ECE519 - Network Centric Systems
3-credits (2 hrs of lectures and 3 hrs of lab)
Spring 2024 (Also offered as an on-line course)

Prerequisites: MATH 369 or ECE/STAT 303 or ECE421 or ECE 456 (or equivalent), and Programming expertise (in any language, e.g., CS165)

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Objectives:

Networks are central to many natural systems and are at the core of complex man-made systems. What are the features of different network types? How can the networks be represented? How do underlying characteristics influence network-based systems? How do communities arise in social networks? What parameters influence the growth and characteristics of networks? What are the principles of network based system design? How to extract network topology from limited measurements? What machine learning techniques can be used for data in the form of or are distributed in networks? These are some of the questions we plan to address. This course provides an overview of principles of network centric systems, and introduces techniques for modeling and analysis of large-scale networks as well as processes that evolve on such networks. Case studies ranging from social networks to communications networks will be used to illustrate network modeling, controlling the evolution of network structures, influence propagation and network analytics. Also considered will be policy and societal implications of modern network centric systems.

Topics:

Network Science
- Network/graph representation and modeling
- Centrality measures and network decomposition
- Network types (small-world, scale-free, multilayer, etc.)
- Influence spread and diffusion over networks
- Distributed pattern detection and prediction
- Tools (e.g., graph neural networks, graph databases, visualization)

Network System Case Studies
- End-to-end vs. centralized designs
- IoT and the Internet
- Network attacks, defense mechanisms and resilience
- Peer-to-peer networks & distributed hash tables
- Distributed ledgers and Blockchain
- Mining social networks
- Selected examples (from Biology, Ecology, Economics, Epidemiology, etc.)

A subset of the topics listed above will be covered depending on time and student interest.

Text: There is no required text book for the course. Online reference material available via Canvas includes: Selected conference and journal papers, and Network Science by A.L. Barabasi. You also have access multiple sources such as IEEE Xplore and ACM Digital Library using your CSU login

Grading:

Labs/Project	– 40%
Assignments	- 10%
Class Presentation	– 25%
Minute Papers	– 15%
Participation	– 10%

- You are encouraged to use generative AI tools to help with programing required for the lab assignments. It is acceptable to do the assignments in C. C++, Java, Perl, Python or another language or a package.
- There will be several homework and reading assignments. Only selected assignments and problems will be graded. Graded problems may vary from student to student.
- Each student/group is encouraged to do a creative project. A short (~10 min) presentation is expected once the project is identified. A final report and a ~20-30 min presentation is required.
- The lectures will be a mix of instructor led and student led presentations on selected topics. Each student is required to make one 70-minute or two 35-minute presentation on a pre-approved course-related topic.
- A minute paper is a short write-up (typically 300 to 500 words) about a lecture and address questions such as: What are the most significant things you learned in the lecture? Why is it significant? What question is uppermost in your mind at the end of the lecture? Be creative!! Since each minute paper is based on a lecture, you must not submit one for a lecture that you did not attend. The minute paper for a given lecture must be submitted prior to the next lecture. Follow the link from course web page to submit minute papers.
- Active participation in class and contributing to discussions will be rewarded. On-campus students are expected to actively participate in the class and contribute to discussions. Participation of on-line students will be evaluated based on their activity in Canvas discussion forums and interaction with the instructor and other students on subject matter.

Academic Integrity: This course will adhere to the CSU Academic Integrity Policy in the General Catalog (http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity) and the Student Conduct Code (https://resolutioncenter.colostate.edu/conduct-code/). At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.