Readings:* TBD
  - *Assignment: TBD*

*memo due