Numerical Analysis

MATH 420–01

Spring 2023

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Office Hours: Monday, Wednesday, and Friday 10:00 AM – 11:00 AM, Tuesday and Thursday 9:30 AM– 11:00 AM, and by appointment.

Important Dates

First Homework due ..... **Saturday, 4 February**
Exam 1 ..... **Friday, 24 February**
Exam 2 ..... **Friday, 31 March**
Exam 3 ..... **Friday, 5 April**
Final exam ..... **Wednesday, 17 May**

Class meeting times

This class meets Monday, Wednesday, and Friday from 9:05 PM – 9:55 PM in Discovery Hall, room 383.

Course Objectives

On completion of this course, students will

(a) understand IEEE arithmetic and know the rules for accurate computation.

(b) understand the concepts of linear and quadratic convergence and use these concepts to analyze the efficiency of an algorithm.

(c) develop an understanding of the algorithms for solving linear and nonlinear equations, interpolation, quadrature, least squares methods, and solution of differential equations.

(d) be able to use a programming language and graphical tools to solve problems numerically.

Catalog description

MATH 420 (Numerical Analysis, 3 credit hours) Principles of error analysis and accurate computation; rates of convergence, the solution of linear and nonlinear equations, interpolation and least squares, numerical integration, and numerical solution of differential equations.

Prerequisite

To be in this class, you must have already earned a passing grade in Calculus II (UNK's MATH 202).

Final Exam

The final exam will be comprehensive and it will be given on Wednesday, 17 May from 8:00 AM–10:00 PM in Discovery Hall, room 383.

Course Resources

1. Our textbook is *First Semester in Numerical Analysis with Julia,* by Giray Ökten. This is an open-source textbook that can be legally downloaded, printed, and used without payment.[1]
2. A free account on UNL's supercomputer.
3. Class notes that are written on the board or distributed via Canvas.
4. Reliable internet access.
5. An internet connected computer (not just a phone or tablet)
6. The Julia programming language, the Jupyter notebook, and the Gadfly graphics package.
7. Pencils, erasers, notebook for note taking. Colored pens or pencils are nice for note taking.

Grading

Your course grade will be based on weekly in class work, three midterm exams, and a comprehensive final exam; specifically:

Homework *10 fifteen point assignments* ..... 150 (total)
Mid-term Exams 1,2, and 3 *100 points each* ..... 300 (total)
Comprehensive Final exam ..... 150 (total)

The following table shows the *minimum* number of points (out of 600) that are required for each of the twelve letter grades D- through A+. For example, a point total of 520 points will earn you a grade of B+, and a point total of 540 points will earn you a grade of A-. If you earn a point total of 359 or less, you will earn a failing course grade.

D-	360	B-	480
D	380	B	500
D+	400	B+	520
C-	420	A-	540
C	440	A	560
C+	460	A+	588

Policies

1. All work you turn in for a grade must be your own. If you need assistance in completing a homework assignment, you may ask me for help but nobody else. Googling for answers, seeking help from the Learning Commons or other faculty members, or using solution keys from previous terms (either from UNK or other universities) is also prohibited. Each homework assignment you turn in for a grade must include the statement:

[1] https://open.umn.edu/opentextbooks/textbooks/first-semester-in-numerical-analysis-with-julia.

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

Using unauthorized materials while taking a test will earn you a failing course grade. Each exam will specify what resources are allowed.

2. The final examination will be *comprehensive*. It will be given on Wednesday 5 May from 8:00 am to 10:00 am.

3. Generally, weekly problem sets are due at 11:59 pm local time each Saturday. If you have an extended illness that keeps you from completing the homework, contact me immediately. Since homework is turned in electronically, requests to turn in homework late (due to minor illness or absences) will generally be declined.

4. The course calendar may change. Changes to the schedule can be made in class, but not noted anywhere else. It is your responsibility to learn of changes to the schedule.

5. If you have questions about how your work has been graded, *immediately* ask me for an explanation.

6. This class has *no option for extra credit.*

7. For pedagogical reasons, our class notes will sometimes differ in notation, style, and level of abstraction from the textbook.

Students with Disabilities or Those Who are Pregnant

It is the policy of the University of Nebraska at Kearney to provide flexible and individualized reasonable accommodation to students with documented disabilities. To receive accommodation services for a disability, students must be registered with UNK Disabilities Services for Students Office, 172 Memorial Student Affairs Building, 308-865-8988 or by email unkdso@unk.edu

It is the policy of the University of Nebraska at Kearney to provide flexible and individualized reasonable accommodation to students who are pregnant. To receive accommodation services due to pregnancy, students must contact Cindy Ference in Student Health, 308-865-8219. The following link provides information for students and faculty regarding pregnancy rights: `http://www.nwlc.org/resource/pregnant-and-parenting-students-rights-faqs-college-and-graduate-students`

Reporting Student Sexual Harassment, Sexual Violence or Sexual Assault

Reporting allegations of rape, domestic violence, dating violence, sexual assault, sexual harassment, and stalking enables the University to promptly provide support to the impacted student(s), and to take appropriate action to prevent a recurrence of such sexual misconduct and protect the campus community. Confidentiality will be respected to the greatest degree possible. Any student who believes she or he may be the victim of sexual misconduct is encouraged to report to one or more of the following resources:

1. Local Domestic Violence, Sexual Assault Advocacy Agency 308-237-2599

2. Campus Police (or Security) 308-865-8911

3. Title IX Coordinator 308-865-8655

   Retaliation against the student making the report, whether by students or University employees, will not be tolerated.

Academic Honesty Policy

Academic honesty is essential to the existence and integrity of an institution of higher education. The responsibility for maintaining that integrity is shared by all members of the academic community. To further serve this end, the University of Nebraska at Kearney has a policy relating to academic integrity. The maintenance of academic honesty and integrity is a vital concern of the University community. Any student found in violation of the standards of academic integrity may be subject to both academic and disciplinary sanctions. Academic dishonesty includes, but is not limited to, the following:

Cheating: Copying or attempting to copy from an academic test or examination of another student; using or attempting to use unauthorized materials, information, notes, study aids or other devices for an academic test, examination or exercise; engaging or attempting to engage the assistance of another individual in misrepresenting the academic performance of a student; or communicating information in an unauthorized manner to another person for an academic test, examination or exercise.

Fabrication and falsification: Falsifying or fabricating any information or citation in any academic exercise, work, speech, test or examination. Falsification is the alteration of information, while fabrication is the invention or counterfeiting of information.

Plagiarism: Presenting the work of another as one's own (i.e., without proper acknowledgment of the source) and submitting examinations, theses, reports, speeches, drawings, laboratory notes or other academic work in whole or in part as one's own when such work has been prepared by another person or copied from another person.

Abuse of academic materials and/or equipment: Destroying, defacing, stealing, or making inaccessible library or other academic resource material.

Complicity in academic dishonesty: Helping or attempting to help another student to commit an act of academic dishonesty.

Falsifying grade reports: Changing or destroying grades, scores or markings on an examination or in an instructor's records.

Misrepresentation to avoid academic work: Misrepresentation by fabricating an otherwise justifiable excuse such as illness, injury, accident, etc., in order to avoid or delay timely submission of academic work or to avoid or delay the taking of a test or examination.

Other Acts of Academic Dishonesty: Academic units and members of the faculty may prescribe and give students prior written notice of additional standards of conduct for academic honesty in a particular course, and violation of any such standard shall constitute a violation of the Code.

Under §2.9 of the Bylaws of the Board of Regents of the University of Nebraska, the respective colleges of the University have responsibility for addressing student conduct solely affecting the college. Just as the task of inculcating values of academic honesty resides with the faculty, the college faculty are entrusted with the discretionary authority to decide how incidents of academic dishonesty are to be resolved. For more information, please visit UNK's Procedures and Sanctions for Academic Integrity and the Student Code of Conduct.

Course Calendar

We will try to adhere to the following schedule, but we will modify it if needed. The exam dates will only be changed for a compelling reason; we won't delay an exam because we are behind the schedule. Neither will an exam date be moved forward because we are ahead of the schedule.

Homework assignments are due at 23:59 local time on Saturday on the week they are assigned.

Week	**Week**	**Section(s)**	**Topic(s)**
1	1/25	§1.2	Introduction to Julia
2	2/1	§1.1	Floating point numbers & calculus tools **HW 1HW 2**
3	2/8	§2.1	Errors and convergence rates **HW 3**
4	2/15	§2.2 – §2.7	Root Finding **HW 4**
5	2/22	§2.2–§2.7	Root Finding **Exam 1, 26 February**
6	3/1		Linear equations **HW 5**
7	3/8	§3.1–§3.4	Interpolation **HW 6**
8	3/15	§3.1 – §3.4	Interpolation **HW 7**
9	3/22	§4.1–§4.2	Numerical integration **HW 8**
10	3/29	§4.3 –§4.4	Gaussian integration & multiple integrals **Exam 2, 2 April**
11	4/5	§5.1–§5.2	Discrete & continuous least squares **HW 9**
12	4/12	§5.3	Orthogonal polynomials and least squares **HW 10**
13	4/19		Differential equations **Exam 3, 23 April**
14	4/26		Differential equations
15	5/		**Final Exam, Wednesday 5 May, 8:00 am–10:00 am**