

Fall 2017

Network Resilience

Course number: CSCI 4977/6962

Instructor: Jianxi Gao

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Textbooks:

1. Network Science, Albert-László Barabási
2. Complex Networks: Structure, Robustness and Function, Reuven Cohen and Shlomo Havlin
3. Introduction to network of networks, Jianxi Gao, Amir Bashan, Shlomo Havlin
4. Control of complex systems: structural constraints and uncertainty, Aleksandar I. Zecevic and Dragoslav D. Siljak

Course description

This course is an interdisciplinary introduction to network resilience and its applications in both science and engineering. Classes will interchangeably present the chapters from these textbooks with emphasis on the current active research related to network resilience, robustness, stability, and control. Topics to be covered include the network theory, dynamical systems, data analysis, and applications to biology, ecology, sociology, technology, and other fields. Students will learn about the ongoing research in the field, and ultimately apply their knowledge to conduct their own analysis of a real network data set of their choosing as part of the final project.

Prerequisites

Junior or senior level standing; some familiarity with probability, linear algebra, and calculus; or permission of the instructor.

Course Content

- Basic conception of single networks
- From single networks to networks of networks
- Robustness of networks of networks
- Dynamical systems, examples from different fields
- Multi-agent systems,
- Network stability,
- Network control

Evaluation and grading

- 1) Homework: 45%
- 2) Intermediate project progress presentation: 10%
- 3) Final project presentation: 35%
- 4) Class attendance and participation: 10%

Student Learning Outcomes

1. Understand the structures and dynamics of networked systems;
2. Apply the concept of network of networks to real systems in different fields;
3. Build the computer programming skills for network analysis and network visualization;
4. Cultivate the resilience thinking: new approaches to manage risks in a complex world.
5. Read, analyze, and critique published literature in the field of network science and dynamical systems

Course Assessment Measures

- (1) Final project assignment: students will collect data representing a real complex networked system and analyze the structural or dynamical resilience of it using the computational tools introduced in class.
- (2) Homework assignments.
- (3) Contributions to in-class discussions.

Academic Integrity

Student-teacher relationships are built on trust. For example, students must trust that teachers have made appropriate decisions about the structure and content of the courses they teach, and teachers must trust that the assignments that students turn in are their own. Acts, which violate this trust, undermine the educational process. The Rensselaer Handbook of Student Rights and Responsibilities defines various forms of Academic Dishonesty and all students should make themselves familiar with these.

In this class, all assignments that are turned in for a grade must represent the student's own work. Submission of any assignment that is in violation of this policy will result in a penalty of 0 points for assignment and failing of the course in case of repetition.

If you have any question concerning this policy, please ask for clarification before preparing or submitting an assignment.

The penalty for not adhering to these academic integrity rules is a failing grade for the assignment on the first offense, then failing the course and potential disciplinary actions by the Institute on any subsequent offenses.

Changes to syllabus and student responsibilities

The instructor reserves the right to modify this syllabus as deemed necessary any time during the semester. Emendations to the syllabus will be discussed with students during a class period. Students are responsible for information given in class. There may be also details about this course not covered in this syllabus.

Do not assume something just because it is not specified in the syllabus. If you are unsure about anything related to the rules guiding this course, consult with the instructor.