MATH 4650-E01 – Numerical Analysis I

Summer 2025
Department of Mathematical and Statistical Sciences, University of Colorado Denver

Instructor information

Instructor: Julien Langou, email: julien.langou@ucdenver.edu or through Canvas.

Office hours: By appointment. I will try to be as flexible as possible while trying to maximize the attendance at office hours.

Course catalog description and requisites

MATH 4650 - Numerical Analysis I - 3 Credits

A first semester course in numerical methods and analysis fundamental to many algorithms encountered in scientific computing, data science, machine learning, and computational models in science and engineering. Rounding errors and numerical stability of algorithms; solution of linear and nonlinear equations; data modeling with interpolation and least-squares; and optimization methods.

This course assumes that students have the equivalent of differential and integral calculus (e.g., MATH 2411), linear algebra (e.g., MATH 3191 or 3195), and computer programming (e.g., MATH 1376 or CSCI 1410).

Prereq: MATH 3191 or MATH 3195 with a C- or higher.

Course Goals

Completion of this course will provide you with

1. an understanding of the basic theory of solving mathematical problems with computers while being cognizant of floating-point arithmetic including issues of overflow and underflow.

2. knowledge of the different issues surrounding errors in using numerical methods including machine epsilon, error analysis, convergence, rounding error, truncation error, and norms.

3. an appreciation of the difficulties involved in finding reliable solutions as well as be able to apply various methods for estimating errors in solutions in order to judge how reliable those solutions are.

4. an awareness of conditioning of problems and stability of algorithms and the distinguish between the two.

Programming Language

We will be using Python through Google Colab Jupyter Notebook (https://colab.research.google.com/).

Course materials and procedures

Textbook. Numerical Analysis, 3rd edition by Tim Sauer, ISBN-13: 9780137982189, published by Pearson, in 2018, updated in 2022. The link to the textbook is https://www.pearson.com/en-us/subject-catalog/p/numerical-analysis/P200000006340/9780137982189.
More procedures. Assignments and additional course materials will be posted on Canvas. Announcements, including any revisions to this syllabus, will be announced and posted on Canvas.

Evaluation

During the semester, grades will be posted on Canvas. Students should regularly check their recorded grades, and immediately bring any discrepancies or disputes to the attention of the instructor. Note that the grade calculation capabilities of Canvas are limited and may not be accurate. Use the grading scheme as described in this syllabus to compute your course grade.

You are encouraged to work together in groups outside of class, as well as consult other resources. However, your solutions must be your own. Any submitted solutions that I feel have been mostly copied from other sources, including classmates, textbooks, or the web, will receive no credit. See also the later discussion on academic honesty.

Homework (10% × 7 = 70%). There will be 7 homework during the semester. Each homework is worth 10% of the final grade. For each homework, you need to turn in a "Google Colab Jupyter Notebook shared link" and a PDF with handwritten or typed solutions. The homework will be made with some questions from the textbook, some "reality check" from the textbook, and/or some questions written by your instructors.

Project (10% × 3 = 30%). There will be 3 "reality check" projects during the semester. Each project is worth 10% of the final grade. For each reality check, you need to turn in a "Google Colab Jupyter Notebook shared link" and a PDF with handwritten or typed solutions.

Final course grade scale. Final course letter grades will be assigned according to a student's total course score (calculated as described above). Letter grades for specific scores are given in the following table.

≥ 93%	A	≥ 87%	B+	≥ 77%	C+	≥ 60%	D	< 60%	F
≥ 90%	A-	≥ 83%	B	≥ 70%	C				
		≥ 80%	B-						

Due Dates.

Homework #1	Monday June 16th 2025	at 11:59pm
Homework #2	Monday June 23rd 2025	at 11:59pm
Homework #3	Monday June 30th 2025	at 11:59pm
Homework #4	Monday July 7th 2025	at 11:59pm
Homework #5	Monday July 14th 2025	at 11:59pm
Homework #6	Monday July 21st 2025	at 11:59pm
Homework #7	Monday July 28th 2025	at 11:59pm
Reality Checks #1, #2 and #4	Friday August 1st 2025	at 11:59pm

Numerical Analysis, Third Edition, Timothy Sauer

University, college, and department policies

Academic Calendar

For university deadlines and procedures (such as the last day to withdraw from a course), please see the Academic Calendar. https://www.ucdenver.edu/student/calendars/academic/

Academic Support

Instructor office hours or other appointments are the best way to get additional help. I'm happy to help with questions not answered during class, additional explanation, or homework assistance.

Other sources of support are

- The Math and Stat Support office is located in the Learning Commons Building Room 1225 and regularly offers CU Denver students free drop-in assistance. Hours of operation, zoom links for virtual options, and other forms of support for mathematics and statistics courses are available on the Math and Stat Support webpage.

  https://clas.ucdenver.edu/mathematical-and-statistical-sciences/math-and-stat-support

- The Learning Resources Center (LRC) provides individual and group tutoring, Supplemental Instruction (SI), study skills workshops, and ESL support.

  https://www.ucdenver.edu/learning-resources-center

- The College of Liberal Arts and Sciences has a summary of campus academic support and school/college advising offices.

  https://clas.ucdenver.edu/faculty-staff/content/clas-academic-policies-deadlines

Recording of Class Meetings

Class meetings held on or streamed over a video conferencing platform (such as Zoom, Microsoft Teams, etc) may be recorded and posted for all members of the class. Student participation and interaction may be included in the recording. If you have any concerns about this, please contact the instructor.

Diversity Statement

It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture, etc. I would like to create a learning environment for my students that supports a diversity of thoughts, perspectives and experiences, and honors your identities (including race, gender, class, sexuality, religion, ability, etc). To help accomplish this:

- If you have a name and/or set of pronouns that differ from those that appear in your official records, please let me know!

- If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with me. I want to be a resource for you. Remember that you can also submit anonymous feedback (which will lead to me making a general announcement to the class, if necessary to address your concerns). If you prefer to speak with someone outside of the course, the Office of Diversity, Equity and Inclusion, is an excellent resource.

- I (like many people) am still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that made you feel uncomfortable, including by me, please talk to me about it. (Again, anonymous feedback is always an option).

Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious or other cultural events, please let me know so that we can make arrangements for you.

Health and Wellness

As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, traumas, increased anxiety, substance use, feeling down, difficulty concentrating, and/or lack of motivation. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. If you or someone you know is struggling, you can find supportive campus and community resources at the Health Center at Auraria or the CU Denver Counseling Center. On weekends, holidays or after-hours you can contact the 24/7 Mental Health Crisis and Victim Assistance Line at 303-615-9911.

The University of Colorado Denver is committed the health and well-being of all students. We recognize that diminished mental health, including significant stress, mood changes, excessive worry, or problems with eating and/or sleeping can interfere with optimal academic performance. The source of such symptoms can be quite varied, and include experiences of trauma (such as sexual and relationship violence, stalking, discrimination, crimes, and accidents), responses to course work, family worries, loss, personal struggle, or crisis. If you or someone you know is struggling, you can find supportive campus and community resources at

https://www.ucdenver.edu/counseling-center

or by calling the CU Denver Counseling Center (303-315-7270) or the Health Center at Auraria (303-615-9999). On weekends, holidays or after-hours you can contact the 24/7 Mental Health Crisis and Victim Assistance Line at 303-615-9911.

Disability Accommodation and Access

The University of Colorado Denver is committed to ensuring the full participation of all students in its programs, including students with disabilities. If you have a disability or think you have a disability and need accommodations to succeed in this course, I encourage you to contact Disability Resources and Services (DRS) and/or speak with me as soon as you can. DRS is located in Student Commons Building Suite 2116, and can be reached at disabilityresources@ucdenver.edu and online at https://www.ucdenver.edu/offices/disability-resources-and-services. I am committed to providing equal access as required by federal law, and I am interested in developing strategies for your success in this course.

Nondiscrimination and Sexual Misconduct

The University of Colorado Denver is committed to maintaining a positive learning, working and living environment. University policy and Title IX prohibit discrimination on the basis of race, color, national origin, sex, age, disability, pregnancy, creed, religion, sexual orientation, veteran status, gender identity, gender expression, political philosophy or political affiliation in admission and access to, and treatment and employment in, its educational programs and activities. University policy prohibits sexual misconduct, including harassment, domestic and dating violence, sexual assault, stalking, or related retaliation. If you have experienced any sort of sexual misconduct or discrimination, please visit the Office of Equity web site at https://www.ucdenver.edu/offices/equity to understand the resources available to you or contact the Office of Equity/Title IX Coordinator at equity@ucdenver.edu.

Please note that I am a Responsible Employee, which means that if I witness or receive information regarding possible prohibited protected characteristic discrimination or harassment, any form of sexual misconduct, and/or related retaliation, I am required to promptly report the information to the Office of Equity or their designee.

Religious Holiday Accommodation

Faculty in the University of Colorado system provide reasonable accommodations to students who must be absent from classes because of religious holidays. If you will miss class or graded assignments in order to observe religious holidays, you must contact me with all course conflicts by the end of the first week of classes.

Student Code of Conduct

As members of the University community, students are expected to uphold university standards, which include abiding by state civil and criminal laws and all University policies and standards of conduct. These standards are outlined in the student code of conduct, which can be found at https://www.ucdenver.edu/student/wellness/student-conduct

Academic Honesty

Students are expected to know, understand, and comply with the ethical standards of the university. A university's reputation is built on a standing tradition of excellence and scholastic integrity. As members of the University of Colorado Denver academic community, faculty and students accept the responsibility to maintain the highest standards of intellectual honesty and ethical conduct.

Academic dishonesty is defined as a student's use of unauthorized assistance with intent to deceive an instructor or other such person who may be assigned to evaluate the student's work in meeting course and degree requirements.

This course assumes your knowledge of the policies and definitions. University policies allow the instructor to decide how to respond to an ethics violation, whether by lowering the assignment grade, lowering the course grade, and/or filing charges against the student with the campus Office of Student Conduct. For more information regarding the Office of Student Conduct policies and procedures, please refer to https://www.ucdenver.edu/student/wellness/student-conduct/academic-integrity. Violating the academic honor code can lead to expulsion from the University.

Examples of academic dishonesty include, but are not limited to, the following:

Plagiarism.   Plagiarism is the use of another person's distinctive words or ideas without acknowledgment. Examples include:

1. Word-for-word copying of another person's ideas or words;
2. The mosaic (the interspersing of one's own words here and there while, in essence, copying another's work);
3. The paraphrase (the rewriting of another's work, yet still using their fundamental idea or theory);
4. Fabrication of references (inventing or counterfeiting sources);
5. Submission of another's work as one's own;
6. Neglecting quotation marks on material that is otherwise acknowledged.

Acknowledgment is not necessary when the material used is common knowledge.

Cheating.   Cheating involves the possession, communication, or use of information, materials, notes, study aids or other devices not authorized by the instructor in an academic exercise, or communication with another person during such an exercise. Examples include:

1. Copying from another's paper or receiving unauthorized assistance from another during an academic exercise or in the submission of academic material;
2. Using a calculator when its use has been disallowed;
3. Collaborating with another student or students during an academic exercise without the consent of the instructor.

Note on use of Generative AI.   Generative AI tools such as ChatGPT may not be used on exams, tests, or quizzes that do not permit the use of outside resources. The instructor will provide guidelines on whether such tools can be used for assignments and projects.

Fabrication and Falsification.   Fabrication involves inventing or counterfeiting information, i.e., creating results not obtained in a study or laboratory experiment. Falsification, on the other hand, involves the deliberate alteration of results to suit one's needs in an experiment or other academic exercise.

Multiple Submissions.   This is the submission of academic work for which academic credit has already been earned, when such submission is made without instructor authorization.

Misuse of Academic Materials.   The misuse of academic materials includes, but is not limited to, the following:

1. Stealing or destroying library or reference materials or computer programs;
2. Stealing or destroying another student's notes or materials, or having such materials in one's possession without the owner's permission;
3. Receiving assistance in locating or using sources of information in an assignment when such assistance has been forbidden by the instructor;
4. Illegitimate possession, disposition, or use of examinations or answer keys to examinations;
5. Unauthorized alteration, forgery, or falsification;
6. Unauthorized sale or purchase of examinations, papers, or assignments.

Complicity in Academic Dishonesty.   Complicity involves knowingly contributing to another's acts of academic dishonesty. Examples include:

1. Knowingly aiding another in any act of academic dishonesty;
2. Allowing another to copy from one's paper for an assignment or exam;
3. Distributing test questions or information about the materials to be tested before the scheduled exercise;
4. Taking an exam or test for someone else;
5. Signing another's name on attendance roster or on an academic exercise.

Incomplete Policy

When a student has special circumstances that make it impossible to complete course assignments, faculty members may choose to award an incomplete grade. All incomplete courses are assigned a grade of Incomplete (I). Incomplete grades are not awarded for poor academic performance or as a way of extending assignment deadlines. Faculty are not required to award an Incomplete.

To be eligible for an Incomplete grade, students MUST:

- Have participated in the class for a significant proportion of the term.
- Have successfully completed a significant proportion of the course assignments.
- Have special circumstances (verification may be required) that preclude the student from attending class and/or completing graded assignments.
- Make arrangements to complete missing assignments with the original instructor by a mutually agreed upon date but within one calendar year.
- Both the instructor and student should complete and sign the incomplete form found at

  https://clas.ucdenver.edu/faculty-staff/content/incomplete-grade-policy.

- The instructor gives a copy of the signed incomplete form to the department.

Incompletes cannot:

- require a student to repeat the entire course,
- repeat or replace existing grades,
- allow the student an indeterminate period of time to complete a course, or
- allow the student to repeat the course with a different instructor.

Student Grievances

Students who have concerns about the course or instructor should first contact the instructor to discuss the issue. If the issue is not resolved, the student should next contact the Associate Chair of the Department of Mathematical and Statistical Sciences (currently Stephen Hartke <stephen.hartke@ucdenver.edu>). If not satisfied, the student should then appeal to the appropriate Associate Dean of the student's home school or college (for CLAS, this is the Associate Dean for Student Success). No step in this process should be skipped.

STUDENT SUPPORT

CARE Team is there for you
Call 303-352-3579 if you
or a classmate needs extra help
Submit a concern at
http://www.ucdenver.edu/care

Call 911 in case of emergency
Auraria Campus Police: 303-556-5000

CAREER COUNSELING at LYNXCONNECT
ucdenver.edu/careercenter - Tivoli 339
303-315-7315 - CareerCenter@ucdenver.edu

COUNSELING CENTER
ucdenver.edu/counselingcenter - Tivoli 454 (4th floor)
303-315-7270 (*Emergency After-Hours: 303-615-9911*)

DISABILITY RESOURCES & SERVICES
ucdenver.edu/offices/disability-resources-and-services
 Student Commons 2116
303-315-3510 - disabilityresources@ucdenver.edu

OFFICE OF EQUITY
ucdenver.edu/equity - Lawrence Street Center 12th floor
303-315-2567 – equity@ucdenver.edu

PHOENIX CENTER AT AURARIA
24/7 Free and Confidential Helpline: 303-556-2255
Info on interpersonal violence, referrals, options, & next steps
www.thepca.org - Tivoli 227 - 303-315-7250 - info@thepca.org

FREE TUTORING
Contact these services for academic assistance throughout the semester

LEARNING RESOURCES CENTER
ucdenver.edu/lrc – Learning Commons Suite 1231
303-315-3531 - LRC@ucdenver.edu

MATH AND STAT SUPPORT
Learning Commons Room 1225
clas.ucdenver.edu/mathematical-and-statistical-sciences/math-and-stat-support

WRITING CENTER
writingcenter.ucdenver.edu - Learning Commons First Floor

UNDERGRADUATE ACADEMIC ADVISING
ucdenver.edu/undergradadvising

Graduate students: contact your graduate program directly for advising information

ARCHITECTURE AND PLANNING (CAP) ADVISING
CU Building 2000
303-315-1000 - cap@ucdenver.edu

ARTS AND MEDIA (CAM) ADVISING
Arts Building 177
303-315-7400 - camadvising@ucdenver.edu

BUSINESS SCHOOL ADVISING
15th and Lawrence Street, 4th floor
303-315-8110 – undergrad.advising@ucdenver.edu

CENTER FOR UNDERGRADUATE EXPLORATION & ADVISING (CUE&A)
Student Commons 1113
303-315-1940 - cuea@ucdenver.edu

EDUCATION & HUMAN DEVELOPMENT (SEHD) ADVISING
Lawrence Street Center 701
303-315-6300 - education@ucdenver.edu

ENGINEERING, DESIGN & COMPUTING (CEDC) ADVISING
North Classroom 3034
303-315-7170 - engineering@ucdenver.edu

LIBERAL ARTS AND SCIENCES (CLAS) ADVISING
North Classroom 1030
303-315-7100 – clas_advising@ucdenver.edu

PUBLIC AFFAIRS (SPA) ADVISING
Lawrence Street Center 525
303-315-2228 – spa.advising@ucdenver.edu

Plan Ahead! **Review Important Dates & Deadlines**
at http://ucdenver.edu/academiccalendar

University of Colorado **Denver**

[UCD Access (Student Portal)](#)
[Registrar Forms](#)
[Registration Information](#)

All deadlines are 11:59 PM MT unless otherwise indicated.

Main Session	Date	Important Notes
Priority registration begins for Summer in UCDAccess.	March 3, 2025 - March 18, 2025	Check UCDAccess for your specific registration date and time assignment. For best course selection, register as soon as possible after your registration time assignment.
Open enrollment begins for Summer in UCDAccess.	March 19, 2025	
Memorial Day	May 26, 2025	No classes. Campus closed.
First day of Summer Main Session classes.	June 9, 2025	
Last day to waitlist Summer Main Session classes using UCDAccess.	June 12, 2025	
Last day to drop a Summer Main Session class without a $100 drop charge.	June 13, 2025	All waitlists will be eliminated today.
Census Day - Summer Main Session 2025	June 17, 2025	Deadline time is 5:00 PM MT.
Last Day to add Summer Main Session classes in UCDAccess.	June 17, 2025	After this date, College Opportunity Fund hours will not be applied and will not be deducted from eligible student's lifetime hours. Deadline time is 5:00 PM MT.
Last day to drop Summer Main Session classes without paying for the course and a "W" recorded on the transcript.	June 17, 2025	Deadline time is 5:00 PM MT.
Last day to apply for Summer graduation in UCDAccess.	June 17, 2025	Deadline time is 5:00 PM MT. After this date, contact your advisor.
Last day to request or cancel Grade Forgiveness in a Summer Main Session class.	June 17, 2025	Refer to the Grade Forgiveness form for restrictions. Deadline time is 5:00 PM MT.
Juneteenth Holiday	June 19, 2025	No classes. Campus closed.
Independence Day	July 4, 2025	No classes. Campus closed.

Last day to withdraw from a Summer Main Session class in UCDAccess.	July 14, 2025	
Last day to request No Credit or Pass/Fail grade for a Summer Main Session class.	July 14, 2025	Graduate degree students can exercise the P+/P/F option for undergraduate courses only. Graduate students should consult their school or college regarding the P+/P/F option. A grade of P+/P/S will not be acceptable for graduate credit to satisfy any graduate education requirement.
End of Summer Main Session	August 2, 2025	
Final grades available on UCDAccess and transcripts (tentative).	August 7, 2025	
Summer degrees posted on UCDAccess and transcripts (tentative).	August 25, 2025	This is the date your degree will be recorded on your transcript. Diplomas begin mailing on September 15th.

Important Information

Refer to the Residency website for important deadlines pertaining to In-State Tuition Rate qualification.

Refer to the College Opportunity Fund (COF) website for important deadlines pertaining to the COF stipend for eligible undergraduate students paying in-state tuition.

Additional Billing/Financial Information: Students are responsible for complying with tuition/fees deadlines. All registered students must access their student account and billing information through UCDAccess. You will also receive an electronic bill to your university email account.

Intensive and Module classes require the same amount of work and number of classroom hours as full-term classes. Intensive classes are less than five weeks. Module classes last five or more weeks, but less than full term. Module/intensive classes may be added up until the first day of the class. After the first day of class, late starting module or intensive classes may be added with the instructor's signature approval. Instructor approval is not required to drop the class within the first 15% of class meetings.