Fall 2020
Network Resilience
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. https://arxiv.org/abs/2007.14464

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 an emphasis on the current active research papers 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 area and ultimately apply their knowledge to conduct their 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
- Introduction to network science
- Graph theory
- Random networks
- Scale-free networks
- Network Robustness
- Network control
- Dynamical systems
- Engineering resilience,
- System resilience
- Network stability

Evaluation and grading
1) Homework: 20%
2) Intermediate project progress presentation: 25%

3) A midterm exam 10%
4) Final project presentation: 35%
5) In class quizzes: 10%

The progress presentations will be graded 0 or 1 (progress made, and effectively communicated). To get an A you need 95%, A– you need 90%, B+ you need 85%, etc.

Student Learning Outcomes

1. Understand the structures and dynamics of networked systems;
2. Apply the concept of network resilience 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.

COVID-19 Guidelines (For In-Person Interactions)

Students taking Computer Science classes are required to abide by the **COVID-19 code of conduct** below. This code will apply to any class that meets fully or partially in an on-campus physical classroom for in-person instruction.
Violations: Refusal to comply with the COVID-19 code of conduct will be treated just as any classroom disruption, which will receive a request for immediate compliance, failing

which the student will be asked to leave the classroom. Any further noncompliance will result in the dismissal of the entire class. All Covid-19 related violations will be reported by the instructor to the Compliance Officer at the School of Science and the Dean of Students. A student found to be in violation of the code, or required repeated reminders for compliance, will be asked to participate in all classes remotely. This is to protect their health and safety as well as the health and safety of their classmates, instructor, and the university community.

Masks: All students must wear a mask in classrooms and all public places, including anywhere inside the classroom building. Masks will be provided to the student by the Institute.

Traffic Flow and Social Distancing: Students and faculty will respect the need for social distancing. They are required to follow the traffic flow arrows posted in all rooms and buildings, including bathrooms and common areas.

In-Class Seating: Students should sit in the appropriate designated seating in the classroom. Students are not allowed to move furniture or sit in seats not designated by the Institute.

Student Health: Students who are ill, under quarantine for COVID-19, or suspect they are ill will report that to Student Life. Student Life will verify and notify all faculty who have that student. Once notification is made, all faculty will make every reasonable effort to accommodate the student's absence and will communicate that accommodation directly to the student. Failure to make an appropriate accommodation for a verified or reasonably suspected case of illness may be appealable under the student grade appeal process. Students who need to report an illness should contact the Student Health Center via email or call 518-276-6287. For student seen off campus, a student may request an excused absence via www.bit.ly/rpiabsence with an uploaded doctor's note that excuses them.

Refusal: Refusal to comply with any appropriate request will be treated as would any classroom disruption and disciplinary actions and sanctions will be taken through our judicial process in the Student Handbook (request to change the behavior; request to leave the class; dismissal of the class and referral to Student Life and the Dean of Students.)

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.