

# Applied Numerical Linear Algebra, MATH 591, 3 Credit Hours

KU Course Number 57143, Spring 2022

The University of Kansas  
Department of Mathematics

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Lectures:	Tuesday and Thursday 09:30 – 10:45, Snow Hall 302
Instructor:	Paul Cazeaux (pcazeaux@ku.edu), Snow Hall 509
Course web site:	class Blackboard site or instructor website: <a href="http://cazeaux.ku.edu">cazeaux.ku.edu</a>
Office hours:	Wednesday 1-2pm (online Zoom), or by appointment

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Course Goals & Description: The goal of this course is to introduce students to the fundamental concepts of numerical linear algebra such as: systems of linear equations, linear least squares, eigenvalue problems, matrix factorizations, singular value decomposition, and the use of computational software. Included are the study of

- Basic linear algebra concepts;
- LU, QR and SVD decompositions;
- Least Squares;
- Optimization Basics;
- Applications to Machine Learning.

Course Objectives: By the end of this class, you should:

- become familiar with basic concepts of Python or Julia programming,
- learn basic numerical linear algebra algorithms and some theory aspects behind them,
- develop new skills in data analysis and scientific computing.

Prerequisites: Students should be comfortable with fundamental concepts from elementary linear algebra (MATH 290). The course is not open to students with credit in MATH 782.

Textbook: There is no required textbook. Class notes will be posted online as the semester progresses. Useful texts (ask at the KU library!) include (among others):

- *A First Course in Numerical Methods* by Uri M. Ascher and Chen Greif, SIAM, 2011 (Chapters 4-8), <https://epubs.siam.org/doi/book/10.1137/9780898719987>
- *Numerical Linear Algebra and Applications, Second Edition* by Biswa Nath Datta, SIAM, 2010, <https://archive.siam.org/books/ot116/>, and
- *Linear Algebra and Optimization for Machine Learning* by Charu C. Aggarwal, Springer, 2020. <https://link.springer.com/book/10.1007/978-3-030-40344-7>

Additional materials may be posted on-line. Please check regularly for updates.

Safety, health, masks: **To protect all of us, everyone must wear a mask in the classroom as required by the Protect KU Pledge and by University policy.** Violations of the mask policy in classrooms are treated as academic misconduct. If you come to class without a mask, I will ask you to put one on. If you do not put on a mask when asked, you will have to leave class. Violations will be reported, and consequences will follow, up to and including suspension from the course.

Attendance: You are expected to attend every class and prepare the material by reading covered sections of the textbook ahead of time. If you miss a class it is your responsibility to make up missed material on your own time.

If you face challenges to fully participating at any time during the semester, please let me know, and please contact me if you expect to miss class. If you are having any difficulties meeting the requirements for the course and are thinking about dropping, please reach out to me. I am available and ready to support your success. Additionally, if you need to report an extended illness or serious accident, please contact Student Support and Case Management at [course-adapt@ku.edu](mailto:course-adapt@ku.edu) or 785-864-4060. A case manager will send email notifications to your instructor(s) on your behalf. When you are able, you will need to follow up with your professors to coordinate a temporary arrangement regarding missed instruction and coursework.

Illness and Participation: The knowledge and skills you will gain in this course highly depend on your participation in class learning activities. Even as we return to in-person instruction this semester, I would like students who are feeling ill, at-risk or wish to protect themselves or others to feel comfortable staying home. Students who are unable to attend class in-person will be provided a complete set of notes and should plan to regularly engage me during office hours or by appointment.

How to be OK: In case you haven't noticed, there is a global pandemic. None of us is really "OK". If you tell me you are having trouble, I'm not going to judge you or think less of you. I hope you will extend me the same grace. Here are some ground rules:

- You never owe me personal information about your health (mental or physical), or anything else.
- However, you are always welcome to talk to me about things that you might be going through.
- If I can't help you, I will try to direct you to KU resources for assistance.
- If you need extra help, please... ask me! I will listen and will work with you.

Grading Policy: Quizzes and Homework Assignments (40%), Midterm Exams (30%) and Project (30%) of the final grade. Final scores of at least 90, 80, 70, 60 guarantee grades of *A*, *B*, *C* and *D*, respectively. The \*total score\* (on a scale 0-1000) will be computed by adding up the following point contributions:

- homework scores (total score on a scale of 0-200);
- quizzes (total score on a scale of 0-200);
- midterm exam scores (each on a scale of 0-150);
- final project score (on a scale of 0-300)

- Exams: Thursday, March 10 (tentative): Midterm (9:30–10:45, in class)  
Friday, April 1: Progress report for the project due,  
Thursday, April 14 (tentative): Midterm (9:30–10:45, in class)  
Friday, May 13: Final project reports due.
- Midterms: There are two midterm exams, each 75 minutes long. All exams will be closed book: no books, no notes, and no papers may be used during the exams. If you are unable to take the exams because of sickness or dire emergencies, please contact me promptly. Questions are based on homework and worksheet problems but are never quoted verbatim. Please use the results of the first midterm to help you decide if you are in danger of failing and should either drop the course, or get extra help.
- Homework: Homework assignments will be assigned approximately **biweekly** over the course of the semester and may include, but are not limited to, problems from the textbook or homemade, and short programming assignments. **Each homework assignment is due at the beginning of the class on the indicated due date**, usually Tuesdays. Not all problems may be graded. No credit for late homework. Your homework must be neatly, clearly and logically written.  
I encourage you to discuss homework problems with your classmates, including strategies for solving different kinds of problems. Indeed this is one of the best ways to improve your understanding of the course. However, when you write up your solutions you must do this on your own. Handing in homework that is almost identical to a classmate's is a form of cheating and will not be tolerated.
- Make ups: (for one-time extraordinary events) Exam absences due to recognized University-related activities, religious holidays, verifiable illness, and family/medical emergencies will be dealt with on an individual basis. For university activities or religious holidays you should make arrangements with your instructor well in advance. If you are suddenly unable to take an exam, you should e-mail me ASAP. If you are too sick to take an exam, do not take the exam. There are no retakes. In all cases of absence from exams a written excuse is required for a make-up to be granted. Ignorance of the time and place of an exam will not be accepted as an excuse for absence from an exam. If you do not take an exam, you will be assigned a grade of zero for that exam.
- Announcements: Students are held responsible for all announcements and all course content delivered in class and in workshop. All official announcements occur in class only. I will not make extraordinary efforts to contact students outside of lecture & Blackboard.
- Special needs: Please inform me of any accommodations granted through the Academic Achievement and Access Center (AAAC) within the first two weeks of class. More specifically, please present a copy of your accommodation letter to your instructor during the first two weeks and set up your accommodations for the whole semester. The instructor will be glad to assist you. *The AAAC coordinates academic accommodations and services for all eligible KU students with disabilities. If you have a disability for which you wish to request accommodations and have not contacted the AAAC, please do so as soon as possible. They are located in 22 Strong Hall and can be reached at 785-864-4064 (V/TTY). Information about their services can be found at <https://www.access.ku.edu>.*
- Withdrawal Policy:
- February 7: first period drop ends. Last day to cancel the course without a W.
- February 14: last day to enroll/add/change on-line.
- April 18: second period drop ends. Last day to withdraw from a class. W on transcript.
- No withdrawals permitted after April 19 through the end of the term.

- Religious Holidays: *Any student having a conflict between a mandated religious holiday and the course schedule should contact the instructor as soon as possible.*
- Policy: *By attending this classes you agree to the University of Kansas Policy as stated in Code of Student Rights and Responsibilities (CSRR) and University Senate Rules and Regulations (USRR), see <http://policy.ku.edu/>, and the rules introduced below.*
- Honor Code: *Plagiarism, e.g., copying exercise solutions, is unacceptable in any academic environment, and is a serious violation of the University's policy, see Article II, Section 6 USRR. You are encouraged to discuss your homeworks with me and your colleagues, however, the submitted solutions and MATLAB codes must be your own original work. The exams must be your own individual work.*
- Diversity, Inclusion, Civility: *The instructor considers this classroom to be a place where you will be treated with respect as a human being - regardless of gender, race, ethnicity, national origin, religious affiliation, sexual orientation, gender identity, political beliefs, age, or ability. Additionally, diversity of thought is appreciated and encouraged, provided you can agree to disagree. It is the instructor's expectation that ALL students experience this classroom as a safe environment.*
- The University of Kansas supports an inclusive learning environment in which diversity and individual differences are understood, respected, and appreciated. We believe that all students benefit from training and experiences that will help them to learn, lead, and serve in an increasingly diverse society. All members of our campus community must accept the responsibility to demonstrate civility and respect for the dignity of others. Expressions or actions that disparage a person's or group's race, ethnicity, nationality, culture, gender, gender identity / expression, religion, sexual orientation, age, veteran status, or disability are contrary to the mission of the University.*
- We expect that KU students, faculty, and staff will promote an atmosphere of respect for all members of our KU community. Civility and respect for the opinions of others are very important in an academic environment. It is likely you may not agree with everything that is said or discussed in the classroom. Courteous behavior and responses are expected at all times. When you disagree with someone, be sure that you make a distinction between criticizing an idea and criticizing the person. Expressions or actions that disparage a person's or race, ethnicity, nationality, culture, gender, gender identity / expression, religion, sexual orientation, age, disability, or marital, parental, or veteran status are contrary to the mission of this course and will not be tolerated.*
- Concealed Carry: *Individuals who choose to carry concealed handguns are solely responsible to do so in a safe and secure manner in strict conformity with state and federal laws and KU weapons policy. Safety measures outlined in the KU weapons policy specify that a concealed handgun: Must be under the constant control of the carrier. Must be out of view, concealed either on the body of the carrier, or backpack, purse, or bag that remains under the constant control of the carrier. Must be in a holster that covers the trigger area and secures any external hammer in an un-cocked position. Must have the safety on, and have no round in the chamber.*

Intellectual Prop-  
erty:      *Pursuant to the University of Kansas' Policy on Commercial Note-Taking Ventures, commercial note-taking is not permitted in this course. Lecture notes and course materials may be taken for personal use, for the purpose of mastering the course material, and may not be sold to any person or entity in any form. Any student engaged in or contributing to the commercial exchange of notes or course materials will be subject to discipline, including academic misconduct charges, in accordance with University policy. Please note: note-taking provided by a student volunteer for a student with a disability, as a reasonable accommodation under the ADA, is not the same as commercial note-taking and is not covered under this policy.*

Disclaimer:      *Course schedule and procedures are subject to change in the event of extenuating circumstances and the instructor reserves the right to modify any information in this syllabus. Notice of changes will be announced in class. Students should check regularly the class Blackboard site for announcements.*

Statement:      *By signing to this class you are acknowledging that you have read and understand the content of this syllabus and you agree to follow all course expectations.*