

Syllabus: CS 6104

Complex Networks

Fall, 2021

1 General Course Information

CRN	91302
MEETING TIME	11:00 AM–12:15 PM; Tuesdays and Thursdays
CLASSROOM	Whittemore 277

Instructor: Lenwood S. Heath

- **Office:** 2160J Torgersen Hall
- **Office Hours:** 2:00–3:30, Tuesdays and Thursdays; Zoom link on Canvas
- **Email:** heath@vt.edu

Website: <https://courses.cs.vt.edu/cs6104/Fall2021/index.php>

Canvas: <https://canvas.vt.edu/>

Prerequisites: CS 5104 (minimum grade of P) or CS 5114 (minimum grade of P)

Textbooks: The following textbooks are not required for the course, but either of the first two should make a good reference for now and the future.

1. **Networks**, Second Edition, Mark Newman, Oxford University Press, 2018, ISBN: 9780198805090.
2. **Complex Networks: Principles, Methods and Applications**, Vito Latora, Vincenzo Nicosia, and Giovanni Russo, Cambridge University Press, 2017, ISBN: 9781107103184.
3. **Random Graphs and Complex Networks, Volume 1**, Remco van der Hofstad, Cambridge University Press, 2016, ISBN: 9781107172876.

2 Course Description

Complex networks are large real-world graphs or networks with complicated structural properties. The study of complex networks cuts across computer science, physics, mathematics, life sciences, statistics, social sciences, and other areas. Typically, a complex network is characterized by a number of properties, such as degree sequence, node centrality, clustering coefficient, and community structure. These properties raise issues in how to generate random networks with specific properties, which in turn brings in the mathematical theory of random graphs. There are also algorithmic questions surrounding how to measure these properties computationally. Algorithms must be efficient, given the great size of complex networks, so approximations are sometimes allowed and distributed algorithms are common. Another research area is the dynamic spread of information or contagion over a complex network.

In this advanced topics course, we will study the above through targeted lectures, readings from the primary literature, and the pursuit of one or more computational or mathematical projects. The selection of papers will reflect the interests of the instructor and the students. Given the instructor's interest in computational epidemiology, topics from that area may be considered. Students can expect to lead the discussion of papers, perhaps in teams. Student teams will be the preferred organization for complex network projects.

3 Grading Policy

Grading for the course is on a 1000-point scale, with the points distributed as follows:

Individual or team presentation of papers	300
Team presentation of research proposal	200
Team presentation of research results	100
Team final research report	400

For in-class presentations of papers, students can select among papers posted on the course website or can recommend their own. Presentation style is rather open; guidelines will be posted under Resources on the website.

For the project component of the course, each student will first have a chance to express interest in several complex network research ideas through a ranking in a survey; it will also be possible for the student to propose their own idea. Based on the ranking of those ideas, research teams, each consisting of a few students, will be formed, each team with an idea to do research on and to report research results. First, each team does a literature review, prepares a brief proposal for their research, and does a 15 minute in-class presentation of the proposal, where each team member participates. Second, team research is performed, while the team reports on progress to the instructor; it is possible that the research will include writing code to investigate some notion in depth, though there may be other modes of research represented. Third, the team puts their research into a 20-minute presentation

done in-class near the end of the semester. Finally, the team submits a 10–12 page research report with references; a \LaTeX template will be provided for structuring the report.

The final research report must be prepared with \LaTeX ¹. and submitted as a tar file to Canvas by 5:00 PM on December 13, 2021; the tar file will contain all \LaTeX files, all graphics files, a PDF of the final report, and a `Makefile` to build the PDF from the source files.

4 Grading Scale

Grade	Points
A	930–1000
A-	900–929
B+	870–899
B	830–869
B-	800–829
C+	770–799
C	730–769
C-	700–729
D+	670–699
D	630–669
D-	600–629
F	0–599

5 Resources

Generally, there will be a reading assignment or perhaps an online video to do before each class to be prepared for the class. These resources will be posted on the class website ahead of time.

6 Planned Topics

The topics to be covered this semester are quite fluid, but here is a likely list for early in the semester, after which the paper studies and team projects will dominate.

- Overview of complex networks; sources, data sets, and software
- Graph theoretic notions
- Random graphs
- Complex network notions and measures

¹See \LaTeX resources on the course website.

- Real-world networks; degree distribution and power laws
- Generating complex networks
- Community structure and algorithms
- Motifs in complex networks
- Percolation
- Spread of epidemics on networks

7 Announcement

If any student needs special accommodations because of a disability, please contact the instructor during the first week of classes.

8 Ethics

The Honor Code applies. All work submitted must be the student's own work. Students may solicit help only from the instructor or the teaching assistant. In the case of research work on teams, all work submitted or presented must be only the work of the team.

The Undergraduate Honor Code pledge that each member of the university community agrees to abide by states:

“As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do.” Students enrolled in this course are responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any assignment is responsible for obtaining specific guidance from the course instructor before submitting the assignment for evaluation. Ignorance of the rules does not exclude any member of the University community from the requirements and expectations of the Honor Code.

Academic integrity expectations are the same for online classes as they are for in person classes. The use of technology assists such as Chegg, CourseHero, and GroupMe must be avoided. The Honor System is able to effectively investigate the use of these websites. All university policies and procedures apply in any Virginia Tech academic environment, and all students are expected to follow them.

For additional information about the Honor Code, please visit:

<https://www.honorsystem.vt.edu/>

Honor Code Pledge for Assignments: The Virginia Tech honor code pledge for assignments is as follows:

“I have neither given nor received unauthorized assistance on this assignment.”

The pledge is to be written out on all graded assignments at the university and signed by the student. The honor pledge represents both an expression of the student's support of the honor code and a commitment to uphold the academic standards at Virginia Tech.

Here are some more detailed considerations.

1. All assignments submitted shall be considered "graded work" and all aspects of your coursework are covered by the honor code. All projects and homework assignments are to be completed individually unless otherwise specified.
2. The Academic Integrity expectations for Hokies are the same in an online class as they are in an in-person class. Hokies are expected to meet the academic integrity standards at Virginia Tech at all times.
3. Commission of any of the acts in the list below shall constitute academic misconduct. This listing is not, however, exclusive of other acts that may reasonably be said to constitute academic misconduct. Clarification is provided for each definition with some examples of prohibited behaviors in the Undergraduate Honor Code Manual located at <https://www.honorsystem.vt.edu/>.

Acts of Misconduct

- **CHEATING:** Cheating includes the intentional use of unauthorized materials, information, notes, study aids or other devices or materials in any academic exercise, or attempts thereof.
- **PLAGIARISM:** Plagiarism includes the copying of the language, structure, programming, computer code, ideas, and/or thoughts of another and passing off the same as one's own original work, or attempts thereof.
- **FALSIFICATION:** Falsification includes the statement of any untruth, either verbally or in writing, with respect to any element of one's academic work, or attempts thereof.
- **FABRICATION:** Fabrication includes making up data and results, and recording or reporting them, or submitting fabricated documents, or attempts thereof.
- **MULTIPLE SUBMISSION:** Multiple submission involves the submission for credit — without authorization from the instructor receiving the work — of substantial portions of any work (including oral reports) previously submitted for credit at any academic institution or attempts thereof.
- **COMPLICITY:** Complicity includes intentionally helping another to engage in an act of academic misconduct, or attempts thereof.
- **VIOLATION OF UNIVERSITY, COLLEGE, DEPARTMENTAL, PROGRAM, COURSE, OR FACULTY RULES:** The violation of any University, College, Departmental, Program, Course, or Faculty Rules relating to academic matters that may lead to an unfair academic advantage by the student violating the rule(s).

4. Lecture notes, assignments, quizzes, tests, exams, solutions, and other materials distributed to or generated in this class are intended for use only by students enrolled in this CRN (section) this semester. Without the instructor's written permission, no one may show, give, or otherwise make such class materials available to anyone not enrolled in this CRN this semester. Prohibited activities include, but are not limited to, uploading a test, uploading solutions to problems, and submitting such class materials for online posting. The prohibition on sharing solutions applies to all solutions, regardless of who wrote the solutions.
5. Academic Misconduct Sanctions:

Here is this instructor's personal statement on honor code sanctions:

If you have questions or are unclear about what constitutes academic misconduct on an assignment, please speak with me. I take the honor code very seriously in the course. The normal sanction I will recommend for a violation of the Honor Code is an F* sanction as your final course grade. The F represents failure in the course. The "*" is intended to identify a student who has failed to uphold the values of academic integrity at Virginia Tech. A student who receives a sanction of F* as their final course grade shall have it documented on their transcript with the notation "FAILURE DUE TO ACADEMIC HONOR CODE VIOLATION." You would be required to complete an education program administered by the Honor System in order to have the "*" and notation "FAILURE DUE TO ACADEMIC HONOR CODE VIOLATION" removed from your transcript. The "F" however would be permanently on your transcript.

9 Mask Mandate Enforcement

Section 9.9: Class Conduct of the Faculty Handbook states that “... [t]he teacher should endeavor to create a classroom atmosphere that is comfortable and welcoming to all students, including women and members of minority groups. Disruptive classroom conduct on the part of some students may be distracting, annoying, or intimidating to other students and should not be tolerated by the teacher.” This part of the handbook clearly states that the instructor has the responsibility and the authority for maintaining the classroom conduct, including upholding the university’s mask mandate. If a student fails to follow or meet the outlined expectations for masking or general health and safety, the instructor

- should engage with student(s) first and address the situation proportional to the exhibited behavior in a deescalating way. The student should be redirected to either meet masking expectations or leave the class meeting.
- can terminate the class meeting but contact the department chair or head if this is done.
- should contact the Office of Student Conduct for guidance and direction if there are persistent disruptions and refusal to comply with expectations.
- should call the Virginia Tech Police if a student engages in behaviors that could be immediately dangerous or threatening to the instructor or the students in the class.

10 Your Mental Health and Well-Being

Here is a timely statement from Dr. Christopher Flynn, Director of the Mental Health Initiatives:

As awareness of mental health concerns in the college population grows, student advocacy groups at Virginia Tech have banded together as the Mental Health Coalition. One of the groups is **Active Minds at Virginia Tech**, and it seeks to raise awareness and fight stigma about mental health; to that end, Alyssa Wills and Saad Khan, two officers of Active Minds, have requested that faculty include the following statement regarding resources for students at Virginia Tech in their syllabi each semester. This statement has the approval of all student groups in the Mental Health Coalition as well as the professionals in each of the offices included below.

Here is the requested statement:

Supporting the mental health and well-being of students in this class is of high priority to the instructor and to Virginia Tech. If you are feeling overwhelmed academically, having trouble functioning, or are worried about a friend, please reach out to any of the following offices:

- Cook Counseling:
 - 540-231-6557 to schedule an appointment and/or 24/7 crisis support
 - <http://www.ucc.vt.edu/> for more information
- Dean of Students Office:
 - 540 231-3787 for general advice
 - 540-231-6411 for after-hours crisis
 - <http://www.dos.vt.edu/> for more information
- Hokie Wellness:
 - <http://www.hokiewellness.vt.edu/> for more information about health and wellness workshops and consultations
- Services for Students with Disabilities (SSD):
 - 540-231-3788 or <http://www.ssd.vt.edu/> for more information about accommodations and other disability-related supports

For a full listing of campus resources check out:

<http://www.well-being.vt.edu/>

Please also feel free to speak with the instructor, who also does care about your well-being.