




HNRS 241: Mathematical Efficiency and Optimization Fall 2022

Contact Me	Meet with Me	Class Info
		
Name: Dr. Maggie Pronouns: She/Her/Hers Email: rahmoeller@roanoke.edu	Office: Trexler 270B Student Hours: Tues/Thurs 1:15-2:15PM Wed 2:30-3:30PM Or email me to meet at a different time!	Location: Maxey 106 Days: MWF Time: Noon-1:00PM

Course Description: An important aspect of mathematical reasoning is modeling real world problems with various mathematical methodologies. This course applies a specific mathematical discipline, Graph Theory, to investigate the tradeoffs between optimization and efficiency in addressing real world problems. The course is split into six units, each of which focuses on a specific question. The first three units focus on various routing problems, the fourth on maintaining connections, the fifth on pairings, and the sixth unit focuses on resource management. Graph theory provides an avenue for advancing critical thinking skills, formulating complex problems into a mathematical structure, and applying and understanding limitations of solution techniques.

Intended Learning Outcomes: Students will be able to

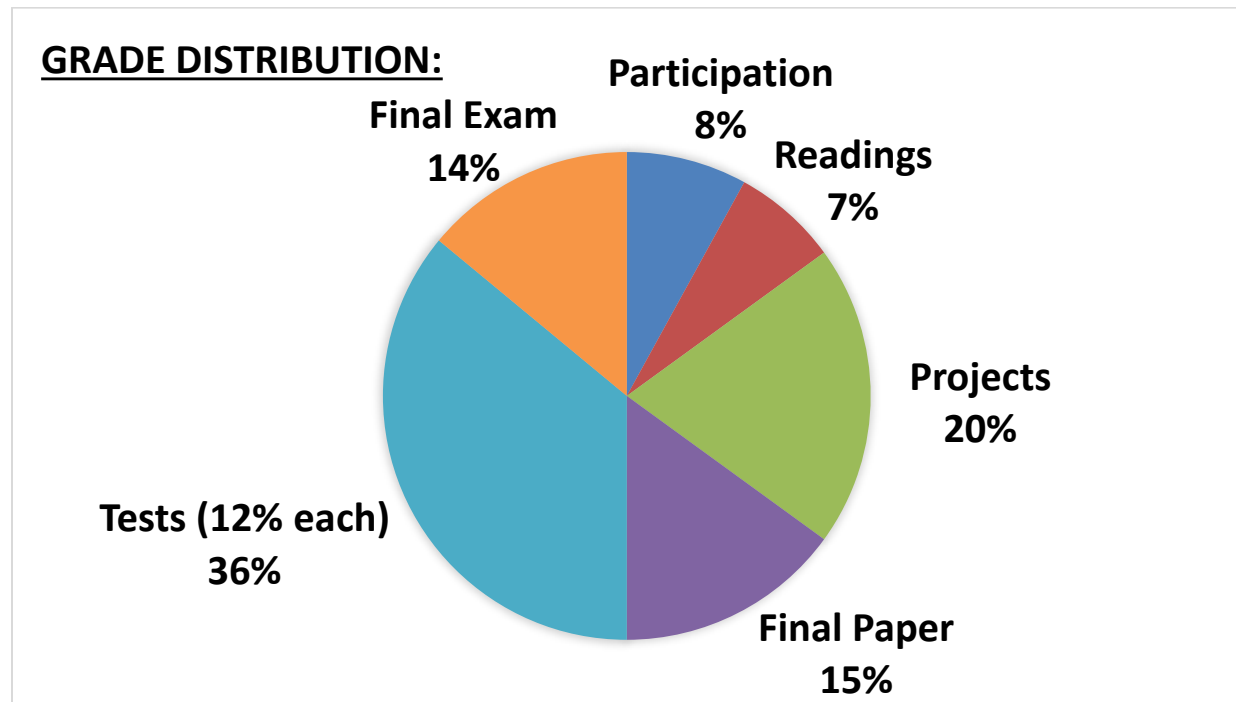
- Describe and apply methodologies of mathematics or computer science appropriate for the course's discipline and topic.
- Write about course topics clearly and effectively.
- Interpret quantitative information related to the course topic.
- Connect course content to their lives and to communities beyond the classroom.

Your success in this class is important to me! We all learn differently and bring a variety of strengths and needs to the class. If there are aspects of the course that prevent you from learning or that make you feel excluded, please let me know as soon as possible. Together we'll develop strategies to meet both your needs and the requirements of the course.

Required Materials:

- A Tour through Graph Theory; Saoub, Karin EasyWriter; Lunsford, Andrea A.
- A basic hand-held calculator
- Recommended: Laptop computer

Commitment Hours: This course expects you to spend at least 12 hours of work a week inside and outside of class.



Grades will be determined based on the following:

A	93-100	B	83 – 87	C	73 – 77	D	63 – 67
A-	90 – 93	B-	80 – 83	C-	70 – 73	D-	60 – 63
B+	87 – 90	C+	77 – 80	D+	67 – 70	F	< 60

COURSE EXPECTATIONS

Classroom Environment: You are expected to treat all students in the class and me with courtesy and respect. Your comments to others should be factual, constructive, and free from harassing statements. You are encouraged to disagree with other students, but such disagreements need to be based upon facts and documentation (rather than prejudices and personalities). My goal is to promote an atmosphere of mutual respect in the classroom. Please let me know if you have suggestions for improving the classroom environment. (Source: Iowa State University)

Diversity and Inclusivity

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Attendance Policy: Our course's success depends on you attending class! If you miss class, you will miss community building, engaging conversations, and information that I deem worthy of your time! Plus, we will miss you!

However, life happens! You may get sick, desperately need a mental health day, or have a game scheduled. It will not be the end of the world if you miss a class very occasionally. At some point, though, missing class can be detrimental to success. So, do your best to be in class! Strive for perfect attendance!

What should you do if you have to miss class? Let me know ASAP! Communication is key! I don't need details (please, spare me the details!) but do let me know ahead of time, so we can make plans, if needed. If you cannot let me know ahead of time (emergencies do happen!), just let me know as soon as you can. Email is typically the best form of communication for me.

If you are sick (and contagious), please either stay home OR come to class wearing a mask (unless you have COVID symptoms). CDC guidelines currently (as of Aug 2022) say that once your symptoms are gone or have lightened considerably, you may go out and about if you are wearing a *good* mask (for at least 5 days). If you have symptoms or a fever, isolate. Always follow Roanoke College guidelines for COVID. And be sure to use Health Services on campus!

Late Work: Whether or not to accept late work is always a tough decision. Life happens – and occasionally we need more time to complete tasks! But, sometimes turning in an assignment late causes more complications than benefits.

I can grant more leeway on certain types of assignments, those with *soft* deadlines. But *hard* deadlines cannot be changed. I would say that the Readings, Quizzes, and Tests have *hard* deadlines. But the projects have *soft* deadlines – other than falling behind, it's not too detrimental to submit a project a little after the set deadline.

BUT the best thing you can do is *communicate* with me. Let me know if you have concerns about turning in an assignment on time – I will do my best to work with you.

Academic Integrity: Students are expected to adhere to the Academic Integrity policies of Roanoke College (https://www.roanoke.edu/inside/a-z_index/academic_integrity). All work submitted for a grade is to be your own work! Doing your own work and properly acknowledging the work of others is of utmost importance in the academic setting.

No collaboration is allowed on quizzes or tests. Unless otherwise stated, you may work together on the homework, but you should write up your solutions separately.

Using unauthorized sources is a violation of Academic Integrity, which includes solutions posted online and “homework help” sites such as Chegg or Course Hero. Uploading our course assignments to these sites is also a violation of Academic Integrity.

COURSE ASSIGNMENTS

Participation: The key to learning a topic in mathematics is participation. We will strive to have an active, rather than passive, classroom environment. The last page of the syllabus is a daily outline of the topics that will be discussed in class. You are fully expected to have read the appropriate section of the textbook before the class meeting!

In addition, Practice Problems will be listed on Inquire. These will serve to both review material from the previous class as well as introduce new material. These will not be collected but you are expected to attempt every problem before the next class period.

Quizzes: There may be quizzes in this class. They may either be in-class quizzes or take-home quizzes. I may occasionally warn you about an upcoming quiz but you should be prepared to take a quiz on any given day. These will generally test definition knowledge and recognizing main concepts.

Readings: Four additional readings will be assigned throughout the course according to the schedule on the final page. The articles will be available through the course Inquire page. These readings will examine additional material or applications not available in our textbook. The class will be split into 4 groups, each of which will be responsible for leading a discussion for their assigned reading.

The first reading will concern the changes to Königsberg over time and how that changes the possible solution to the Eulerian circuit problem.

The second reading will investigate the use of Hamiltonian cycles and DNA reconstruction.

The third reading will look at scheduling of independent tasks and the added complexity introduced when constraints are relaxed.

The fourth reading will concern the National Resident Matching Program, which matches medical students to residency programs, and its relationship to the Stable Marriage Problem.

Projects: Projects will be assigned throughout the term. Each project will apply the concepts from a class unit to a business scenario, and therefore are more in-depth and open ended than the practice problems. Instructions will be handed out well in advance and I will gladly help you with the assignments up until the night before they are due. Projects will be graded on the correctness of the mathematics and models used, explanations of concepts, and the overall form of the document. A grading rubric will be provided along with the assignment instructions.

Final Paper: Even though this is a math course, we will be spending some time on written communication. Each project will contain a writing component, but the main grade will primarily focus on the mathematics completed. These projects will develop your ability to discuss mathematics in writing and properly describe the solution techniques and any deficiencies in their application. Our community partner will present a problem of interest that can be solved using one of the topics of the course. You will spend time throughout the semester determining the best way to display the data, the proper solution technique needed to solve the presented problem, and write up a polished report of your findings. Your grade will heavily rely on the written portion, though the correctness of the mathematics will still be emphasized. This paper will be a formal report that will be submitted to our community partner, both in writing and through an oral presentation. The final paper must be a polished document with all figures and tables labeled and referenced appropriately.

Honors e-Portfolio: All projects and the Final Paper should be placed in your Honors e-Portfolio.

Tests and Final Exam: Three tests will be given (roughly according to the schedule at the end of this document) throughout the semester. Each test will focus on the material learned since the last test, but as with most mathematics classes, the exam will necessarily require you to understand and remember things from the past. If you miss or will be missing a test for reasons beyond your control (college sports team event, sickness, family tragedy, etc.), notify me as soon as possible.

The final exam will be comprehensive and given during the scheduled time for the final exam for Block 4: Friday December 16, 2:00 PM – 5:00PM.

MCSP Conversation Series: The MCSP+ department and Roanoke College offer many opportunities to engage with mathematical ideas outside of classes. These co-curricular sessions engage the community to think about ongoing research, novel applications and other issues that face our discipline.

Members of this class are invited to be involved with all of these meetings. **Within one week of attendance** you must submit a brief response to the activity. This should not simply be a regurgitation of the content, but rather a personal contemplation of the experience. The prompt for this reflection is on Inquire. These reflection papers earn extra credit, with .5% added to your course average for each attended, up to 2% total. In addition, individually you may request that other appropriate events count.

RESOURCES

Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4-9 PM, Sunday-Thursday. Subject Tutors are highly trained, current students who offer free, one-on-one (and small group) tutorials in over 80 courses taught at Roanoke College, including: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, and Social Sciences. Check out all available subjects and schedule 30- or 60-minute appointments at www.roanoke.edu/tutoring. If you have a question, feel free to stop by, or contact us at

subject_tutoring@roanoke.edu or 540-375-2590. See you soon!

The Writing Center @ Roanoke College, located on the Lower Level of Fintel Library (Room 15), offers free tutorials focused on writing projects and oral presentations for students working in any field. Writers and presenters at all levels of competence may visit the Writing Center at any point in their process—including brainstorming, drafting, organizing, editing, or polishing presentation skills—to talk with trained peer tutors in informal, one-on-one sessions. The Writing Center is open Sunday through Thursday from 4 to 9 PM. Simply stop in, or schedule an appointment at www.roanoke.edu/writingcenter. Questions? Email writingcenter@roanoke.edu or call 540-375-4949.

Accessible Education Services (AES) is located in the Goode-Pasfield Center for Learning and Teaching in **Fintel Library**. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Becky Harman, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Becky Harman at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Student Health & Counseling Services supports students through in-person health appointments, in-person counseling, 24/7 telehealth (TimelyCare), Therapy Assistance Online, as well as resources related to general wellness, LGBTQ+, sexual assault, substance abuse, and suicide prevention. Unmet health needs can negatively impact your performance in this course. Student Health & Counseling Services can help. Please see <https://www.roanoke.edu/shcs> for more information and to access services.

Tentative Course Schedule

Week	Date	Section	Topic	Assignment Due
Week 1	Aug 31	1.1-1.2	Königsberg Bridge Problem	
	Sept 2	1.3-1.4	Touring a Graph and Algorithms	
Week 2	Sept 5	1.4-1.5	Eulerian Circuit Algorithms	
	Sept 7	1.5	Eulerizing a Graph	
	Sept 9		Modern Königsberg Ch 2.1, if time	Reading 1
Week 3	Sept 12	2.1	Hamiltonian Cycles <i>Final Project: Community Partner Presentation</i>	
	Sept 14	2.1	HC Algorithms	Project 1
	Sept 16	2.2	HC Algorithms	
Week 4	Sept 19		HC and DNA	Reading 2
	Sept 21		<i>Final Project: group meetings</i>	
	Sept 23		Review	Project 2
Week 5	Sept 26		Test 1	
	Sept 28	3.1	Shortest Paths	
	Sept 30	3.1	Dijkstra's Algorithm	
Week 6	Oct 3	3.2	Project Scheduling	
	Oct 5	3.2	Project Scheduling	
	Oct 7		Independent Tasks <i>Final Project: progress check-in</i>	Reading 3
Week 7	Oct 10	4.1	Trees	
	Oct 12	4.2	Spanning Trees	Project 3
	Oct 14	4.3	Shortest Networks	
FALL BREAK!!!				
Week 8	Oct 24	4.4	Shortest Networks & TSP	
	Oct 26	5.1	Bipartite Graphs	
	Oct 28		Review	Project 4

Week 9	Oct 31		Test 2	
	Nov 2	5.2	Matching Strategies	
	Nov 4	5.2	Matching Strategies	
Week 10	Nov 7	5.3	Stable Matching	
	Nov 9	5.3	Stable Matching	Reading 4
	Nov 11	5.4	Non-bipartite Matching	
Week 11	Nov 14		Group Check-In <i>Final Project: first draft due</i>	
	Nov 16	6.1	Four Color Theorem	
	Nov 18	6.2	Coloring Bounds and Strategies	
Week 12	Nov 21	6.3	Online Coloring	Project 5
THANKSGIVING BREAK!!!				
Week 13	Nov 28	6.4	Interval Tolerance Graphs	
	Nov 30	6.5	Weighted Coloring <i>Final Project: second draft due</i>	
	Dec 2		Group Check-In	
Week 14	Dec 5		Review	Project 6
	Dec 7		Test 3	
	Dec 9		Final Paper Presentations	Final Paper
	Dec 16	2-5PM	Final Exam	