

# MATH 4326/5322: Linear Algebra

CRN: 20778/23702

Spring 2023

Education building, room 309

Mondays, Wednesdays, 10:30-11:50

3 credit hours

Instructor: Dr. Art Duval

Office: Bell Hall, room 303

Phone:

*(915)747-6846/office: 24 hours/day; if I'm not in, please leave a message.*

*(915)747-6502/fax: Include a cover sheet with my name, please.*

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Office hours:

- Mondays, 1:00-2:00
- Tuesdays, 1:00-2:00
- Wednesdays, 1:00-2:00
- Thursdays, 10:00-11:00

Please feel free to come by my office any time during scheduled office hours. You are welcome to visit at other times, but in that case you might want to make an appointment, just to make sure that I will be there then. You can make an appointment simply by calling me, or by sending e-mail. You can just propose a time, and I will respond either by agreeing to that time, or, if I cannot make it then, I will propose different times.

Alternatively, you can talk with me by Zoom at <http://tinyurl.com/ArtDuvalSpring23> during office hours or by appointment.

You may also ask any questions directly via phone or e-mail. If I'm not in when you call, please leave a message on the voice mail or answering machine with your name, number, and a good time for me to call you back. I will try to respond to your phone or e-mail message as soon as possible.

Prerequisite: Principles of Mathematics (MATH 3325)

Or, an equivalent course where you learn the basics of writing proofs.



## Course Objectives

Upon successful completion of the course, you will be able to prove (and occasionally discover) theorems in linear algebra, at the level of abstraction of linear transformations and vector spaces; other major topics include eigenvalues/eigenvectors and inner product spaces. You will know, understand, and be able to apply, prove, and explain major results in this area. You will be better able to independently read advanced mathematics.

*Note:* In contrast to Matrix Algebra (Math 3323), we will be focusing on proofs and theory instead of applications (though theory lies closer to applications in linear algebra than it does in, say, analysis), vector spaces instead of  $\mathbb{R}^n$ , and linear transformations instead of matrices. Otherwise, many topics will look familiar.

## Required Materials

*Textbook: Linear Algebra Done Right, 4<sup>th</sup> edition (preliminary version), by Sheldon Axler (Springer).* We will discuss Chapters 1-7. All other material in the course will be aligned to the textbook. We will discuss approximately two sections per week. We will skip some sections as announced on Blackboard. There are a set of videos recorded by the author, generally one per section, corresponding to the textbook. These videos are available to you on Blackboard.



This preliminary version of the textbook is available to you, as a .pdf file, **free** on Blackboard. The publisher has agreed to the author's request that this edition of the book will be an Open Access book, meaning that the electronic version will be available free to the world. However, the author does not want this preliminary version circulating or available to the world on the web because it would be impossible to get preliminary versions removed from the

internet once the final version appears. **Please do not to distribute the file to anyone else or to post it on the internet.**

The author also states, "I deeply appreciate your help in making Linear Algebra Done Right into a better book. Throughout the coming semester or quarter, please send me suggestions for improvements and items that should be corrected. I want to make LADR as good as possible, so even minor typos or a misplaced comma should be brought to my attention." Send your comments, corrections, and suggestions to [linear@axler.net](mailto:linear@axler.net)

You will spend a substantial amount of time outside of class reading the textbook. The course will be structured to encourage and support you in this endeavor. In-class activities will center around our making use of what you have read outside of class.

## Technology Requirements

*Blackboard:* Announcements, assignments, and course grades are all delivered via the Internet through the Blackboard learning management system (LMS). Ensure your UTEP e-mail account is working and that you have access to the Web and a stable web browser. Mozilla Firefox and Google Chrome are the most supported browsers for Blackboard; other browsers may cause complications with the LMS. When having technical difficulties, update your browser, clear your cache, or try switching to another browser. Check for announcements on Blackboard, or via your UTEP e-mail account (where announcements will also be sent), at least once per day.

*Gradescope:* We will be using Gradescope this term, which allows us to provide fast and accurate feedback on your work. Assignments will be submitted through Gradescope, and assignment and exam grades and feedback will be returned through Gradescope. As soon as grades are posted, you will be notified immediately so that you can log in and see your feedback. Grades will also be posted on Blackboard.

Your Gradescope login is your university email, and your password can be changed at [https://gradescope.com/reset\\_password](https://gradescope.com/reset_password). The same link can be used if you need to set your password for the first time. More support for Gradescope can be found [here](#).

*Scanning:* You may want to be able to upload your handwritten work for assignments. To do this, you will need to be able to scan your work, and upload it to your computer. If you don't have access to a scanner (they are sometimes built into all-in-one printers), you can use phone apps such as GeniusScan, TinyScanner, CamScanner, AdobeScan, and the scanning feature of the Notes app in iOS. Please upload your work as a .pdf file. (Using your phone camera to take a picture leaves the document in a format that is harder for me to work with.)

*LaTeX/Overleaf (optional):* If you prefer to type your work, I strongly recommend using LaTeX. (Typing math in a normal word processing system is often clumsy.) LaTeX produces textbook-quality mathematical typesetting, yet the commands you'll need for homework are mostly very simple. If you haven't used LaTeX before, but you want to now, then the best way to learn and use LaTeX is through the free website [Overleaf](#), which has good tutorials to get you [started quickly](#), and an [extensive help page](#) if you want to do anything more advanced.

## Course Assignments and Grading

### Homework

For each section of material we encounter, there will be three kinds of homework, as follows (more details are in the Appendix):

*Advance preparation (20%)* You will read each section, write responses to reading questions, create some of your own questions, and reflect. The written part of this assignment will be due *before* we discuss the material in class, generally 5:00 p.m. the day before we discuss that material in class. This will give me a chance to use your responses to plan the class meeting.

*Warmup exercises (10%)* On the day of our class discussion over the material, we will discuss easier warmup exercises. You will prepare your answers, in writing, before class, and the class will share answers in small groups or whole class discussions. Then turn in your final version of these problems by 11:59pm that day.

I expect everyone to attend and participate actively in class, in particular to speak up during class discussion with questions and ideas, and to work well with others. Your active participation in class will constitute a substantial part of this part of your grade for the course.

*Main exercises (30%)* *After* our class discussion over the material, you will turn in clearly-written solutions to harder homework problems. These will generally be due weekly, by 11:59pm on Saturday. [Graduate students](#), who are enrolled in MATH 5322, will be assigned more main exercises than undergraduates, who are enrolled in MATH 4326, in accordance with university policy.

For homework, you may consult with various sources for general help with any problem, but you must solve the particular problem by yourself. Sources you may consult include: classmates; friends, tutors; any material from the class, including the textbook or its associated videos; online books and videos. **If you consult any sources outside of the class, you must let me know which sources you used** (a short message, by email or within Blackboard, will suffice). More details about homework is in the Appendix.

For each of the first two types of homework, the two lowest scores will be dropped. For the Main Exercises, the lowest score will be dropped.

## Exams

*Midterm exam (15%)* The midterm exam will cover all material up to that point (Chapters 1-3). It will be in class, on **Wednesday, March 8**.

*Final exam (25%)* The final exam will be comprehensive over all material of the course. The final will be on **Friday, May 12, 1:00 – 3:45 p.m.**

Once you begin an exam, you will not be allowed to leave the classroom until you have finished the exam. There will be no bathroom breaks. If you have a medical reason for needing more frequent bathroom breaks, please provide documentation in advance.

## Grading scale

All graded items will be graded on, or converted to, a scale where 4 is the minimum score for an A, 3 is the minimum score for a B, 2 is the minimum score for a C, and 1 is the minimum score for a D.

## Late work

*Homework:* Extensions on homework deadlines will only be given under unusual circumstances, and with an explanation. (Too much work in other classes is not a sufficient explanation.) It is generally better to submit an incomplete assignment than a late assignment. Remember, too, that one or two of the lowest homework scores of the semester for each type of homework will be dropped, and this is usually the best solution for that one week in the semester when everything in your life goes wrong.

*Exams:* Make-up exams will only be given under extraordinary and unavoidable circumstances, and with advance notice if possible. You will need to provide written documentation. If you anticipate a conflict with any exam date, please contact me as soon as possible. Otherwise, please make space on your calendar right now for all exams.

## POLICIES

### Attendance

I strongly encourage you to attend every class you can (but stay home if you are sick), though there is no particular grade penalty for absences. You are responsible to find out any assignment that must be made up if you are absent. My goal is for class meetings and activities to complement, rather than echo, the textbook, and thus for every class to be worth attending.

### Courtesy

We all have to show courtesy to each other, and the class as a whole, during class time. Please arrive to class on time (or let me know when you have to be late, and why); do not engage in side conversations when one person (me, or another student) is talking to the whole class; turn off your cell phone (or, for emergencies, at least set it to not ring out loud), and do not engage in phone, email, or text conversations during class.

## Scholastic Integrity

Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as one's own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. I report all suspected violations of academic integrity to the [Office of Student Conduct and Conflict Resolution \(OSCCR\)](#) for investigation and possible disciplinary action. To learn more, see [HOOP: Student Conduct and Discipline](#).

## Copyright Statement for Course Materials

All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

## Student Resources

UTEP provides a variety of student services and support:

- [Math Tutoring Center \(MaRCS\)](#): Ask a tutor for help and explore other available math resources.
- [UTEP Library](#): Access a wide range of resources including online, full-text access to thousands of journals and eBooks plus reference service and librarian assistance for enrolled students.
- [Help Desk](#): Students experiencing technological challenges (email, Blackboard, software, etc.) can submit a ticket to the UTEP Helpdesk for assistance. Contact the Helpdesk via phone, email, chat, website, or in person if on campus.
- [University Writing Center \(UWC\)](#): Submit papers here for assistance with writing style and formatting, ask a tutor for help and explore other writing resources.
- [Military Student Success Center](#): UTEP welcomes military-affiliated students to its degree programs, and the Military Student Success Center and its dedicated staff (many of whom are veterans and students themselves) are here to help personnel in any branch of service to reach their educational goals.

## Drop Policy

To drop this class, please contact the [Registrar's Office](#) to initiate the drop process, by the deadline of **Thursday, March 30, 2023**. After this date, you will not be able to drop the class (as per the Dean's office). Furthermore, a grade of incomplete is only for extraordinary circumstances, such as a missed exam.

I hope everyone will complete the course successfully, but if you are having doubts about your progress, I will be happy to discuss your standing in the course to help you decide whether or not to drop. You are only allowed three enrollments in this course, and only six withdrawals in your entire academic career, so please exercise the drop option judiciously.

## Accommodations Policy

[The University is committed to providing reasonable accommodations](#) and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs,

services and activities with documented disabilities in order to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. If you have, or suspect you have, a disability and need an accommodation, you should contact [UTEP Center for Accommodations and Support Services \(CASS\)](#) at (915)747-5148 or [cass@utep.edu](mailto:cass@utep.edu), or apply for accommodations online via the [CASS portal](#). You are responsible for presenting to me any CASS accommodation letters and instructions.

#### Exceptional Circumstances

If you anticipate the possibility of not being able to participate in the course due to exceptional circumstances such as military service and/or training, childbirth, etc., please let me know as soon as possible.

#### COVID-19 Precautions

*If you are sick, stay home!* Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to [covidaction@utep.edu](mailto:covidaction@utep.edu), so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID-19 testing (see below).

*Vaccines.* The best way that Miners can take care of Miners is to get the vaccine, which is now widely available for free in the El Paso area. Learn more at [epcovidvaccine.com](http://epcovidvaccine.com).

*Testing.* UTEP is offering two convenient options for free COVID-19 testing on campus. For more details, see <https://www.utep.edu/ehs/covid/>.

Current UTEP students have access to **free on-campus testing in the UTEP Student Health and Wellness Center** located in Union Building East, first floor. No appointment is necessary, although preregistration online is required at [medicatconnect.com](http://medicatconnect.com). Click [here](#) for more information about student on-campus testing at UTEP

The University also offers **free self-administered COVID-19 PCR testing through a kiosk located at the UTEP Testing Site at 3333 N. Mesa**. The kiosk is located outside the building's entrance, and it is available 24 hours a day, seven days a week. Register online at <https://register.testandgo.com/> or access the registration app by scanning the QR code at the machine.

## APPENDIX: More details about homework

In all cases, strive to write your responses clearly. Use complete sentences where appropriate, and show steps of any calculations, etc.

### Advance preparation

You may work with others on this part, but you must write your responses by yourself.

*Reading questions:* Read assigned material. Reread as needed for complete understanding. Then write clear responses to assigned questions about the reading.

*Your questions:* Write down some of your own explicit questions about your reading, ready to bring up in class. This may involve new or old concepts which are confusing to you, and connections to other ideas. You may also write down what was well explained and interesting, what was confusing, what you had to reread but eventually understood. Do not leave this section blank, or just write, "This section was easy." If the section was indeed easy for you, then be sure to comment on where the textbook explanation was good or bad, or find connections to other ideas.

*Reflection:* Write two or three sentences reflecting on the process of your work; this should only take a few minutes. Write about how things went with any assignment or reading done for class, and other course work. This should reflect both your ongoing personal feelings about the course as a whole and your interaction with the material at hand.

*Time and resources:* Write how much time you worked on the Advance preparation, and with whom. Also write down any other sources you consulted.

### Warmup exercises

Work individually, and **then** with others outside class time, on a few assigned easy warmup exercises on the new material we will discuss, based on your Advance preparation. Write up the solutions to these individually, to share in in class. I will ask individuals and groups to present some of these to the class, to get us started discussing new material. You may use the class discussion to improve your solutions before you turn them in.

Also always write how much time you worked on the Warmup exercises, and with whom. Also write down any other sources you consulted.

### Main exercises

Work individually and with others on these problems. Also visit me during office hours or at other appointment times to ask questions. I am happy to help you. Then write up your final solutions completely by yourself, without comparing with other people. The paper you submit should be entirely your own writing, not the same as anyone else's.