

Title: Introductory Numerical Analysis

Instruction style: Hybrid instruction (face-to-face & remote);

- Mondays and Wednesdays 1100-1150: In-class SMLC 120
- Fridays 1100-1150: remote live lectures will be given in Zoom
<https://unm.zoom.us/j/93589182672>

Instructor: Mohammad Motamed, Associate Professor of Computational Mathematics

Contact: motamed@unm.edu (the title of your email must be **Math 505**)

If you need extra help:

1. First, you will need to notify the instructor by email (motamed@unm.edu) via your unm e-mail address and request for an appointment. The title of all your emails must be **Math 505**, no matter what the content is. Please do not use other titles, such as “question”, “need appointment”, “late homework”, “missing Zoom”, etc.

In your email, you will need to provide the instructor with the following information:

- a few time slots and dates when you will be available so that the instructor can find a time that would work for him and you.
 - a method for discussion that you feel comfortable with. Examples include: In-person, Zoom, and MS Teams.
2. Then, the instructor will work with you to set up a time and a method so that you and the instructor can meet and discuss.

Prerequisites: Linear Algebra; Calculus; Numerical Computing.

Description: This is a graduate-level course on numerical analysis. We will cover the following topics:

- Approximation of functions (70%)
 - Polynomial interpolation
 - Polynomial approximation (in uniform norm and 2-norm)
 - Piecewise polynomial approximation (splines)
 - Least squares and weighted least squares
 - Trigonometric/Fourier-type approximation
 - Nonlinear approximation
 - * Free-knot linear splines
 - * n -term approximation
 - * Artificial neural networks (ReLU networks and Fourier features)
- Numerical Optimization (20%)
 - Convex optimization
 - Stochastic optimization (stoch. gradient descent, Metropolis sampling, etc.)
- Numerical Integration and differentiation (10%)

Recommended Texts: There is no required textbook. Much of the material in the course is based on either various classical books or recent research that has not yet appeared in any book. Primary sources of material include:

- An Introduction to Numerical Analysis, by Süli and Mayers.
- Numerical Analysis, by Gautschi.
- Numerical Methods in Scientific Computation, Vol. I, by Dahlquist and Björk.

Grading: Your grade will be based on homework (90%), and active participation in class (10%). Letter grades will then be assigned according to the following scheme: A+/A, 98/90 points or above, B+/B, 88/80 points or above, F below 80 points. The instructor reserves the right to "curve" grades to offset unforeseen circumstances. The curving of grades will never decrease a student's letter grade below that given by the above formula.

Homework: We will have several homework assignments. Each assignment consists of a combination of theoretical problems and/or programming tasks. You need to submit a hard copy of your report on the due date in class. Refer to the *HW Report Format* for instructions on how a report should look like. I take the structure and organization of your reports seriously and will help you improve your writing skills and reports by giving you feedback. You are encouraged to work with your peers on homework problems, but each of you must hand in a homework report in your own words. In most cases late homework is not accepted. If you are to miss a homework due date, you will need to talk to me in advance. In this particular course, assignments are not only a way of assessment. They also serve as important tools for you to digest the course topics by learning how to apply theory to computers in an efficient and correct way.

Dishonesty Policy: Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, including dismissal, against any student who is found responsible for academic dishonesty. Any student who has been judged to have engaged in academic dishonesty in course work may receive a reduced or failing grade for the work in question and/or for the course. Academic dishonesty includes, but is not limited to, dishonesty on quizzes, tests or assignments; claiming credit for work not done or done by others; and hindering the academic work of other students.

Accommodations: UNM is committed to providing equitable access to learning opportunities for students with documented disabilities. As your instructor, it is my objective to facilitate an inclusive classroom setting, in which students have full access and opportunity to participate. To engage in a confidential conversation about the process for requesting reasonable accommodations for this class, please contact Accessibility Resource Center (<https://arc.unm.edu/>) at arcsrvs@unm.edu or by phone at 505-277-3506.

Title IX: Our classroom and our university should always be spaces of mutual respect, kindness, and support, without fear of discrimination, harassment, or violence. Should you ever need assistance or have concerns about incidents that violate this principle, please access the resources available to you on campus. Please note that, because UNM faculty, TAs, and GAs are considered "responsible employees" by the Department of Education, any disclosure of gender discrimination (including sexual harassment, sexual misconduct, and sexual violence) made to a faculty member, TA, or GA must be reported by that faculty member, TA, or GA to the university's Title IX coordinator. For more information on the campus policy regarding sexual misconduct, please see:

<https://policy.unm.edu/university-policies/2000/2740.html>.

Support: LoboRESPECT Advocacy Center and the support services listed on its website, the Women's Resource Center and the LGBTQ Resource Center all offer confidential services and reporting.

COVID-19 Health and Awareness: UNM is a mask friendly, but not a mask required, community. To be registered or employed at UNM, Students, faculty, and staff must all meet UNM's Administrative Mandate on Required COVID-19 vaccination. If you are experiencing COVID-19 symptoms, please do not come to class. If you have a positive COVID-19 test, please stay home for five days and isolate yourself from others, per the Centers for Disease Control (CDC) guidelines. If you do need to stay home, please communicate with me at *motamed@unm.edu*; I can work with you to provide alternatives for course participation and completion. UNM faculty and staff know that these are challenging times. Please let us know that you need support so that we can connect you to the right resources and please be aware that UNM will publish information on websites and email about any changes to our public health status and community response.

Disclaimer: I reserve the right to make reasonable and necessary changes to the policies outlined in this syllabus. Whenever possible, the class will be notified in advance of such changes. An up-to-date copy of the syllabus can always be found on the course webpage. You need to regularly check the course webpage for possible updates. It is **your responsibility** to know and understand the policies discussed therein and to be up-to-date. If in doubt, ask questions.