General Course Information:

ELEN E6767x or y: INTERNET ECONOMICS, ENGINEERING AND THE IMPLICATIONS FOR SOCIETY

Instructor Information

Debasis Mitra
Senior Research Scientist and Adjunct Professor
Department of Electrical Engineering
http://www.ee.columbia.edu/debasis-mitra
email: debasismitra@columbia.edu

Prerequisites

Recommended preparation: CSEE W4119 or E6761, ability to comprehend and track the development of sophisticated mathematical models and analyses of economic and network interdependencies in the Internet and industry. Knowledge of basic microeconomics and communication network engineering, including models, their analyses and optimizations. Interest in the economics of markets, applications of economic principles in policy and regulations for the Internet, environment and industry, and their societal impact.

Course Description

The Internet has become an integral part of modern life and also an essential enabler of technological innovations. Its future is the subject of intense public interest, e.g., Net Neutrality, in which engineering and economics are intertwined. The goal of the course is to obtain a fundamental understanding of major issues involving the Internet, and also related societal topics, by combining knowledge of economics, networking, and industry structure. Course topics include pricing for various models of the communication industry, market structures in which subscribers, bandwidth providers and content providers are players, network engineering, regulation and also longer-term issues, such as investments in the infrastructure of the future Internet. Mathematical models and their analyses are basic tools. Future research directions and open problems are highlighted.

The course starts with basic microeconomics of pricing, market structures, i.e., competitive, duopoly and monopoly, social welfare maximization and the theory underlying regulations of large firms with special attention to the Internet. This is followed by game theory concepts, revenue allocations in network coalitions, ISP settlements, network externalities, two-sided markets, i.e., platform economics, and their ubiquitous role enabled by the Internet. Also covered are economic principles in networking and network design, decentralized vs. centralized resource allocation, “price of anarchy”, “tragedy of the commons”, and congestion control. The methodologies developed are also explored for application in environmental protection and the deregulated electric power industry. Students do projects researching and applying concepts learnt in the course to topical issues, such as the regulation of Big Tech, privacy protection and the societal impact of automation. A review of approaches taken by governments and regulators around the world concludes the course.
Course requirements: Two papers; project with oral presentation; homework

Approximate schedule:
Weeks 1-3: Basic Economics, including Pricing, Fairness, Efficiency, and Stability; Market Models; Natural Monopoly and Regulation
Weeks 4 - 6: Internet - Fundamental Models, Relations and Structures: Network Externalities; Two-Sided (Platform) Market Economics
Weeks 7-8: Applications of Economic Principles in Networking (e.g., Coalitions, Core of the Game, Shapley Value, Routing), Environmental Policy, Deregulation in Electric Power Industry
Week 9-10: Students’ presentations on projects
Week 11: Topics in Economic Principles in Internet Engineering (e.g., Content Delivery)
Week 12: Societal, Industry and Network Issues in Net Neutrality
Week 13: Approaches to Internet Governance from around the world

Grading policy:
10% active participation
20% homework
20% mid-term paper
25% project and oral presentation
25% final exam paper
For CVN students, the “active participation” component is eliminated, and its percentage is distributed equally over the remaining components.

Reading:

Basic Communication Network Economics, Pricing & Regulation

Review of basic economic concepts: utility, demand, consumer’s surplus, social welfare, monopoly behavior, price discrimination


Impact of Monopolies and Regulations


Network Coalitions, Cooperation and Revenue-Sharing Concepts from Game Theory

M.O. Jackson, “Allocating the Value”, Sec 12.1.2 in “Social and Economic Networks”, Princeton University Press


Internet Models: Network Externalities, Two-Sided Markets


M. Armstrong, “Competition in Two-Sided Markets”, May 2005


Economic Principles in Networking, Environmental Policy, Power Industry, the Internet


D. Autor, “Externalities, the Coase Theorem and Market Remedies”, MIT, 2010


D. Mitra and A. Sridhar, ”Consortiums of ISP-Content Providers Formed by Nash Bargaining for Internet Content Delivery”, Proc. IEEE INFOCOM 2019

Projects Concerning Society and the Internet

(i) Is wealth inequality a grave social problem, and, if so, what remedial actions should be taken?
(ii) Is the impact on society and the workforce of automation and AI going to be severe, and, if so, what action should be taken in the short and long terms?

(iii) Should the balance of environment protection be tilted more towards market-based mechanisms or by rules and regulations set by Congress and government agencies?

(iv) Do anti-trust laws and regulations need to be updated to address societal interests with the growth of Big Tech?

(v) Do the nation’s laws governing social media require updating?

(vi) As AI and Big Data become more prevalent in society, should the ethics of AI theory and practice be examined more closely, and, if so, where should the priorities lie?

Societal, Industry and Network Issues in Network Neutrality


Industry Structure, Approaches from Around the World

“Next Generation Connectivity: A review of broadband Internet transitions and policy from around the world”, Berkman Center, Harvard University, Feb 2010


Stokab, “Stockholm IT-Infrastructure”, 2012
Singapore: IDA Fact Sheet Next Generation Nationwide Broadband Network (June 2012)  