Sabancı Üniversitesi

Faculty of Eng. & Natural Sci.

EE554-202102

Networking - Theory and Fundamentals

Instructor(s)

Name	Email	Office	Phone	Web	Office Hours
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https://sabanciuniv.zoom.us/j/98088893121?pwd=TnhuWVI5YWdHOFRQWk9FUnoyRytRdz09

Course Content

The course introduces analytical models and methodologies for modern networking, with focus on congestion control and routing. Topics from queueing theory, optimization, graph theory, distributed and asynchronous algorithms and their application to networking will be studied.

Objectives

As networking systems such as the Internet, wireless and mobile networks are becoming increasingly versatile and complex, mathematical methods for modeling, analysis, and design of computer networks and their protocols have become important. A wide variety of mathematical tools and techniques drawn from the areas of convex optimization, stochastic modeling, and control theory help to unify and to understand the key concepts of protocol design for optimum performance in computer networks. Concern for optimal operation of networks is quite often of crucial importance in protocol design due to the scarcity of resources such as wireless spectrum and battery lifetime.

In this course, some of the major mathematical concepts and techniques underlying modern network design are described in the setting of concrete examples drawn from network design problems such as congestion control, wireless scheduling, and multi-access protocols. The significance of these concepts and tools goes far beyond the setting of the specific examples in which they are presented. As the mathematical topics we use here are quite vast and varied fields by themselves, we focus on how these different tools are often brought together to provide an understanding of the given problem in network design. We do not develop the mathematics beyond what is necessary to understand the networking examples we consider.

Recommend or Required Reading

Textbook

Bertsekas, Gallager, Data Networks

Readings

Papers from the literature will be distributed.

Assessment Methods and Criteria

	Percentage(%)	Number of assessment methods
Final	30	
Midterm	30	1
Exam		0
Term-Paper	10	1
Participation	5	
Presentation	25	1

Course Outline

PART I:
Week 1: Markov chains
Week 2: Queuing theory
Week 3: Queuing theory and medium access control
Week 4: Random access
Week 5: Random access and network utility maximization
Week 6: Network utility maximization
PART II:
Week 7-8: Economic Modeling in Networking
Week 9-10: Age of Information
Week 11-12: Modern Random Access Protocols
Week 13-14: Online Learning Methods for Networking

Course Policies

Active participation in every lecture is required. Hence, if you cannot be in the classroom, I expect you to TURN ON your camera and microphone at all times.

The course consists of two parts. In the first part of the course, I will be teaching fundamental topics necessary to understand, design, and analyze communication networks. These topics include queuing theory with special emphasis on understanding and modeling with Markov chains; medium access with an emphasis on random access; and dynamic control of networks with (in)famous network utility maximization formulation. After these fundamentals, in the second part of the course, the instruction will be given by the students. Each student (1 or 2 depending on the number of registered students) will be responsible for 1.5-2 weeks of lecture material. The lecture materials are available on Sucourse; however, you have to present the material as clearly as possible to your fellow students. You will present it not by PowerPoint but by writing it on Whiteboard. This requires a significant amount of thinking and work on your part, so a major portion of your final letter grade will be from your presentation. You will also prepare EXAM questions from your lectures and I may use them in the final. The midterm exam will be from the first part, and the final exam will be from the second part of the course.

The term paper will be an original paper written by you with mathematical and numerical analysis of a certain problem you will choose with my guidance. It will be in IEEE double-column conference format and its length will be 4 pages. Those who can prepare and submit their paper to a conference will be getting one letter grade up. Otherwise, its percentage is 10%.