

Syllabus - Fall2021

Course CSCI-6250/4250 4cr: Frontier of Network Science

Monday - Thursday 12:00-13:40, classroom TBA

Office Hours: Monday 15:00 – 16:00, Wednesday 13:00 – 14:00 MRC335A

Class Web site

<http://www.cs.rpi.edu/~szymansk/fns.21/index.php>

Instructor

Prof. Boleslaw K. Szymanski, e-mail: szymansk@cs.rpi.edu

Textbooks

Albert Laszlo Barabasi *Network Science*,

Cambridge University Press, 2016

On-line version is available at <http://barabasi.com/networksciencebook/>

In addition, class notes will be used.

Course Description

This course offers an introduction to Network Science and a review of current research in this field. Classes will interchangeably present chapters from the textbook and the related current research. The emphasis will be on mathematical background of network science: graphs and networks; random networks and various types of scale-free networks; and on network properties such as assortativity, mobility, and robustness; social networks and communities; and dynamics of processes on networks.

Prerequisites

CSCI-2300; a 4000 level algorithms-based CSCI (e.g. 4020, 4050, 4260, 4800), or MATH (4100, 4150, 4200, 4210, 4800) course; junior or senior level standing; some familiarity with probability theory, linear algebra, and calculus; or permission of the instructor.

Course Content

- Mathematical background of network science: graphs and networks.
- Random networks and their properties.
- Scale-free networks, small world networks and Barabasi-Albert model.
- Mobility and networks
- Network robustness
- Social networks and communities
- Assortativity of networks
- Dynamic processes

Grading Criteria

Undergraduates: One individual programming homework (40% of the total grade), followed by **one individual presentation** of the selected research paper (50% of the total grade), with questions and participation in discussions for at least two student presentations will providing the remaining (10%) of the total grade.

The programming homework will be handed out approximately after the end of the 4th week, and due in three weeks after that. The homework will require using network analysis tools (or programming) and analysis of the results obtained for the real and synthetic networks. The graded homework will be returned to undergraduates approximately one week after they are handed in. Students will have these grades as their means to determine progress in the course by mid-semester.

The research paper to be presented will be assigned in the 7th week of the course, and the 15 min discussion of the plans for presentation will be due for one of the classes in the 8th week. The final 30 min in class presentation the assigned paper will be scheduled in the last two weeks of the class.

Graduates: Students will choose a topic for research and presentation either from the list of topics associated with textbook or seminal papers, or from their own current work, if approved by the instructor. Around 4th week of the course, the research plan will be due of 3-5 pages defining project part of presentation, and short presentation (20 min) on the material on which research will be based (40%), and the 45 min presentation will be due in November/December time frame (50%). The remaining 10% of the grade will be assigned based on participation in discussions of the presentations.

Grade ranges: A 96, A- 91, B 85, B- 80, C 70, C- 60, F <60.

Student Learning Outcomes

Upon completion of this course, all students will be able to:

1. Apply fundamental network science ideas to create models and understand dynamics of networked systems;
2. Compare, contrast, and describe the similarities and differences of different kinds of networks and processes modeled on networks;
3. Critique the strengths and weaknesses of each of the models and types of networks based on them and these network types performance in diverse network science applications;
4. Understand the principles of applying network science to disciplinary science and design and set up basic models for some specific applications.

Additionally, graduate students will also be able to:

5. Read, analyze, and critique published literature in the field of network science and social networks;
6. Assess novelty of network science research and its relation to the state of the art in the field.

Course Assessment Measures

Undergraduates: The students' performance will be measured using four different methods listed below.

- (i) Programming homework
- (ii) Selection of a current research paper for presentation and its evaluation plan
- (iii) Presentation on the selected paper, including slides content, and evaluation of its scientific results
- (iv) Contributions to in-class discussions

The programming homework and presentation plans will measure the student's ability to apply concepts of network science to networks analysis.

The presentation slides and evaluation of the paper results will measure student's ability to prepare summary material based on fundamental scientific concepts and basic research.

Graduates: An individual presentation on planning the discussion of the paper and experiments to test methods and results of the paper (35% of the total grade). This will be followed by an individual presentation of the selected research paper and results of the test experiments (55% of the total grade), with questions and active participation in discussions for at least two student presentations will providing the remaining (10%) of the total grade.

The research papers for presentations will be listed after the second lecture and the choice of one of them has to be made two weeks later. The 20 min presentations of the plans will be scheduled for lecture 13 on October 14. The final 45 min in class presentation of the assigned papers and related experiments will be scheduled in the last five weeks of the classes.

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 forms to avoid them.

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 or making a presentation.

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.

Attendance Policy:

Attendance in classes is in general not required but it is recommended because the material presented in classes includes topics beyond the textbook. However, the attendance and active participation is required in at least two research presentations with active participation is needed to receive score for active participation.

Missed deadline for homework, unless justified by medical or personal reasons and approved by instructor, will lower the achieved score by 10% for each week of delay.

Presentations can be rescheduled but only in emergencies.