CSCE 2120 Foundations of Computing: Vectors and Matrices

Instructor Information

Name: Bailu Zhang (she/her)
Office Location: F296
Office Hours: Wednesday 10-12pm
Email: Bailu.Zhang@unt.edu
IA: TBD (tbd@my.unt.edu) Office hours: TBD

Course Description, Structure, and Objectives

This course introduces vector and matrix operations and computations as central data abstractions for algorithmic systems, graphics engines, and artificial intelligence. Topics include representations of vector spaces, matrix transformation strategies, solving systems of equations, and eigenvalue problems through algorithms and coding. The focus is on building, analyzing, and applying software solutions to computational problems in computer engineering and computer science, emphasizing the role of matrix and vector operations and optimizing for performance and accuracy in modern programming environments and their libraries such as Python.

Course Structure

This course takes place face-to-face with a split lecture/lab cadence. There are 14 modules of content that you will move through.

Course Outcomes

Upon successful completion of this course, learners will be able to:

1. Apply knowledge of vector spaces, matrices, and linear systems to solve contemporary computer engineering and computer science problems (such as computer graphics and AI).
   (ABET EAC SO1: Apply knowledge of mathematics, science, and engineering.)
   (ABET CAC SO1: Analyze complex computing problems and apply computing principles and disciplines to identify solutions.)
2. Formulate and solve linear systems arising from real-world computing applications using both analytical and computational techniques.
   (ABET EAC SO2: Identify, formulate, and solve engineering problems.)
   (ABET CAC SO2: Design, implement, and evaluate computing-based solutions to meet a given set of requirements in the context of the discipline.)
3. Use numerical linear algebra algorithms to perform matrix computations with awareness of floating-point accuracy and computational limitations.
   (ABET EAC SO6: Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment.)
   (ABET CAC SO1: Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.)
4. Implement algorithms in software to solve and visualize problems involving eigenvalues, matrix factorizations, and least-squares, using computational tools such as Python.
   (ABET EAC SO7: Acquire and apply new knowledge as needed, using appropriate learning strategies.)

(ABET CAC SO6, Apply computer science theory and software development fundamentals to produce computing-based solutions.)

5. Communicate mathematical and algorithmic solutions effectively**,** both in writing and through visualizations, for technical and non-technical audiences.
   (ABET EAC SO3: Communicate effectively with a range of audiences.)
   (ABET CAC SO3: Communicate effectively in a variety of professional contexts.)

Prerequisites and Corequisites

Prerequisite(s): CSCE 2100 and CSCE 2110, with a grade of C or better, MATH 1710 or MATH 1810 with a C or better.

Corequisite(s): None

How to Succeed in this Course

Netiquette

Netiquette, or online etiquette, refers to the way students are expected to interact with each other and with their instructors online. Here are some general guidelines:

- Treat your instructor and classmates with respect in email or any other communication.
- Remember that all college level communication should have correct spelling and grammar (this includes discussion boards).
- Avoid slang terms such as “totes magotes” and abbreviations such as “u” instead of “you.”
- Humor and sarcasm are highly encouraged. People who take the world seriously are in for a rough journey.
- Don’t lead your emails off with your social security and bank account numbers, password manager master password, home address, credit score, and dental record jpegs. Three of those will suffice.
- No extra credit will be given for mentioning my kitten.

See these Netiquette Guidelines for more information.

Communication Expectations

Please email me from your official student UNT email account (my.unt.edu) for all course communication. Do not send course messages through Canvas; I will not reply to Canvas messages.
Just like you, I receive a virtual ton of spam to my email address, and if it has $[EXT]$ in the subject line, there's a ~95% chance I'm just deleting it. Additionally, I cannot discuss any student issues through external email due to FERPA, i.e. I cannot confirm that I *know* it's *you* I'm conversing with.

I have a 48 hour reply policy on all emails, excepting weekends and holidays. All grades will be posted promptly after grading has been completed.
Please come to me with any issues. Sending an email is free and if I can’t resolve it, we can move the issue up the chain.
In your emails please include:

Subject	the course (e.g. CSCE2120) that you are emailing about and a few words (aka, *the Subject)*
Body	a signature with your email with your name and UNT ID number.

This helps me not only help you, but if there are multiple issues with the course (i.e. a module is broken for instance), I can quickly collate the issue. I flag these emails with my preferred color.

Academic Accommodations

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time; however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information, refer to the Office of Disability Access website (https://studentaffairs.unt.edu/office-disability-access). You may also contact ODA by phone at (940) 565-4323.

Academic Success Resources

UNT strives to offer you a high-quality education and a supportive environment, so you learn and grow. As a faculty member, I am committed to helping you be successful as a student. To learn more about campus resources and information on how you can be successful at UNT, go to unt.edu/success and explore unt.edu/wellness. To get all your enrollment and student financial-related questions answered, go to scrappysays.unt.edu.

Supporting Your Success and Creating an Inclusive Learning Environment

Every student in this class should have the right to learn and engage within an environment of respect and courtesy from others. We will discuss our classroom's habits of engagement and I also encourage you to review UNT's student code of conduct so that we can all start with the same baseline civility understanding (Code of Student Conduct) (https://policy.unt.edu/policy/07-012).

Required/Recommended Materials

Required Textbook

Bass, Berrier, Chan, & Siu. *CSCE 2120: Foundations of Computing: Vectors and Matrices*. zyBooks, 2025.
ISBN: 979-8-203-30096-6
Access: https://learn.zybooks.com/zybook/UNTCSCE2120Fall2026 (subscription required)

Recommended Supplemental Materials

Boyd, Stephen, and Lieven Vandenberghe. *Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares*. Cambridge University Press, 2018. Free online book site and PDF: https://web.stanford.edu/~boyd/vmls/. This text is recommended for applied examples, computational intuition, and least-squares applications.

Cook, *Applied Linear Algebra*. Recommended for additional lecture notes, worked examples, and practice materials: https://supermath.info/AppliedLinearAlgebra.html.

Course Requirements/Schedule

Module	Topic	Description
1	Vectors First + Modeling Linear Systems	Introduces vectors as data and uses them to model real-world systems of linear equations.
2	Row Operations, Echelon Forms, and Solution Sets	Develops Gaussian elimination and connects row-reduced forms to existence, uniqueness, and structure of solutions.
3	Inner Products and 3D Geometry	Uses dot products, lengths, angles, planes, lines, and projections to study geometry in $\mathbb{R}^3$.
4	Matrix Algebra and Matrix Equations	Introduces matrix operations, products, powers, and equations such as $Ax = b$.
5	Inverses, Elementary and Block Matrices	Studies invertibility, elementary matrices, and block matrix methods for computation and structure.
6	LU Factorization + Leontief and Markov Applications	Covers matrix factorization for efficient solving, with applications to economic input-output models and Markov chains.
7	Vector Spaces and Bases	Introduces subspaces of $\mathbb{R}^n$, span, independence, bases, and dimension.
8	General Vector Spaces and Fundamental Subspaces	Extends vector space ideas beyond Euclidean space and studies null spaces, column spaces, row spaces, and left null spaces.
9	Determinants: Properties and Interpretations	Develops determinants as tools for invertibility, volume scaling, orientation, and computation.
10	Linear Transformations and Representations	Studies linear maps through geometry and matrices, especially transformations of the plane.
11	Eigenvalues and Eigenvectors	Introduces invariant directions, characteristic equations, diagonalization, and long-term behavior.
12	Inner Products, Norms, Orthogonality, Projections	Builds the geometry of vector spaces using length, angle, orthogonal bases, and projection methods.
13	Least Squares and the Pseudoinverse	Studies best-fit solutions to inconsistent systems and introduces the pseudoinverse as a solution tool.
14	Complex Inner Products, ODE Systems, PCA	Connects advanced inner product spaces with dynamical systems, eigenspaces, and data reduction methods.

Please see the Canvas schedule for specific dates for modules and due dates for assignments.

Students will be notified by Eagle Alert if there is a campus closing that will impact a class and describe that the calendar is subject to change, citing the Campus Closures Policy (https://policy.unt.edu/policy/15-006).

Assessing Your Work

Assignment percentages

Type	Quantity	Percentage	Lowest Scores Drop
Administrative quiz	2	4%	None
Academic quiz	14	12%	2
Labs	14	24%	2
Zybook	14	24%	2

Assignment percentages

Type	Quantity	Percentage	Lowest Scores Drop
Project	1	12%	None
Midterm Exam	1	12%	None
Final Exam	1	12%	None

Grading scale

Final Grade	Letter
90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
< 60	F

Grades are rounded to the nearest whole integer.

There is no curving of grades, nor "extra" credit, as it is unfair to the other students.

Grades are based on mastery of the content. I encourage you to find opportunities to learn with and through others. Explore Navigate's Study Buddy (https://navigate.unt.edu) tool to join study groups. Maximize your learning with our coaching staff at the Learning Center. Focus on areas where you are struggling in this course by attending scheduled study group sessions with me the week before each exam. Forward together!

Attendance and Participation

I have great respect for students who are balancing the demands of their coursework with the responsibilities of caring for family members. If you run into challenges that require you to miss a class, please contact me or my TA. There may be some flexibility we can offer to support your academic success.

Course Evaluation

Student Perceptions of Teaching (SPOT) is the student evaluation system for UNT and allows students the ability to confidentially provide constructive feedback to their instructor and department to improve the quality of student experiences in the course.

Assignment Policies

Submittal Policy

All assignments are posted to Canvas and should be submitted to Canvas. Assignments cannot be accepted through email.

Late Work Policy

No late submissions will be accepted for any reason. Please start work on assignments and quizzes well before the deadline and on a stable Internet connection to avoid any submission delays due to technical difficulties.

AI (Artificial Intelligence) and AI (Academic Integrity) Policy

You may use AI tools in this course as learning aids. Appropriate uses include asking conceptual questions, brainstorming approaches, checking syntax, debugging code, generating small examples, and getting feedback on your reasoning. Learning to use AI responsibly is part of modern computing practice, and I am happy to discuss effective uses during office hours or after class.

The boundary is simple: AI may support your learning, but it may not replace your work.

- Do not copy an assignment problem into an AI tool and submit the AI-generated response as your answer.
- Your submitted work must reflect your own understanding. You should be able to explain, reproduce, modify, and defend any solution, proof, calculation, or code that you submit.
- You are responsible for verifying every AI-assisted claim, computation, proof step, and line of code. AI tools can be confidently wrong, especially in mathematics and programming.
- If you use AI on an assignment, include a brief acknowledgment at the end stating which tool you used and how you used it. You do not need to disclose routine spelling or grammar help unless it changes the mathematical or computational content.
- Misrepresenting AI-generated work as your own, using AI when an assignment explicitly forbids it, or submitting copied AI output violates academic integrity expectations and may result in academic penalties.

When in doubt, ask before submitting.

Screenshot Submission Policy

Some assignments may ask for screenshots as evidence of completed work, program output, or a required setup step. If a screenshot is required, the assignment instructions will say so. Screenshots should make the relevant work clear without exposing unnecessary personal information.

1. Use your operating system's native screenshot tool. Do not submit a photo of your screen unless the assignment specifically permits it.
2. Include enough context to verify the work, such as the relevant window, output, file name, or Canvas prompt.
3. When identity verification is requested, show your EUID or another approved identifier in the screenshot, such as in a small text editor window or an appropriate UNT/Canvas profile area.
4. Crop the image to the relevant area. Remove unrelated windows, notifications, browser tabs, or private information whenever possible.
5. Use the file type requested in Canvas. If the assignment does not specify a type, PNG, JPG, or PDF screenshots are acceptable as long as Canvas can preview the file.
6. Unreadable, incomplete, or unverifiable screenshots may be graded based only on the evidence that is visible.

Canvas File Upload Policy

Assignments may require multiple file uploads. Do no archive/compress/zip these into one file: Attach them individually.

The only acceptable file type for upload is what can be previewed automatically by DocViewer in Canvas (https://community.canvaslms.com/t5/Instructor-Guide/What-types-of-files-can-be-previewed-in- Canvas/ta-p/607).

Examination Policy

You may use the Internet or any printed resources during exams, but please do not rely on this as the exams and quizzes have a time limit and many questions are not easily 'Google-able'.

DO NOT POST quiz questions to any online venue (Quizlet, Chegg, CourseHero, CheatMyDegree, etc.) or share quiz questions with other students (GroupMe, Discord, etc.).

Violation of this policy will result in a zero for the assignment or exam. You may use online resources during the exam, but all quizzes and exams must be taken by yourself without human help.

Technical Assistance

Part of working in the computer industry involves dealing with the inconveniences and frustration that can arise when technology breaks down or does not perform as expected. Here at UNT we have a Student Help Desk that you can contact for help with Canvas or other technology issues.

UNT Help Desk
Call: 940-565-2324
Telephone Availability:

- Monday–Thursday: 8am – 9pm
- Friday: 8am- 5pm
- Saturday: 11am- 3pm

Email: helpdesk@unt.edu
Walk-in: Sage Hall, Room 330
Walk-in Hours: Monday–Friday: 8am - 5pm

For additional support, visit Canvas Technical Help

The following library service desks provide laptop checkouts during hours of operation. MacBooks are only available at Willis Library.

- **Willis Library:** The Spark, First Floor
- **Sycamore Library:** Sycamore Service Desk
- **Discovery Park:** Library Service Desk, Room B112

Student Support Services

- Registrar
- Financial Aid
- Student Legal Services
- Career Center
- Counseling and Testing Services
- Student Affairs Care Team
- Student Health and Wellness Center

Academic Support Services

- Academic Resource Center
- Academic Success Center
- UNT Libraries
- Writing Lab
- Math Lab