Recent Announcements

Deadline extension for homework 3

(https://canvas.cornell.edu/courses/63188/discussion_topics/724066)

Dear all,I have decided to extend the deadline for homework 3 to Monday 25 at 9pm. Thank you,Francesca

Posted on:

Mar 22, 2024, 3:58 PM

ECE 4210 COMBINED-COMEET Network Systems and Games (2024SP)

Logistics

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Class Meeting Times: MW 2:55-4:10pm
Classroom: Upson Hall 206

Course Description

Network systems pervade our society in both social and technological contexts. On the one hand, social networks play a central role in the transmission of information or viruses with fundamental consequences for team communication, product marketing, technology adoption, voting decisions, spread of false news and epidemiology. On the other hand, network topology fundamentally affects the performance and resilience properties of large-scale multi-agent systems, such as the power grid, the internet of things, traffic and robotic sensor networks.

This course will provide the necessary mathematical and modeling tools needed to describe and understand these network systems. Questions of interest will be how the network structure impacts the dynamics of network systems, how network properties can be exploited to maximize system performance or resilience and how one can address these questions while also accounting for strategic human behavior. The course will introduce tools that can be used to address these questions and successfully overcome challenges related to the coupled, distributed, and large-scale nature of network systems in environments with limited sensing, communication, and control capabilities.

Course Objectives

This course is composed by 5 modules. The first module introduces concepts from linear algebra, graph theory and stability theory that will be needed throughout the course. The next four modules will cover: (i) network data and centrality measures, (ii) linear dynamics over networks with emphasis on averaging algorithms, (iii) nonlinear dynamics over networks with emphasis on compartmental and epidemic models, (iv) game theory and applications to network games with emphasis on traffic, power and marketing applications. The course draws on studies by economists, mathematicians, computer scientists and engineers. Classic results will be complemented with current research outlooks.

At the end of this course the student will have learned:
• the theory of graphs (with emphasis on algebraic and spectral graph theory);
• data analysis, network properties and centrality measures, with application to web-search algorithms and graph neural networks;
• basic models and stability properties of multi-agent dynamical systems;
• distributed averaging algorithms (with applications to team dynamics, social influence, wireless sensor networks, robotic coordination, optimal sensor placement, electric networks;
• epidemic models and network contagion, stochastic simulations;
• models of strategic behavior (game theory) and decision-making principles with application to traffic and power networks;
• network games and targeted interventions with application to marketing and economic systems;
• applications in social and economic networks, sensor and robotic networks, electric power grid, supply chains and traffic networks.

Prerequisites

MATH 2930, MATH 2940 or permission of instructor.
Recommended: good background in linear algebra. ECE 3250 encouraged. Additionally, students should be comfortable with some mathematical rigor and mathematical proofs. Beyond these concepts, the course will be self-contained. In case of doubt, please contact me.

Text and Materials/Course Reading

The class will be mainly based on lecture notes.

Additional (optional) references are:
B18: Francesco Bullo, Lectures on network systems, CreateSpace, 2019.
(Available online at: http://motion.me.ucsb.edu/book-lns/)
H17: Joao P. Hespanha, Noncooperative Game Theory: An Introduction for Engineers and Computer, Scientists, Princeton, 2017
BT89: Dimitri P. Bertsekas and John N. Tsitsiklis, Parallel and Distributed Computation: Numerical Methods, Prentice hall Englewood Cliffs, 1989
J08: Matthew O. Jackson, Social and Economic Networks, Princeton University Press, 2008 FP07: Francisco Facchinei and Jong-Shi Pang, Finite-dimensional variational inequalities and complementarity problems, Springer Science & Business Media, 2007
EK10: David Easley and Jon Kleinberg, Network, Crowds and Markets, Cambridge University Press, 2010 Connection to recent journal publications will also be provided.

Assignments

There will be 5 homeworks (approximately due on friday every two weeks up to week 11). Each homework contains a list of problems with associated points. This class co-meets with ECE4210/ECE5210/ECE7210/SYSEN5420. Depending on the class you enroll (ECE4210/ECE5210/ECE7210/SYSEN5420) the number and type of problems you need to solve in each homework will be different. Specifically:

• ECE4210: must solve any desired combination of problems to gain 12 points

• ECE5210/SYSEN5210: must solve any combination of problems to gain 15 points

• ECE7210: must solve all and only the problems marked as required for ECE7210 (total of 15 points).

NOTE: Problems marked as advanced are considerably harder and time consuming than standard problems, often requiring new proofs and derivations. This option is recommended to PhD students only.

Final

This class co-meets with ECE4210/ECE5210/ECE7210/SYSEN5420. Depending on the class you enroll (ECE4210/ECE5210/ECE7210/SYSEN5420) the final will take a different form.

Specifically,

• ECE4210/ECE5210 and SYSEN5210: will take part in a final written exam.

• Students enrolled in ECE7210 have the option of substituting the final exam with a final research-oriented project. This project will require a final report and will be presented to the class in the last lectures of the course.

NOTE: The option of a final project instead of a final exam is not available for students enrolled in ECE4210/ECE5210 and SYSEN5420, no exception will be made.

Grading Policies

Homeworks: There are 5 problem sets for the semester. These should be submitted on Canvas and are due as indicated in the course schedule. The lowest grade of the 5 homeworks will not count towards the final grade.

Homeworks: 60% Final: 40%

Course Expectations

Personal Conduct

Students are expected to be respectful and professional in all participation and communication. You are expected to maintain professional conduct and speech in all aspects of this course. Professional behavior demands you have a responsible and mature attitude in person and online. Disrespectful, unethical, and/or unprofessional behaviors will not be tolerated and can result in course failure.

Class Participation

Class participation: Students are expected to actively participate in class, including answering questions to gauge learning during lecture.

Attendance Policy

Life happens policy: In case of a legitimate situation or emergency that arises during the semester that is going to hinder your ability to complete work on time, consult with me as soon as possible to find a solution.

Academic Standards

Each student is expected to abide by the Cornell University Code of Academic Integrity (https://theuniversityfaculty.cornell.edu/dean/academic-integrity/code-of-academic-integrity/). Work submitted by students for academic credit must be a student's own. For homework assignments, students are encouraged to help one another to understand the material and to develop solution strategies; with that strategy, each student should work out their own solution.

Violations of the Code of Academic Integrity, especially plagiarism, may result in a failing grade in the course.

Students are urged to read and complete the exercises on "Recognizing and Avoiding Plagiarism" at: https://plagiarism.arts.cornell.edu/tutorial/index.cfm

By registering for this class and accessing course materials through Canvas, students agree to abide by University, College, Department, and Course policies.

Inclusive Learning Environment

Cornell supports an inclusive learning environment where diversity and individual differences are understood, respected, appreciated, and recognized as a source of strength. It is expected that students in this class will respect differences and demonstrate diligence in understanding how other peoples' perspectives, behaviors, and worldviews may be different from their own.

Accommodations for Students With Disabilities

Cornell University is committed to full inclusion for all persons to its educational program and services. Services and reasonable accommodations are available to persons with temporary and permanent disabilities when conditions cause barriers to equal educational opportunity. Student Disability Services (SDS) determines the eligibility of students to receive accommodations and works collaboratively with the student and university faculty and staff to recommend appropriate accommodations. Students are advised to contact SDS as early as possible in the semester to ensure appropriate accommodations: www.sds.cornell.edu.