

Information and Communications Technology

Economics 3270, Spring 2026

Tuesday and Thursday, 2:45 – 4:00, Buttrick Hall 205

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Course Description

Advances in information and communications technology (ICT) have had a transformative effect on our society and economy. The first Internet browser was developed by Marc Andreessen of the NCSA (National Center for Supercomputing Applications) in 1993, and now cloud computing, social networks, ecommerce, streaming content, big data, analytics, informatics, VOIP, MMOG, universal wireless connectivity, and ubiquitous surveillance, are part of our daily lives.

Emerging technologies such as machine learning, artificial intelligence, the Internet of Things, blockchain, and quantum computing will have an enormous impact in the next several years. Economists are certainly aware of these innovations, but economic research in ICT is limited and scattered.

This course will survey what economics has to say about ICT and outline some of the open questions. Students should gain an understanding of how these technologies came into being, how they fit together, and where they might lead us in the future. My hope is that this course will give you knowledge and tools that will help you navigate a world where fundamental change occurs at an increasing rate in ways that are decreasingly possible to comprehend. Class participation will be emphasized.

Mechanics

I will expect you to do background reading on your own before class. ICT is an enormous and rapidly evolving topic. I also encourage you to do deep dives into topics that interest you using Wikipedia, search, YouTube videos, even books. Getting up to speed on a topic, and then keeping up, takes work, but is an important habit to get into. The only way to stay on top of technological change for either personal or professional reasons is to become an autodidact.

I will email you the problem sets, but please turn them in using Brightspace. The same goes for the project.

Exam and Due Date Schedule

Midterm: Wednesday, October 15, 2025, in class

Project: Wednesday, November 19, 2025

Final: Thursday, December 17, 2026 – 9:00am- 11:00am, in class

If you find that you will not be able to be present on any one of these three dates, please drop the class now and choose an alternative. Also see the course policies, below.

Grading Plan

25% Assignments: I will generate five mostly, two-page assignments, over the course of the semester. These will ask you to dive into some topic and learn as much as you can. The two-pagers should give a clear, succinct. summary of your findings and understandings. In general, references (mostly web-based) only need to be provided if especially relevant. A main objective of these exercises is to learn how to reduce a complex idea to its essentials and explain it clearly. If you can do this, you probably understand it yourself and can convey it to others. Assignments will be graded on a 100 point scale. The TA will base this on his subjective ranking of the assignments relative to one another. Also see the AI policy below.

5% Attendance: This is a capstone course that makes use of many of the tools and approaches you have learned in more foundational courses. We will be connecting these tool to technologies and institutions related to ICT. Much of this material will be new to you, and some of it is complex. Attendance is important both because it is difficult to master and contextualize these topics, and because discussion and questions are central to the learning process. I will ask you to sign in at the beginning of class. If there is a valid reason that you cannot attend, please send me an email before class.

20% Projects: Below are listed several projects that require hands-on interaction with technology. I Choose one, and actually complete the assignment in real-life. The point of these exercises is to gain a better understanding of how technologies, platforms, or ecosystems both enable and constrain us. We will schedule some out-of-class time for students who are working on the same project to show their results. Details to be determined. In addition, a three to five-page paper outlining what you did, how you did it, and what you learned is required. Grading is based on how complete and elegant your solutions are, how little they cost, and the quality of your paper.

25% Midterm: There will be one in class midterm. The point of this will be to test your understanding of the basic technologies, economics, and ideas covered in the class up to that point. Keeping up with the assigned readings, the lecture notes, and the discussion in class is all that you should need.

25% Final: The final is based on the same principles as the midterm and will be comprehensive.

Policies

Neither make-up exams, nor alternate final exams, will be offered: It is simply impossible to produce two exams of equal difficulty, and it is therefore not a fair procedure. If you find that you will not be able to be present on any one of the two exam dates above, please drop the class now and choose an alternative. In the event of a verified emergency as defined by the University rules, I will adjust the weights give above to compensate for the missing work to determine a final grade.

The TA will be in charge of grading the assignments and exams: If you have any questions regarding how an assignment or exam was scored, please start by talking to the TA. If you feel the TA is being unfair or unreasonable, come to me next. On the other hand, I will be grading the projects, so I should be your first stop for this.

Ask Me Anything: You are more than welcome to ask me anything. I encourage questions, and will answer them if I can. I don't know everything, however, and so I would also like to learn what you know, and what your perspectives are, on the subjects we cover. I probably will choose at few people at random to Tell Me Something related to the topics and readings if things get too quiet.

Questions about the course material, homework, or exams will not be answered via email: If you have a question, please ask it in class or in office hours. I have instructed the TA not to respond to emails asking questions that fall into this category. I have instructed myself to do likewise. On the other hand, if you have other questions or issues that relate to you personally, feel free to send an email, or talk to me after class.

Final Grades: Final grades are based on the weighted sum of the scores from assignments, attendance, projects, and exams. **Grading is on a curve rather than an absolute scale.** This means that a final score of 80% might give you a B+ and a 90% might give you a B-. Your grade depends on your ordinal rank compared to the rest of the class. I will ask the TA to report average scores and distributions so you will know your relative standing.

Grading Rubric The assignments, project, and many of the questions on the tests, tend to be more qualitative rather than quantitative. Good responses should be:

- Correct
- Clearly expressed
- Concise
- Reasonably complete
- Well-argued
- Insightful
- Use paragraphs with topic sentences.

and should not:

- Make incorrect or internally inconsistent statements
- Omit elements that are key to the question or problem

This creates an unavoidable subjective element to grading. **My instructions to the TA are that each such assignment and exam question starts with a score of 80%.** Points are added for elements that are better than the norm, and deducted for elements that are worse (and for omitted elements). The TA will only be able to determine what the norm is after reading what is turned in. I will also instruct the TA to establish a consistent approach, uniformly applied, once this norm is determined.

AI Policy: What to do? On the one hand, AI is unreliable. If you trust it to do your research, you will likely to develop a very skewed view of objective reality. If you allow it to do your writing and reading, your skill with language will atrophy. If you let it do your thinking, your ability to process, probe, and criticize, will similarly diminish.

On the other hand, the world, especially its technology, is changing far too fast for most humans to track, much less understand. If you don't understand the mechanics of your universe it may as well be magic. AI is good at integrating, summarizing, and explaining in simpler terms. It can be good at doing tasks that are tedious or repetitious, and may be better at doing things you are not well-practiced in, such as writing or addition.

In any event, AI is here to stay. It has had, and will continue to have, a profound effect on society, for better or for worse, no matter what we do. To ignore it would be foolish. The best defense is to master the skills needed to use AI effectively (which means better than most of the people around you). One of the chief goals of this course is help you use such tools with understanding and skepticism rather than awe and credulity.

That said, here is the policy:

- Take a first pass on doing the assignments without any AI assistance. Do old-fashioned web searches, find a YouTube, consult an expert, even read a book, if you happen to swing that way. Try to consult a variety of sources, and try to understand the biases and credibility of your sources.
- For all five, assignments include a short discussion of the advantages and disadvantages of each approach, whether you came to different conclusions, and any other differences that seem relevant.
- Write your own answers. Put the computer down. Turn away from the screen. Using only what is in your own brain after your research, write your answers without AI assistance. (Okay, you will probably have to go back to your computer to write your answers, but you get my point).
- Similar rules apply for the projects, but they are probably less relevant.
- **I will ask the TA to deduct as much as 10% if it seems that your answers are not human produced.** This is a subjective judgement, so your assignments should be intentionally composed and written so that it seems like a human wrote them. Note that this means that even if you did not use AI, but your answers seem like you did, you will be penalized. Part of the assignment is learning, and practicing, how to clearly signal that you are a human without being physically present. If you sound like a bot, you will find that your texts, emails, social media posts, job applications, and so on, are likely to be ignored, or even worse, filtered or suppressed by firewalls and AI algorithms. So, to be clear, being penalized is not an accusation that you used AI inappropriately, nor is the fact that you did not use AI a basis for an appeal.

Office Hours

Katherine Parslow: will be our TA. Office hours to be announced. (katherine.r.parslow@Vanderbilt.Edu).

John Conley: I will generally be available after shortly class. If you wish to see me, please send an email, or catch after class. I sometime have to schedule other things in this time slot, so if you need to see me, please tell me before showing up. My office is 414 Calhoun Hall.

Textbook

I have been written textbook entitled “[The Economics of Information and Communications Technology](#)”. The focus is to point the reader to the basic tools from different areas of economics that directly relate to the policy and social questions raised by specific aspects of ICT. It does not, however, attempt to give detailed economic analyses since this would essentially require explaining the whole corpus of the field. ICT touches on almost everything including game theory (especially), micro, macro, behavioral, network, and computational economics, industrial organization, finance, public economics, law and economics, business economics and even economic history. Instead, the objective is to provide a high level view of what economics has to say about ICT, and offer readers a structure to think about the issues and challenges that these transformative technologies pose for our society.

You will find a list of additional reading at the end of the syllabus. You will find these, as well as the textbook at:

<https://johnpconley.com/about/ict/>

Project Topics

Below is a let of potential project topics. I may add more as the semester goes on. Feel free to suggest your own project if you think you have something interesting.

- Get Ecosystem free – Find a way to get email, a calendar, a task list, web storage space, document sharing, search, maps, and other major cloud services you typically use without resorting to any Google, Microsoft, or Apple services. This means no Gmail, Google Docs, Microsoft 365 or anything in the Apple cloud. Outline how you put together alternative platforms such as Telegram, Discord, WhatsApp, and others to get the collection communication, collaboration, creation, and organization services that suit your needs. The services you find should be either free or low cost, as well as minimally invasive to your privacy.
- Jailbreak an Android, Apple, or Chrome OS device – These devices are all set up to keep you within the ecosystem that they establish. These systems steer you to the platform’s preferred providers of services, and prevent you from completely controlling the hardware that you own. More recently, platforms have actually started to prevent the placement of applications they find distasteful for various reasons in their official stores. Jailbreaking means establishing root control so that you can install any applications you want, and so break your device free of its native ecosystem.

- Install Linux – Install a version of Linux on a laptop, tablet, or desktop. You can either overwrite your existing OS or make a dual-boot machine, **but do not simply use a Virtual Machine for this project**. Ubuntu, Mint, and Debian are examples of distributions that are easy to work with. Make printers, scanners, webcams, and other peripheral you used before work with your Linux system, finding and installing drivers if needed. Find and install free and open source programs that allow you to do all the things you did with your original OS (word processing, email, cloud storage, watch or listen to media, play games, messaging, etc.) What is easier and what is more difficult? What things can't you do, and what things can you now that you could not with your original OS?
- Set up a Pixel phone with Graphine OS – What did you do? What problems did you encounter? Use the phone. Does it work as well as an Android or Apple phone? What privacy and security features do you gain?
- Anonymize yourself – Establish an anonymous web identity. Participate on Facebook and at least one other social network, get an email address that cannot be traced to you, be able to search and browse without leaving a trail to follow, and make a physical purchase on the web without it being connected to you any way.
- Micro-kernels and embedded systems – Get a Raspberry Pi, Arduino, or similar open source hardware platform up and running. Find a creative application, and get it running on your device.
- Hold cryptocurrency – Get an account on a centralized crypto exchange such as Coinbase. What sorts of KYC-AML did you go through, and how much personal information did you have to give up? Now buy some amount of a cryptocurrency of your choice. What were the transactions costs of acquiring your crypto-assets? Find a way to hold your assets using your own private key instead of letting the exchange keep them in a custodial account. Do it, and explain your method. Finally, find a way to use your assets to buy something or to provide some useful service. What did you do?
- Cloud Computing Platforms – Microsoft and Amazon, Google, and Microsoft are some of the biggest providers of generalized IaaS and PaaS. Adobe, Atlassian, Box, DocuSign, Dropbox, GitHub, Google Workspace, Intuit, MailChimp, Okta, Oracle, Salesforce, Shopify, Slack, Square, Survey Monkey, Twilio, Wordpress, Zoom, among others, provide SaaS of many types. Chose a project that needs a variety of different kinds of cloud services. This might be an idea for a startup or small business, a web app or web service, a front end for a club or organization site. a backend services for the same, or something to organize or improve your life or work.
 - Makes a chart of the cloud services you need and show how they must share information and fit together. What is the workflow, and what is the end goal or use case?
 - Find a set of cloud services from different providers that offer the services, at reasonable cost. Of course there are tradeoffs, some might be more expensive, but offer a service that is a better fit. Show how these services fit into your workflow. Do they work together and integrate easily? Is anything missing? is anything less than satisfactory?

- Go as far as you in actually getting your solution set up. Use free services, free trials, or cheaper alternatives where you can. How far did you get? What unexpected problems did you run into?

Reading list

These reading should be considered as background foundation. Read them with a view to understanding the recent history of ICT, and people were thinking about the problems in real-time. If you managed to read this far into the syllabus, wear something red on the first day of class.

Chapter 1: Introduction

Nothing.

Chapter 2: The History and Future of ICT

Michael Armbrust, Armando Fox, Rean Griffith, Anthony D. Joseph, Randy Katz, Andy Konwinski, Gunho Lee, David Patterson, Ariel Rabkin, Ion Stoica, and Matei Zaharia (2010) “[A View of Cloud Computing](#)”, Communications of the ACM, Vol. 53, pp. 50-58.

Ergin Bayrak, John P. Conley and Simon Wilkie (2011) “[The Economics of Cloud Computing](#)” *Korean Economic Review*, Vol. 27, pp. 203-230.

Jason Dedrick, Vijay Gurbaxani, and Kenneth L. Kraemer (2003) “[Information Technology and Economic Performance: A Critical Review of the Empirical Evidence](#)” *ACM Computing Surveys*, Vol. 35, No. 1, pp. 1-28.

Avi Goldfarb and Catherine Tucker (2019) “[Digital Economics](#)” *Journal of Economic Literature* Vol.57 pp. 3-43.

Hal Varian (2003) “[Economics of Information Technology](#)”, Working paper.

Simon Wilkie (2016) “[Economic Perspectives on the Digital Transformation](#)” Power Point Deck.

Chapter 3: Information Creation, Marketing, and Protection

John P. Conley and Fan-chin Kung (2010) “[Private Benefits, Warm Glow and Reputation in the Free and Open Source Software Production Model](#)” *Journal of Public Economic Theory*, (Special issue edited by Ted Bergstrom, Parkash Chander and Lise Vesterlund), Vol. 12, No. 4, pp. 665-689.

Georg von Krogh and Eric von Hippel (2003) “[Special issue on open source software development](#)” *Research Policy*, Vol. 32 pp. 1149-1157.

Josh Lerner and Jean Tirole (2005) “[The Economics of Technology Sharing: Open Source and Beyond](#)”, *Journal of Economic Perspectives*, Vol. 19, pp. 99-120.

Eric Raymond (2000) “[Homesteading the Noosphere](#)”, Working paper.

Eric Raymond (2000) “[The Cathedral and the Bazaar](#)”, Working paper.

Eric Raymond (2000), “[Revenge of the Hackers](#)”, Working paper.

Hal Varian (2005) “[Copying and Copyright](#)”, Working paper.

Chapter 4: Computers and Hardware

Rajeev Alur, Emery Berger, Ann W. Drobniś, Limor Fix, Kevin Fu, Gregory D. Hager, Daniel Lopresti, Klara Nahrstedt, Elizabeth Mynatt, Shwetak Patel, Jennifer Rexford, John A. Stankovic, and Benjamin Zorn (2016) “[Systems Computing Challenges in the Internet of Things](https://arxiv.org/abs/1604)” <https://arxiv.org/abs/1604>.

Mary Meeker (2017) “[Internet Trends 2017 – Code Conference](https://www.kpcb.com/internet-trends)” Slide Deck, [kpcb.com/InternetTrends](https://www.kpcb.com/internet-trends).

Joseph Y. Halpern and Rafael Pass (2015) “[Algorithmic Rationality: Game Theory with Costly Computation](#)” *Journal of Economic Theory* Vol 156, pp. 246-268.

Jeffrey MacKie-Mason and Hal Varian (2006) “[Some Economics of the Internet](#)”, Working paper.

Chapter 5: Networks and Infrastructure and Architecture

Mary Meeker (2017) “[Internet Trends 2017 – Code Conference](https://www.kpcb.com/internet-trends)” Slide Deck, [kpcb.com/InternetTrends](https://www.kpcb.com/internet-trends).

Picornell, Miguel, Tomás Ruiz, Maxime Lenormand, Jose Javier Ramasco, Thibaut Dubernet, and Enrique Frias-Martinez (2015) “[Exploring the potential of phone call data to characterize the relationship between social network and travel behavior](#)” *Transportation* Vol. 42, 42.10.1007/s11116-015-9594-1.

Chapter 6: Wireless, Wired and Spectrum Basics

Badr Benmammar and Francine Krief (2014) “[Game theory applications in wireless networks: A survey](#)” In *Proceedings of the 13th International Conference on Software Engineering, Parallel and Distributed Systems* (SEPADS’14), Gdansk, Poland, 15–17 May 2014; pp. 15–17.

John P. Conley, (2019) “[Economic Implications of New Technologies for Licensed and Unlicensed Spectrum](#)”, *Vanderbilt University Department of Economics Working Papers*, VUECON-19-00011.

[Ericsson Mobility Report](https://www.ericsson.com/4adc87/assets/local/mobility-report/documents/2020/november-2020-ericsson-mobility-report.pdf) (2020) <https://www.ericsson.com/4adc87/assets/local/mobility-report/documents/2020/november-2020-ericsson-mobility-report.pdf>

Paul Milgrom, Jonathan Levin and Assaf Eilat (2011) “[The Case for Unlicensed Spectrum](#)” Discussion papers, Stanford Institute for Economic Policy Research.

Richard Thanki (2009) “[The Economic Value Generated by Current and Future Allocations of Unlicensed Spectrum](#)” Perspective Associates, <http://apps.fcc.gov/ecfs/document/view?id=7020039036>.

Chapter 7: Systems Software

Nothing.

Chapter 8: Encoding, Encrypting, Hashing, and Security Protocols

John P. Conley, (2019) “[Encryption, Hashing, PPK, and Blockchain: A Simple Introduction](#)”, *Vanderbilt University Department of Economics Working Papers*, VUECON-19-00013.

Chapter 9: Authentication

Christian Rathgeb and Andreas Uhl (2011) “A Survey on Biometric Cryptosystems and Cancelable Biometrics” *EURASIP Journal on Information Security*, Vol 2011, Article number: 3.

Chapter 10: Banking and Credit

Nothing.

Chapter 11: Blockchain Basics

John P. Conley (2019) “[Proof of Honesty: Coalition-Proof Blockchain Validation without Proof of Work or Stake](#)”.

Yossi Gilad, Rotem Hemo, Silvio Micali, Georgios Vlachos, Nickolai Zeldovich (2017) “[Algorand: Scaling byzantine agreements for cryptocurrencies](#)” in Proc. 26th ACM Symp. Operating Syst. Principles, pp. 51–68.

D. Mazières (2016) “[The Stellar Consensus Protocol: A Federated Model for Internet-level Consensus](#)” White Paper, <https://www.stellar.org/papers/stellar-consensus-protocol.pdf>.

Chapter 12: Blockchain, Game Theory, and Incentives

Joseph Abadi and Markus Brunnermeier (2018) “[Blockchain Economics](#)” Working paper.

Primavera De Filippi and Benjamin Loveluck, B. (2016) “[The invisible politics of Bitcoin: governance crisis of a decentralised infrastructure](#)” Internet Policy Review, 5(3). DOI: 10.14763/2016.3.427.

Ittay Eyal and Emin Gün Sirer (2014) “[Majority is not enough: Bitcoin mining is vulnerable](#)” Financial Cryptography and Data Security 18th International Conference, FC 2014, pp. 436–454.

Houy, Nicolas (2014) “[It will cost you nothing to “kill” a proof-of-stake crypto-currency](#)” Economics Bulletin, Vol. 34, pp. 1038-1044.

Aggelos Kiayias, Elias Koutsoupias, Maria Kyropoulou, and Yiannis Tselekounis (2016) “[Blockchain Mining Games](#)” eprint arXiv:1607.02420.

Yuan Liu and Chunyan Miao (2016) “[A Survey of Incentives and Mechanism Design for Human Computation Systems](#)” eprint arXiv:1602.03277.

Chapter 13: Cryptocurrency and Monetary Theory

John P. Conley, (2017) “[Blockchain and the Economics of Crypto-tokens and Initial Coin Offerings](#)”, *Vanderbilt University Department of Economics Working Papers*, VUECON-17-00008.

John P. Conley, (2019) “[Blockchain as a Decentralized Mechanism for Financial Inclusion and Economic Mobility](#)”, *Vanderbilt University Department of Economics Working Papers*, VUECON-19-00012.

Chapter 14: Security and Privacy

Nothing.