MAT 410: Numerical Analysis

Fall 2026

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"Character is the aim of true education; and science, history, and literature are but means used to accomplish the desired end. Character is not the result of chance work but of continuous right thinking and right acting. . . . True education seeks, then to make men and women not only good mathematicians, proficient linguists, profound scientists, or brilliant literary lights, but also honest men, combined with virtue, temperance, and brotherly love — men and women who prize truth, justice, wisdom, benevolence, and self-control as the choicest acquisitions of a successful life. . . . It is regrettable, not to say deplorable, that modern education so little emphasizes these fundamental elements of true character. The principal aim of many of our schools and colleges seems to be to give the students purely intellectual attainments and to give but passing regard to the nobler and more necessary development along moral lines."

—David O. McKay
(*Gospel Ideals*, p. 440)

Information for all my students

Student Hours: Student hours are like office hours but they are not in my office. They are held, instead, right next door in the Magnolia Hall conference room (Magnolia Hall 109). They are at these times:

Tuesday and Thursday from 12:00 PM to 4:00 PM.

or by appointment. If you can't make student hours physically but can drop in on Zoom, please let me know before hand. The Zoom link will be https://zoom.us/my/drmcbsvu. Please, feel free to drop in with your questions. No appointment is necessary.

If you have a private matter to discuss, please make an appointment to see me. If it is quick (these things usually are) feel free to come to student hours and we can step into my office.

My tentative weekly schedule is as follows:

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:00 AM	MAT 305		MAT305		MAT305
9:00 AM	MAT 100	MAT221	MAT100	MAT221	MAT100
10:00 AM	MAT 343	MAT221	MAT343	MAT221	MAT343
11:00 AM	MAT 221		MAT221		Forum
12:00 PM	MAT 221	Student Hours	MAT221	Student Hours	
1:00 PM		Student Hours		Student Hours	
2:00 PM		Student Hours		Student Hours	
3:00 PM		Student Hours	Faculty Meeting	Student Hours	
4:00 PM			Faculty Meeting		

AI Use Policy: The purpose of this course is to help you develop both skills and deep understanding, especially of mathematical concepts. Homework and assignments are designed to give you the practice you need to build those skills.

Some students may be tempted to use AI tools to complete their work instead of working through problems themselves. This is like signing up for a weight training class but using a machine to do the lifting for you; you wouldn't build the strength you need. The same is true here: if AI does the work, you miss the chance to develop the understanding and skills necessary for success in this course and in future courses.

That said, AI can be a helpful learning aid when used appropriately. Think of it like using a box to assist with pull-ups: you can use the box to help you get above the bar, then slowly lower yourself to build strength. After a while, you'll be able to do pull-ups without the box. Similarly, you can use AI to help you get "unstuck" on a problem—by asking for hints, clarifications, or explanations of a concept, rather than simply asking for the full answer. This is using AI to facilitate your learning rather than rob you of the chance to learn. This is what I referr to as using AI wisely.

Illustrative examples:

- **Wise use:** You are working on the homework and there is a question that you have already worked on but you keep getting it wrong, even after going to your notes and checking your method. You ask ChatGPT the question and observe what it did differently, You try it again and get it right with that modification. You make a note of that in your notes so you get it right next time. Or you make a note to ask about it in class.
- **Unwise use:** You have not yet attempted a certain homwork question but becaue you are low on time you copy the question and ask ChatGPT. Only some of the explincation makes sence or seems familiar to you, but you submitt it anyway. This is dishonest and not acceptable.

In this course, the policy for AI use is to use it wisely, which often means not using it at all. The unwise use of AI is prohibited and results in a loss of points and in some cases may be reported to the Provost office as a breach of academic integrity. Also, the use of AI on any quiz or test of any kind is prohibited, and if discovered will result in a zero on that quiz or test. If you are unsure about whether your use of AI is wise or unwise, please ask me before you submit your work.

If you rely on AI to do the work for you, you may finish assignments faster, but it is unlikely that you will develop the skills you need to succeed.

One more thing, the wise use of AI is likely to be extremely important in your career. Start now learning how to get the full benefit of AI usage without compromising your own DEVELOPMENT.

Policies Specific to MAT 410: Numerical Analysis

Here is the class in a nutshell: this is a hands-on scientific-computing course. Before most class meetings there is a lesson guide to fill out as you read the assigned section of the textbook, followed by a short open-book lesson quiz — both worked through before our check-in and turned in by Friday night. In class, we discuss the reading and then step through examples and problems together, usually in a Julia/Jupyter notebook. After we finish a topic there are a few light homework problems — part written, part notebook — to complete. The real heart of the course is the projects: two code projects, in which you implement an algorithm from class and contribute it to our shared class GitHub repository, and a larger final project. When you finish a project you present it to the class. There are also two exams taken in the Testing Center. There is **no final exam**; instead, the course concludes with final-project presentations during the scheduled final exam period.

Textbook: We will use *Numerical Analysis*, 9th Edition, by Richard L. Burden and J. Douglas Faires. A PDF of the book is available online, and used print copies are inexpensive (roughly $20–$40; I have even seen copies for around $11). This is not the most recent edition, which is why it is so affordable, but everything we need is in it.

Required Materials:

- Access to a computer with the internet. We will be doing a lot of scientific computing throughout this course. Our primary language is **Julia**, which we run in Jupyter notebooks (locally or in the cloud). Julia is open source and free. No prior Julia experience is assumed — we begin with a short introduction on the first day.

NOTE: If you would rather not install anything, you can run everything in the cloud through a browser (for example, Google Colab). It is still recommended that you have a computer of your own on which you can play around with the language.

- A **GitHub** account (free). We will use it for the code projects. If you do not already have one, I will walk you through setting it up early in the semester. For those of you interested in careers that involve coding, a history on GitHub demonstrating that you can fork and merge branches, write unit tests, and document your code is a real advantage.

Course Description: Survey of methods to approximate numerical solutions of problems in root-finding, interpolation, differentiation, integration, differential equations, linear systems, and approximation. Derivations, limitations, and efficiency of the different algorithms are considered.

Prerequisites: MAT 343: Linear Algebra and MAT 344: Elementary Differential Equations. The text does not assume a differential equations course — everything we need for Chapter 5 is developed within the book.

Course expectations:

- Regular attendance is essential and expected.
- In general, it is expected that you will spend at least **2 hours** outside of class for each hour in class in order to understand the material. To achieve excellence, more time may be required. So, budget at least 6 hours each week (in addition to class time) to spend learning this material. Note that if you are taking 15 credits that comes to about 45 hours of work a week.
- Keep cell phones on silent unless you are expecting an emergency call. Please do yourself a favor and allow yourself to focus by putting your phone away.
- Class time is work time. During the times we meet, I expect you to be ready to work. This is not a lecture series in which you can sit and listen passively. Our meetings are active: expect to write and run code, work problems, and discuss.

General Instructional Format: Before each class you are expected to complete a lesson guide and a short lesson quiz on the section we will discuss (see the separate *Course Schedule* handout). In class, we discuss the reading and step through examples and problems, usually in a Julia/Jupyter notebook. When you finish a coding project you will take 15–20 minutes presenting it to the class. For this course, assessment comes from the lesson guides and quizzes, light homework, two Testing-Center exams, and three projects.

Grading Scheme:

Lesson Guides	10%
Lesson Quizzes	5%
Homework	15%
Project 1 (Code Project)	10%
Project 2 (Code Project)	10%
Final Project	20%
Exam 1	15%
Exam 2	15%
Total	100%

(The percentages guarantee at least the following letter grades.)

A	93%	C+	77%
A-	90%	C	73%
B+	87%	C-	70%
B	83%	D+	67%
B-	80%	D	63%

Lesson Guides (10%): Before each class meeting you will be given a lesson guide to help you become familiar with the material for that day. You fill these out as you read the assigned section of the textbook. They are due by 11:59 PM on the Friday of that week. Fill yours out *before* our check-in, though — the whole point is that you arrive having already wrestled

with the reading, so we can spend our time on what actually tripped you up. You may submit them late for half credit, but they must be turned in within a week of the deadline. Because it is so important that you come to class prepared, **none** of these will be dropped.

Lesson Quizzes (5%): Once you have completed the lesson guide for a given day, you will take a short quiz on that material. These quizzes are open book and open note, but they are **not** open AI — you may use the textbook and your notes, but not AI tools. They are due by 11:59 PM on the Friday of that week, and I do not accept them late. However, at least two of these quizzes will be dropped at the end of the semester, so missing one or two will not hurt your grade.

Homework (15%): Homework is light and drawn from the textbook exercise sets; the specific problems are posted on Canvas and listed in the *Course Schedule*. Each set typically has a written part and a short Julia notebook, and you will upload both. Due dates follow a simple rule:

Everything for a given week — lesson guides, lesson quizzes, and homework — is due by 11:59 PM on the Friday of that week.

I will drop your one or two lowest homework scores at the end of the semester. Please use AI wisely, if at all, on these assignments (see the AI Use Policy above).

Exams (30%): There are two exams, each worth 15%. Both are taken in the **Testing Center** (open T/W/R, 4:00–10:00 PM) during a listed multi-day window. Most often the questions will be a mix of conceptual multiple choice, a handwritten math problem, and the occasional short code snippet.

- **Exam 1** — covers Chapters 1–3; window **Oct 20–22**.
- **Exam 2** — covers Chapters 4–8; window **Dec 8–10**.

There is no separate comprehensive final exam. Exams cannot be made up or retaken after the window has closed except in genuinely exceptional circumstances; if you know in advance of a conflict, contact me at least one week beforehand so we can make arrangements.

Projects (40%): Projects are the heart of the course. There are three, and detailed handouts and rubrics are provided separately.

- **Project 1 & Project 2 (Code Projects, 10% each):** Implement an algorithm from class in Julia — adding a well-documented, tested function to our shared class GitHub repository — and present it to the class (about 20 minutes: the algorithm, existing implementations, and runtime/memory considerations). Project 1 is drawn from root-finding (Chapter 2); Project 2 is your choice from Chapters 3–6. The rubric rewards working code, abundant and clear comments, quality documentation, good style, and an accompanying unit test.
- **Final Project (20%):** A larger, multi-stage applied problem — a parameter-optimization problem built on an initial-value problem — documented in a self-contained Jupyter notebook, with an in-class presentation. The project is **due before** the presentations, which take place during the scheduled final exam period.

Schedule: A detailed day-by-day schedule — topics, assigned homework problems, due dates, exam windows, and project milestones — is provided in the separate *Course Schedule* handout and posted on Canvas. It is subject to change; I will announce any changes.

Course Goals: After completing the course you should be able to:

1. Converse meaningfully about algorithms, convergence, stability, error analysis, and runtime. (SLO 1,2,5)
2. Provide theoretical results about the error, stability, and convergence of the algorithms discussed. (SLO 1,2)

3. Use Julia to implement the algorithms of the course. (SLO 1,3,4)
4. Understand floating-point arithmetic and its limitations. (SLO 2,3)
5. Access and use existing implementations of these algorithms. (SLO 3,4)
6. Analyze and solve a variety of application problems. (SLO 1,3,4)
7. Navigate GitHub and contribute to the scientific-computing community. (SLO 5)

Since this is a major course, I feel it is important to give students ample opportunities and resources to develop their skills as independent learners. In my experience, one characteristic that sets math majors apart from other students is their ability to assimilate complex procedures and concepts in a short period of time. For better or worse, this ability is universally expected of math majors in both industry and academia. This is often referred to as a soft skill in graduate school, or as part of what is called the "hidden curriculum." My hope is that all of my students are well practiced in this skill by the time they graduate—so that they are not only capable of learning something on their own, but can do so effectively.

The way I attempt to foster this skill is by asking students to read the textbook before class. We then work through the section together during class time. Throughout this process, you will have ample opportunity to ask questions and—most importantly, in my opinion—to **discuss**, in your own words, what is happening. In doing so, we leverage the significant benefit of having a very small class size while we still have it. Each of you will have the opportunity to test and develop your understanding of the material through discussion with your peers and with me.

Student Learning Outcomes (SLO) for the Mathematics Major: A student successfully completing this major will:

1. Competently work with the concepts of calculus, differential equations, geometry, analysis, algebra, and statistics. (Foundation-Formulate)
2. Learn to read, understand, analyze, and produce proofs at increasing depth. (Mathematical Proofs-Prove)
3. Use appropriate technology to enhance mathematical thinking and understanding, solve mathematical problems, and judge the reasonableness of results. (Technology-Solve)
4. Exhibit knowledge of formulating and solving problems, interpreting solutions, and modeling techniques central to applications of mathematics. (Mathematical Modeling-Model)
5. Demonstrate the ability to effectively communicate mathematics and other quantitative ideas in written and oral forms. (Communication-Communicate)

Core Learning Goals (CLG): Here is a reminder of the goals SVU has for each graduate. Students completing Southern Virginia's core curriculum are expected to attain the following college-level competencies:

- *Careful Writing:* Students will be able to present arguments in clear written English with proper spelling, grammar, vocabulary, and transitions.
- *Critical Thinking:* Students will be able to separate a conclusion from its premises and evaluate how well the premises support the conclusion.
- *Analytic Reasoning:* Students will be able to evaluate a body of evidence and draw appropriate conclusions.

Core Values: Lastly, Here is a reminder of the values SVU endeavors to foster in each student. Students demonstrate:

- *Scholarship* by coming prepared to class, focusing on activities in class, and meticulously completing homework assignments.

- *Discipleship* by being respectful of others and showing courtesy and concern for others and the learning environment.
- *Accountability* by faithfully attending class and coming on time, coming prepared, being aware of assignments given and completing them on time.
- *Enthusiasm* by participating in class discussions and completing in-class activities, showing interest in cultural material and discussions about mathematics in general.
- *Refinement* by going above and beyond in living the dress and grooming standards, their manner of speech and actions, cleaning up the classroom and following proper classroom etiquette. This includes not using cell phones (texting, etc.) or other electronic devices that may disrupt learning in the class.

Title IX
Southern Virginia University is committed to providing an environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking.

Southern Virginia University, in compliance with Title IX, supports the academic success of pregnant students and students with pregnancy-related conditions (pregnancy, childbirth, termination of pregnancy, lactation, and all related medical conditions or recovery). Students may request reasonable, related modifications from the University by contacting the Title IX Coordinator at titleix@svu.edu.

Title IX of the Education Amendments of 1972 states that "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance." Title IX applies to all employees and students and covers discrimination in programs, admissions, and activities.

You can report any concerns to the Title IX Coordinator, Nathan Friesema (titleix@svu.edu), your professor, the Wellness Center, or any university administrator. Please be aware that all instructors are mandated reporters, so by law, we must disclose details relayed to us about any possible Title IX infraction to the University's Title IX coordinator.

Accommodations: Southern Virginia University is committed to providing a learning environment that accommodates and supports students with disabilities through accommodations. The Office of Accessibility Services oversees Academic Accommodations. Students with any type of physical, medical, psychological, or emotional disability may be eligible - through the Americans with Disabilities Act (ADA) - to receive accommodations to provide equal access to the academic settings. Any student seeking accommodations should contact the Office of Accessibility Services by emailing accessibility@svu.edu. Students are advised to take care of the necessary documentation and paperwork early in the semester. Accommodations are not made until the student follows the procedures outlined on the website,
(https://catalog.svu.edu/policies/accessibility-and-accommodations) receives an official accommodation letter AND discusses it with their professors.

Academic Honesty: Following the code of conduct, (https://svu.edu/about/faith/code-of-conduct/), students are expected to "be honest in all things, obey the law and follow university policies, and not cheat, steal, or plagiarize." The objective of every faculty member is to empower students by providing opportunities for learning in the best environment possible. If there are questions about what is honest or dishonest behavior, please speak to your professor. Violations of academic honesty are reported to the Office of the Provost and appeals are handled through the student grievance process.

Wellness: We are located on the second floor of Main Hall, Room 234. We are open from 8am to 5pm Monday to Friday. To schedule an appointment with a therapist please Call or Text 540-261-8474, email counseling@svu.edu, or stop by in-person. We strive to accommodate same-day appointments for urgent needs whenever possible.

For Mental Health Emergencies After Hours:

Please use any of the following options:

- **Call or text 988** — Suicide and Crisis Lifeline
- **1-855-222-2046** — Rockbridge Area Community Services Behavioral Health Hotline
- **540-261-4911** — SVU Campus Security
- **Visit the ER** — Carilion Rockbridge Community Hospital
  1 Health Circle, Lexington, VA 24450
- **Call 911**

AI was used in the development and editing of this document.