Network Science II

NETS 6116, Spring 2022

Instructor: Prof. Dima Krioukov, 177 Huntington Ave, 2nd floor, Rm. 227, x2934, dima@northeastern.edu
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Office Hours: By appointment
Credits: 4
Course Schedule: WF 11:55am-1:35pm, Jan 19 – May 2, 2022
Course Location: 177 Huntington Ave, 2nd floor, Conference room 207

Course Description: The second half of the foundational graduate course in network science. Provides in-depth coverage of the core concepts in network science dealing with network properties and network models. Assumes familiarity with basic concepts in networks science and hands-on experience working with network data.

Course Prerequisites: PHYS 5116, *Network Science I* (currently *Complex Networks and Applications*)

Textbooks:
M. Newman, *Networks*, 2nd ed., Oxford University Press, 2018.
R. van der Hofstad, *Random Graphs and Complex Networks*, Cambridge University Press, 2017.
V. Latora, V. Nicosia, G. Russo, *Complex Networks: Principles, Methods and Applications,* Cambridge University Press, 2017.

Course Objectives and Learning Outcomes: The main learning objective of the course is to gain in-depth knowledge of the core concepts, methods, and computational techniques in network science, necessary in hands-on work with real data on complex systems. The course consists of two unequal parts. The first shorter part revisits the most basic properties of networks introduced in the prerequisite course *NetSciI* (PHYS 5116). The focus is on addressing common misunderstanding and confusion points. The second part considers a collection of best-studied models in network science, and teaches the analytical and computational methods to analyze networks using these models and the properties considered in the first part. The focus is on deepening and broadening the foundational knowledge and skills acquired in *NetSciI*.

Course Organization: The first part of the course utilizes the flipped classroom methodology, except the students present and teach not new but old material they already know from *NetSciI* concerning foundational concepts in network science, such as network sparsity, small worldness, scale freeness, etc. The instructor and other students question the teachers trying to fix common misconceptions, misunderstanding and confusion points concerning the presented concepts. The second part of the course follows a more traditional teaching methodology, covering core concepts in network science omitted in *NetSciI*, such as the stochastic block model, configuration model, exponential random graphs, multilayer/multiplex networks, etc.

Homework: There will be several homework assignments of either analytic-calculation or computer-simulation types, or mixture thereof. The assignments will be of different levels of difficulty, and their grades will be weighted proportionally. Late submissions incur the 10%/day penalty.

Final examination will be at the level of a difficult homework, dealing with the in-depth analysis of some network models.

Grading: Final course grades will be determined as follows:

- **30%** Teaching
- **30%** Homework
- **40%** Final exam

Policies:

- Announcements in the class that are in conflict with the material in this syllabus override the syllabus
- Students who cannot attend a class are required to notify the instructor beforehand, and are responsible for finding out about any announcements and assignments that they might have missed
- No electronic device use is allowed during the class, other than for taking notes or when explicitly allowed by the instructor
- All the students are required to review and follow the Northeastern University Academic Integrity Policy available at http://www.northeastern.edu/osccr/academic-integrity-policy/