

CSC 565 / MA 565 / OR 565: Graph Theory

Fall 2024, 3 credit hours

Tuesday/Thursday 8:30-9:45am, 4134 Fitts-Woolard Hall

Course Information

Course Description

Basic concepts of graph theory. Trees and forests. Vector spaces associated with a graph. Representation of graphs by binary matrices and list structures. Traversability. Connectivity. Matchings and assignment problems. Planar graphs. Colorability. Directed graphs. Applications of graph theory with emphasis on organizing problems in a form suitable for computer solution.

Prerequisite: CSC 226 or MA 351.

Instructor

[Dr. Rada Chirkova](mailto:Dr.Rada.Chirkova), Department of Computer Science EB2-2276, 919-513-3506, cscma-565-fall-2024-support@wolfware.ncsu.edu

Office Hours (see [exceptions](#)): Tuesdays 5:30-6:30pm [on zoom](#) (meeting ID 956 2910 6499, passcode 726646)

Teaching Assistants

CSC: TBA cscma-565-fall-2024-support@wolfware.ncsu.edu

Office Hours (see [exceptions](#)): TBA

Communicating with Instructor and Teaching Assistants: Please contact the instructor and teaching assistant(s) through NCSU e-mail. (There is an e-mail alias that sends a message to the instructor and TAs: cscma-565-fall-2024-support@wolfware.ncsu.edu.) Please note that an immediate response is not guaranteed when an assignment is about to be due. We will be sending information about the course through NCSU e-mail (via Moodle announcements), so please be sure that you check your account (or the Moodle announcements) frequently.

Learning Outcomes

By the end of the course, students will be able to:

- Use the vocabulary of graph theory to describe a range of natural problems.
- Model newly encountered questions as graphs problems.
- Identify the differences between the combinatorial, geometric, topological, computational, and algebraic perspectives on graph theory in general, as well as for specific graph questions.
- Work in a group to solve problems.

Required textbook: The textbook for the course will be provided in digital format by the instructor. The book is: Graph Theory Across Categories by Dr. Donald Sheehy.

Supplementary readings (not required) have all been posted and are listed on the [Course Reserves web page](#).

Technology requirements:

NC State University Libraries offers [Technology Lending](#), where many devices are available to borrow for a 7-day period. [Computer labs](#) are available in various locations around campus for student use.

Computer: A computer is required for students taking this course. NC State's Office of Information Technology provides [recommendations for your computer at NC State](#).

Other devices: No other peripheral tools will be needed for the course.

Software and digitally-hosted course components: The following software and tools may be used in this course. Some tools are a part of NC State's enterprise tools. See [information about their purpose, how to access them, accessibility information, and privacy policies](#).

- Youtube. Lecture segments (presented by Dr. Donald Sheehy) can be viewed outside of class. They are available as a playlist at <http://go.ncsu.edu/graphtheory>.
- Moodle. Moodle will be used for five purposes. (1) Broadcast announcements to the whole class from the instructors. (2) Distribution of class documents including policies, lecture notes, homework assignments, and quizzes. (3) Discussion boards. (4) Submission of papers for grading. (5) Grade reporting.
- Perusall. We will use Perusall to access and interact with the textbook.
- Zoom. Office hours may be conducted via Zoom. If, for some reason, we are unable to meet in person for a class session, the lecture will be conducted over Zoom. In such cases, I will announce it over Moodle. We will have a single Zoom link for all meetings related to the class.
- LaTeX. You will be expected to typeset your homework with LaTeX. This is a standard skill that all computer scientists should be able to pick up on their own. Overleaf is recommended for beginners to get started. The internet is full of tutorials to help you, and the homework assignments themselves will give you some good examples if this is new for you.

GEP: This course does not fulfill a General Education Program category or co-requisite.

Course schedule (tentative):

- Week 1: Sets
- Week 2: Intro to Graphs
- Week 3: Coloring to k-Connectivity
- Week 4: Trees, Forests, and Euler Walks
- Week 5: Drawing Graphs
- Week 6: Linear Embeddings and the Jordan Curve Theorem
- Week 7: Planar Graphs, Coloring, and Crossings
- Week 8: Simplicial Complexes and Fary's Theorem
- Week 9: Graph Minors
- Week 10: Kuratowski' Theorem and Wagner's Theorem
- Week 11: Linear Algebraic Invariants of Graphs
- Week 12: Laplacians
- Week 13: Tutte's Algorithm
- Week 14: The Maxwell-Cremona Correspondence to Steinitz's Theorem

Course assignments: The students will do readings of the required textbook on a weekly basis, with comments submitted for the *Perusall* portion of the course grade. There will be five homeworks throughout the semester, and a cumulative final exam between 8:30am-11am on Tuesday December 10. The exam cannot be rescheduled for any reason. There will also be unannounced in-class quizzes on the materials of that day's lecture *or* of the previous lecture, around one quiz per week. The top 70% of your quiz grades will be used as the *Quizzes* component of your course grade. No excuses for any reasons will be accepted for missed in-class quizzes. Make-up quizzes are not possible in this class, even in those cases where a student is present in a lecture in which a quiz is offered, but arrived in the classroom after the quiz questions were unveiled to the class.

Textbook reading due dates (tentative):

- Training module "Making the most of learning with Perusall" (optional) - August 28 (this and all the other deadline times are 11:59pm)
- Chapter 1: Sets and Functions - August 28
- First half of Chapter 2 - August 30
- Second half of Chapter 2 - September 13
- Topology, part 1 - September 20
- Topology, part 2 - September 27
- Topology, part 3 - October 4
- Simplicial Complexes I - October 11
- Simplicial Complexes II - October 25
- Chapter 6: Linear Algebra - November 8
- Chapter 7: Polyhedra - November 22

Homework due dates (tentative):

- Homework 1: September 5 (this and all the other submission times are 11:59pm)
- Homework 2: September 20
- Homework 3: October 7

- Homework 4: October 22
- Homework 5: November 6

Note that in each homework submission via Moodle, it is your responsibility to check that your submission has gone through successfully. (If in any doubt concerning the Moodle submit boards, feel free to email the course staff with your submission before the submission deadline as a backup.)

If a student joins the class after the add cutoff date and has missed one or more assignments, they will receive a zero grade for all the missed assignments unless they have reached an agreement with the instructor in writing, within one week of joining the class, on the schedule of making up the assignments.

Extra credit: There are no opportunities for extra credit in this course.

Communication Guidelines: The [NC State Code of Student Conduct](#) outlines expectations for behavior in the classroom (whether virtual or physical) and the consequences for students who violate these expectations. Any behavior that impacts other students' ability to learn and succeed will be addressed, but expressing diverse viewpoints and interpretations of course content is welcome.

Some course activities will require you to interact with other students in the course. This is especially the case for in-class exercises. It is a major part of your learning experience to be able to communicate your knowledge. If there is a group exercise, these are not optional. If you refuse to participate in these activities, you may be asked to leave.

Course Policies

The students are responsible for reviewing the NC State University Policies, Rules, and Regulations (PRRs) which pertain to their course rights and responsibilities, including those referenced both below and above in this syllabus:

- Equal Opportunity and Non-Discrimination Policy Statement <https://policies.ncsu.edu/policy/pol-04-25-05> with additional references at <https://oied.ncsu.edu/divweb/policies/>
- Code of Student Conduct <https://policies.ncsu.edu/policy/pol-11-35-01>

Grading

Perusall (textbook readings)	15%
Homeworks	40%
Quizzes	15%
Final exam	30%

All the course grades will be calculated in a completely transparent way using (i) your grades posted in the gradebook (including the perusall grades), (ii) the assignment-category percentages listed in the course syllabus, and (iii) the assignment types specified in the assignment schedule (above). All the assignments within each assignment type have equal weights.

Attendance

You should review the official attendance regulations at <http://policies.ncsu.edu/regulation/reg-02-20-03>. The final exam cannot be rescheduled for any reason. No excuses for any reasons will be accepted for missed in-class quizzes; the quizzes also cannot be retaken. Otherwise, excuses for unanticipated absences must be presented to the instructor within one week after the return to class. Please see [here](#) for the University policy on absence verification.

Distance-education students: The recordings of the lectures are typically available from [the EOL Office](#) on the same day. The students are expected to complete watching the recording of each lecture on the same week (before 11:59pm on Saturday of the week during which the lecture was recorded), in part due to the strict quiz-closure deadlines. For all the homeworks, the paper submission is to be done via Moodle submit boards, with the same deadlines for the entire class (both distance and on-campus students). Each distance-education student is responsible for scheduling their individual proctored final exam, with the exam scheduled for a date between Tuesday December 3 and Monday December 9 (both days inclusive). Please follow the instructions of [the EOL Office](#) on the scheduling and administration of the final exam.

Late assignments and homework policies: There are 6 units in the course. There are 5 homeworks, one per unit with the last unit pushed to the final exam. The lowest homework score will be dropped. You may submit the homeworks late at a penalty of 3 points per day. Assignments submitted more than ten days past the due date will not be accepted. **Please do not ask for an extension.** You may submit homework with a group of at most 4 people. This does not apply to the final exam, which is to be taken individually.

Multiple solutions or papers submitted per assignment

If a student submits multiple solutions to the same problem in the same paper (in both the exam papers and the non-exam papers submitted for grading) *and does not clearly mark exactly one of these solutions as “the correct” solution*, then the TAs/graders will assign zero points as a grade for this problem. In case a student submits multiple papers for the same assignment, the course staff will grade the latest submission *only*, even if the latest submission does not contain solutions to some problems, and solutions to those problems can be found in earlier submissions for that assignment. (If the multiple submissions are not timestamped by the student, then the course staff reserves the right to pick one submission out of these multiple submissions and to grade that submission only.) In case that latest submission for an assignment is a late submission (permitted only if the submission conforms to the late-submission policy, see under **Late Assignments** in this Syllabus), no earlier-submitted paper will be considered for grading for that assignment, even if that earlier-submitted paper is not a late submission.

Final-exam instructions

All the questions in the final exam will be covered by the final-exam study guide (TBA). For the exam rules, please review the exam cover page (TBA). Specifically, the exam is closed book and closed notes; calculators, PDAs, and other aids are not permitted either. However, a one-page (i.e., one-side) crib sheet may be used, on no more space than letter-size paper (8.5 x 11 inches), with font size 12 or larger, or a handwritten equivalent, with at least 1-inch margin on each of the four sides of the sheet; [this file](#) is a template that shows the maximal permitted density of information on a crib sheet. Crib sheets may not be shared. Abuse of the crib-sheet requirement is considered cheating. Collusion or cheating of any form are forbidden. You can be asked to explain your solutions verbally. The instructor never asks any trick questions. In solving exam problems, you may not make additional assumptions, unless explicitly encouraged to do so in the problem assignment. You can get partial credit for an English description.

Regrade Policy

If you feel a regrade is warranted, the following items may be of interest:

- You must clearly and concisely describe why what you wrote is more correct than what we gave you credit for.
- The entire problem set or project report will be regraded. In other words, by requesting a regrade, you risk lowering your grade.
- You should send your request, in writing, to the course staff.
- All regrade requests must be made no later than a week after each homework, quiz paper, or exam paper is returned to the class; this includes all corrections to your grade in the Moodle gradebook. The only exception to this rule would be made for documented NCSU-recognized (<http://policies.ncsu.edu/regulation/reg-02-20-03>) absences for the entire regrade week period in question. No corrections to gradebook grades for any assignments or individual grade components in the course are possible after the final exam.
- The only exception to the second bullet point will be arithmetic errors made by the course staff. If we subtracted 5 from 10 and gave you 2, we will not regrade your solutions.

Requirements for Credit-Only (S/U) Grading

If you are taking this course for credit only (S/U), your grade will be reported as S (Satisfactory) when the coursework is equivalent to a C- or better, or U (Unsatisfactory) when the coursework is equivalent to less than a C-. For more information, see the [Credit Only Courses regulation](#).

Requirements for Auditors

Auditing this course is approved on a case-by-case basis. Please contact the course instructor to attain approval. Refer to the [Audit regulation](#) for more information and links to the required forms.

Incomplete Grades, Withdrawals

Information on incomplete grades can be found at [REG 02.50.03 – Grades and Grade Point Average](#). If you encounter a serious disruption to your work not caused by you and you would have otherwise successfully completed the course, contact your instructor as soon as you can to discuss the possibility of earning an Incomplete in the course for the semester, including an agreement on when the remaining work must be done in order to change the grade to the appropriate letter grade.

If you must withdraw from a course or from the University due to hardship beyond your control, see [here](#) and [here](#) for information and instructions.

Lecture Recordings

Please be advised that this course is being recorded for current and potential future educational purposes. By your continued participation in this recorded course, you are providing your permission to be recorded.

Academic Integrity

Students are required to comply with the university policy on academic integrity found in the [Code of Student Conduct](#) at <https://studentconduct.dasa.ncsu.edu/students/>. See <http://policies.ncsu.edu/policy/pol-11-35-01> for a detailed explanation of academic integrity and misconduct. Your signature on any test or assignment indicates “I have neither given nor received unauthorized aid on this test or assignment.”

The university, college, and department policies against academic dishonesty will be strictly enforced. *In this class, there will be zero tolerance of academic dishonesty and of misconduct; the penalty for each case of academic dishonesty or misconduct, including cases falling under items 6, 8, and 10 of the [NCSU Code of Student Conduct](#), is at least 15% of the course grade.* You may obtain copies of the [NCSU Code of Student Conduct](#) from the [Office of Student Conduct](#); Section 6 of the Code is dedicated to standards of classroom behavior, and Section 8 of the Code focuses on academic misconduct.

The course staff will be explicit about which assignments should be completed in teams and which should be completed individually. For individual homework, all forms of collaboration are prohibited. For team homework, students may collaborate and discuss approaches, but each student must write their own code, write and document their own solutions, and list the names of all their collaborators on the solutions being submitted. All kinds of collusion will be subject to disciplinary action. Students must acknowledge sources such as books (other than the required textbook) and old assignments. Unacknowledged use of any such material is subject to disciplinary action. Any attempts to circumvent computing system security or interfere with others' work will also be subject to disciplinary action.

Violations of academic integrity will be handled in accordance with the Student Discipline Procedures ([NCSU REG 11.35.02](#)).

Electronically-Hosted Course Components and Student Privacy

The course staff will communicate with the students through NCSU e-mail and through Moodle. Software may be used in this course to detect the originality of student submissions. Students may be required to disclose personally identifiable information to other students in the course, via electronic tools such as email or web postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Accommodations for Disabilities

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (NCSU [REG 02.20.01](#)).

Non-Discrimination Policy

NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at <http://policies.ncsu.edu/policy/pol-04-25-05>. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the [NCSU Office of Institutional Equity and Equal Opportunity](#).

Policy on Class Disruption: This class, like the University as a whole, is an at-will activity. You and your classmates are in class to learn the material and to participate. Willful disruption of the lecture or other similar actions that impede the progress of your peers will result in deductions to your total grade. Disruptive students will receive one warning before any deductions take place. For any persistent or repeated activities points will be deducted from your grade at the discretion of the course instructor, and may also result in a report to the NCSU Office of Student Conduct and/or NCSU Public Safety. Please see [POL 11.35.01 – Code of Student Conduct](#) for more details on University policies on classroom conduct.

Policy on Professional Conduct: The classroom is a professional environment. Students are expected to conduct themselves in a professional and courteous manner both within the classroom and in their out-of-class interactions. This includes their interactions with teaching staff and classmates, both in class and in online forums. Documented complaints of uncivil, aggressive, harassing, or threatening behavior will be reported to the appropriate campus authorities and may adversely impact your grade.

Grading scale (all the numbers are percentages of the maximal possible score):

A+ >= 97; A = [94,97); A- = [90,94); B+ = [87,90); B = [84,87); B- = [80,84); C+ = [77,80); C = [74,77); C- = [70,74); D+ = [67,70); D = [64,67); D- = [60,64); F < 60.

Supporting Fellow Students in Distress: Academic and Student Affairs maintains a website with links for student support on campus, including academic support, community support, health and wellness, financial hardship or insecurity, and more. [Find Help on Campus](#).

As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that this classroom and the campus as a whole remains a safe environment for learning. Occasionally, you may come across a fellow classmate whose personal behavior concerns or worries you. When this is the case, we would encourage you to report this behavior to the NC State Cares website, <https://prevention.dasa.ncsu.edu/nc-state-cares/about/>. Although you can report anonymously, it is preferred that you share your contact information, so they can follow up with you personally.

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- Equal Opportunity and Non-Discrimination Policy Statement <https://policies.ncsu.edu/policy/pol-04-25-05> with additional references at <https://oied.ncsu.edu/divweb/policies/>
- [Code of Student Conduct](#) - also see <https://policies.ncsu.edu/policy/pol-11-35-01>
- [Grades and Grade Point Average](#)
- [Credit-Only Courses](#)
- [Audits](#)

Course evaluations:

ClassEval is the end-of-semester survey for students to evaluate the instruction of all university classes. The current survey is administered online and includes 12 closed-ended questions and 3 open-ended questions. Deans, department heads, and instructors may add a limited number of their own questions to these 15 common-core questions.

Each semester students' responses are compiled into a ClassEval report for every instructor and class. Instructors use the evaluations to improve instruction and include them in their promotion and tenure dossiers, while department heads use them in annual reviews. The reports are included in instructors' personnel files and are considered confidential.

Online class evaluations will be available for students to complete during the last two weeks of the semester for full-semester courses and the last week of shorter sessions. Students will receive an email directing them to a website to complete class evaluations. These become unavailable at 8 am on the first day of finals.

- Contact ClassEval Help Desk: classeval@ncsu.edu
- [ClassEval website](#)
- [More information about ClassEval](#)

Syllabus-modification statement: This syllabus represents a flexible agreement. It outlines the topics we will cover and the order in which we will cover them, as well as the applicable rules and policies. Dates for assignments represent the earliest possible time they would be due. The pace of the class depends on student mastery and interests, and sometimes approaches need to be revised. Thus minor changes in the syllabus can occur if we need to slow down or speed up the pace of instruction, or to modify any applicable rules and policies.

Acknowledgment: All the materials for this course have been provided by [Dr. Donald Sheehy](#).

Last modified: Saturday, August 17, 2024, 9:24 AM

◀ Announcements

Jump to...

Course textbook by Dr Donald Sheehy ▶