Instructor: Dr. Ilya Safro, isafro@udel.edu

TA: TBD

Office Hours: Thursdays 11:00am-12:00pm or by appointment. Always request an appointment in Slack, and you will get Zoom link for it.

Recommended Textbook: M. Newman "Networks: An Introduction"

Prerequisites: No official prerequisites. However, basic knowledge of graphs, probability, and linear algebra is required. For example, if you know one third of "Introduction to Algorithms" by Cormen et al. and your background is good enough to finish this book then, perhaps, you are fine. You must be familiar with at least one programming language. Python, C/C++, Java or Matlab are recommended. **Currently there is an AI prerequisite in the system that was added by mistake. Please contact instructor to approve prerequisite override.**

Tentative Course Outline:

> **Introduction and Preliminaries** ....**1-2 days**
> **Measures and Metrics** .... **2-3 days**
> **Models and Structure of Networks** ....**3-4 days**
> **Network Formation** ....**2-3 days**
> **Spectral Methods** ....**2-3 days**
> **Partitioning and Clustering** ....**1 days**
> **Visualization of Networks** ....**1 day**
> **Network Representations** .... **2 days**
> **Epidemics on Networks** ....**1-2 days**
> **Robustness of Networks** .... **2 days**
> **Network Comparison** ....**1 day**
> **Multiscale Methods for Networks** ....**2-3 days**

Course Description: Network science is one of the most important disciplines in the research areas such as data mining, physical complex systems, epidemiology, communications, electrical circuits, social science, and bioinformatics. Most of these areas have a common formal basis when the studied system contains a set of individual objects or components connected together in some way. In this course we will cover basic topics related to this common basis. They will include models and properties of networks (small-world, scale-free, degree distributions, etc.), measures of importance of network elements (centrality, clustering coefficients, etc.), robustness, optimization and visualization. Practical work will include analysis of real-world networks.

Grading

Homework and paper reading (20 points); Oral presentation (20 points); Final project or exam (50 points); Quizzes (10 points). Total: 100 points

Points	$90\ldots\infty$	$80\ldots 89.99$	$60\ldots 79.99$	$50\ldots 59.99$	$0\ldots 49.99$
Grade	A	B	C	D	F

Bonuses

Work in class, extra work in home exercises, etc - up to 10 points. We do not want to miss the next Turing, Fields and Nobel laureates, so any submitted conference/journal paper written during and as a result of this course - 100 points (just to make it clear: one or two students do this almost every time when I teach this course!), and new interesting ideas - up to 100 points (both are based on instructor's subjective judgment).

Homework will include theoretical questions, practical exercises, and analysis of scientific papers. **Any implementation must be done and will be graded on the UD machines**.

Each homework is due at the date and time specified for it. Homework may be submitted a maximum of two days late according to the following policy: for each additional day you will receive a 20% penalty. Homeworks more than two days late will not be accepted.

Oral presentations: One of the goals of this course is to prepare students to be able to read, understand and present ideas of interdisciplinary research papers in which the network analysis plays an important role. Each student will give 1 overview talk (20-40 minutes each, depending on the number of students in the class).
Important:

- Students are more than welcome to suggest the papers or topics they would like to present.

- Once your presentation is scheduled you cannot cancel it unless there is a *documented* medical reason. However, you can switch with another student by mutual agreement.

Final Project (aka final exam). You will be asked to implement some methods for the analysis of real-world networks (such as social network, consumer-product network, power grid, etc.). We will discover the structural properties that are relevant to their applications. Alternatively, you can perform a theoretical analysis of networks or develop novel algorithms, models or metrics. The project will be given for at least 5-6 weeks.
Important:

- Students are more than welcome to suggest the networks, algorithms, principles, and theories they would like to analyze.

- A significant part of implementation must be yours. In other words, you cannot use the third party libraries.

Quizzes. A short pop up quiz can be given out almost every class. These quizzes will test your understanding of the readings and lecture material from that or previous weeks and will help you to prepare for the exercises and other activities. Unless otherwise noted, all quizzes must be completed on Canvas during the class time *with webcam turned on*. Quizzes are time-restricted, closed-book and closed any other aids.

Extra Help: Dot not hesitate to contact the instructor to discuss any aspect of the course. Contact the instructor using Slack, email, or Canvas.

Teaching Technologies: We will use three platforms in this class: Canvas, Zoom and Slack.

- We will use Canvas to share course materials, post and collect assignments, and send announcements.

- We will use Zoom for video lectures, discussions during the class, and to hold office hours. If you are not speaking (e.g., when you ask a question) please make sure you are muted. However, always use your webcam. We want to see your face! In Zoom you must use your full name (not UD id or nickname).

- We will use Slack for any discussion that you may need. If you need to ask a question during the class, and you don't want or cannot speak, use Slack channel #in-class-questions. In Slack you must use your full name (not UD id or nickname).

Communication: It is your responsibility to check Canvas, Slack for this class, and your UD email at least once a day. All email to the instructor and TA must come from your UD email address. Please allow 24 hours for instructor and TA to respond to your email on weekdays, and 48 hours on weekends/breaks.

Technology: You are required to have a functioning computer with webcam and microphone for this course. You are also strongly encouraged to have a working set of headphones with microphone for engaging via remote technologies, especially in situations where privacy may be warranted (such as discussing course grades with your instructor). A reliable broadband internet connection is required for students engaging in the remote delivery components for this course. If your internet is unreliable, you should email askit@udel.edu and ask for assistance.

Attendance and Participation: Attendance during lectures is required. Studies have found that the single most important factor that contributes to success in a course is class attendance. With this class, like others, each lecture builds upon preceding lectures. Missing even a single class can make it difficult to keep up with the course material. Students are allowed two unexcused absences from lectures without penalty. Every unexcused absence from lecture after the first two will lower your final grade by 3 points. Attendance will be recorded on Canvas or Zoom. It is your responsibility to make sure that your attendance is correctly recorded. Participation includes presence during the video lectures and group activities. Participation measures whether you speak

during lectures and help make the class dynamic and interactive. Do you ask questions on the Slack in-class channel? Do you actively participate in the exercises and activities completed during class time? Do you contribute to your group project? Do you help your team members to make the group project successful? Extra points for participation may be given as per the instructor's discretion.

Participation in the online class lectures requires that you have a webcam and that you must turn on the camera during the class time. Please be properly dressed similar to how you would dress if you were coming to an actual classroom. Any behavior that results in a classroom distraction will draw a warning, and if repeated will result in your expulsion from the class session.

Late Instructor Your instructor will make every effort to be in class on time, or to inform you of any delay or cancellation. In the unusual event that he should not arrive in class or send word by 15 minutes from the class start time, the class is officially canceled.

Unclaimed Materials All unclaimed, graded or ungraded, written or printed work such as homework, assignments, exams, and quizzes will be sent to recycling 30 days after the beginning of the next term.

Collaboration is Encouraged, Plagiarism is not Permitted If you are not sure what exactly plagiarism is please read the Student Handbook. Some forms of plagiarism include but are not limited to:

- Directly reproducing or paraphrasing someone else's work (published or unpublished), including insights and opinions, without attribution, regardless of length

- Failing to clearly identify quoted material by using quotation marks (for short sections) or blocked text

- Directly quoting your own text from previous projects or papers without attribution.

- Plagiarism also includes using someone else's ideas, art, figures, tables, maps, charts, diagrams and so forth, even if you recreate or reformat the material.

The instructor encourages discussions on course material and conceptual ideas with your fellow students. However, cooperation on homeworks and programs with anyone else is not permitted unless it is a group assignment. For both homeworks and programming projects, students are not permitted to access or compare any answers or code with anyone else, including current student, past student, or non-student unless it is a group assignment. Further, students may not use the web to locate answers to any assignment. Looking at another person's work or comparing answers or code before submitting one's work is considered cheating. If any students are suspected of violating this policy, they will be prosecuted according to University guidelines. This applies both to the student who gets answers and the student who gives answers. If you have any questions about the policy as it applies to this course or to any specific situation in the course, the instructor encourages you to come and talk to him.

Copyright Materials in this course are copyrighted They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further.

They are provided in compliance with the provisions of the Teach Act. Students should refer for additional information at `https://guides.lib.udel.edu/copyright`

Academic Honesty You are expected to know and abide by the University's policy on Academic Honesty found in the Official Student Handbook and also available on the Web at `http://www.udel.edu/stuguide/20-21/code.html#honesty` The Code of Conduct listed therein applies to this course.

Special accommodations If you need special accommodations or assistance, please contact the Office of Disabilities Support Services at the University of Delaware (http://www.udel.edu/DSS/). It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students should present a Faculty Accommodation Letter from Student Disability Services when they meet with instructors. Please be aware that accommodations are not retroactive and new Faculty Accommodation Letters must be presented each semester.

Changes to Syllabus: Lecture topics and assignments are subject to change. The course syllabus is a general plan for the course; deviations to the class may be necessary and will be announced to class by the instructor.