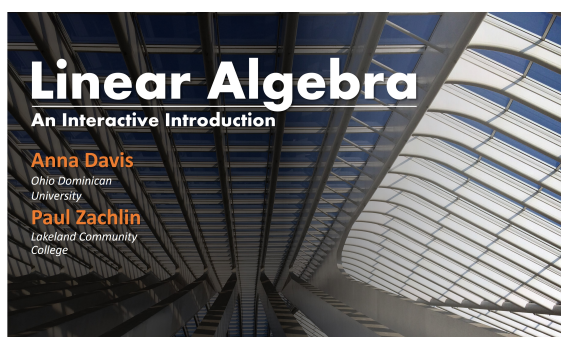

Front Matter

June 5, 2026

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About this Project

About this Text

This is the third edition of *Linear Algebra, An Interactive Introduction*. The [first edition](#) (2018) was funded by the Ohio Open Ed Collaborative (OOEC) through the Ohio Department of Higher Education Innovation grant. The [second edition](#) (2023) was made possible by Fall 2022 sabbatical leaves granted to Anna Davis and Paul Zachlin by Ohio Dominican University, and Lakeland Community College, respectively.

This edition contains significant updates to content, as well as formative assessments. We have added different types of chapter review exercises, Octave exercises, and included an Octave tutorial with links to sample code. This phase of the project was funded by the [Ximera Project](#) through the [Open Textbook Pilot Program](#) grant (2024-2026).

We have taken care to ensure these materials satisfy the [Ohio Transfer Assurance Guidelines](#) for a first course in Linear Algebra, as well as the recommendations for a first course in linear algebra made by [The Linear Algebra Curriculum Study Group \(LACSG 2.0\)](#).

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Textbook Website

A PDF version of this text, as well as links to previous editions of the text are available on our website <https://sites.google.com/view/lin-alg-interactive-intro/>. The website also includes links to student and instructor surveys, as well as an errata form.

Acknowledgements

- We would like to thank our reviewers Jim Fowler of Ohio State University and Jim Cottrill of Ohio Dominican University for their thoughtful comments and suggestions regarding the first edition.
- This project would not have been possible without the XIMERA platform. Many thanks go to Bart Snapp and Jim Fowler of Ohio State University for their continued guidance and support.
- We would also like to thank Wim Obbels of KU Leuven, Belgium, for sharing his expertise in formatting and deploying Ximera documents.
- We are also grateful to Steven Valvoda for his careful reading and editing.
- Our inspiration and some of our content came from other open textbooks. We would like to thank Keith Nicholson and Ken Kuttler for making their texts available under a Creative Commons license. Since one of the authors taught Linear Algebra using the excellent book by David Poole for fifteen years, that text has most certainly influenced our work as well.
- Funding and support for this project was generously provided by
 - Ohio Open Ed Collaborative through the Ohio Department of Higher Education Innovation grant (2017-2018).
 - Ohio Dominican University, and Lakeland Community College through author sabbatical leaves (2022).
 - The [Ximera Project](#) through the US Department of Higher Ed Open Textbook Pilot Program (2024-present).

Bibliography

Ken Kuttler, *A First Course in Linear Algebra*, Lyryx 2017, Open Edition. (CC-BY)

W. Keith Nicholson, *Linear Algebra with Applications*, Lyryx 2018, Open Edition. (CC-BY-NC-SA)

David Poole, *Linear Algebra, A Modern Introduction, 4th Edition*, Cengage Learning, 2015.

Questions and Comments

For questions and comments about the content, please contact the authors.

For questions about XIMERA, please write to ximera@math.osu.edu

For anonymous feedback, and to report errata, please visit our website: <https://sites.google.com/view/lin-alg-interactive-intro/>.

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3 To the Instructor

Linear Algebra: An Interactive Introduction is designed to be used for a first course in linear algebra. Of course, so many different students take linear algebra that the content of a first course can vary quite a bit. We have worked hard to make sure that this text can serve a wide variety of introductory courses.

Features of the Text

The text is housed on the [XIMERA](https://ximera.sdsu.edu/) platform. Our text is open source, made available under [CC BY-NC-SA 4.0](https://creativecommons.org/licenses/by-nc-sa/4.0/) license. Source code is available at <https://github.com/annadavismath/LinearAlgebraDZ>

Most of the sections begin with some sort of Exploration which lets students explore the ideas of the section before getting into terminology and other details. We make use of embedded GeoGebra interactives, Octave cells, Google Sheets, YouTube Videos, and machine-graded exercises to create a more interactive experience than could possibly be provided by a traditional textbook. The main narrative, which follows the initial exploration, usually contains a few additional interactive elements. The interactive nature of the text makes it well-suited for online learning, or for an “inverted” or “flipped” classroom where students read and begin working on sections before they are actually “covered” in class. The end of each section contains Practice Problems designed to reinforce the concepts taught in that section.

Chapter 1 contains material that may be skipped or covered very briefly, as much of it would be seen by students in other courses. Each of Chapters 2-10 begins with a list of student learning outcomes that the students should achieve by studying that chapter. This edition also contains extensive review sections and test prep materials. These are located in Chapter Reviews and include solved problems, challenge problems, chapter tests, and links to vocabulary quizzes. We have also added an Octave tutorial, and Octave Exercises which harness free computing software to further student understanding. Chapter 11 contains Applications, which are one of the most important aspects of any introduction to linear algebra. In addition to the seven applications featured as sections of Chapter 11, links to resources containing more than seventy other applications appear at the beginning of the chapter. Chapter 12, the Appendix, includes sections on The Triangle Inequality, Complex Numbers, and Complex Matrices, as well as an Index. In addition, it contains links to more than 30 GeoGebra interactives that appear throughout the text. Instructors can copy these for their own instructional purposes.

Possible Course Schedules

As stated earlier, this text is designed to serve a variety of introductory courses, and here we will give some sample course schedules that may be used.

The first sample schedule reflects the course one of the authors teaches each year to a variety of students. Most years the (small) class contains a mixture of future engineers, teachers, math majors, computer science or other STEM majors, and some advanced high school students. Therefore, a balance between pure and applied mathematics approaches is appropriate. This schedule reflects fifteen weeks of teaching, and a pace of 4 sections per week, slowing down in the later chapters when the sections become more challenging.

For this course, we cover Chapter 2: Systems of Equations and Chapter 3: Big Ideas about Vectors during the first two weeks, along with the last two sections of Chapter 1 on lines and planes in $\mathbb{R}^3$. Chapter 4: Matrices takes another two weeks, and we may skip the last section on LU-Factorization, unless time allows. We spend another week on Chapter 5: Subspaces of $\mathbb{R}^n$, and another on the first four sections of Chapter 6: Linear Transformations.

At this point we explore some Applications from Chapter 11 or elsewhere and only finish Chapter 6 if there is extra time before Spring Break (the end of week 8).

Week 9 is devoted to Chapter 7: Determinants, after which we spend two entire weeks on Chapter 8: Eigenvalues and Eigenvectors. we spend another two weeks on Chapter 9: Orthogonality, although this is not enough time to finish the entire chapter. We spend a week on Chapter 10: Abstract Vector Spaces, and while there is plenty more that could be done there, we usually explore a few more applications with any remaining time.

Weeks	Chapters	Weeks	Chapters
1,2	2, 3	9	7
3,4	4	10,11	8
5	5	12,13	9
6	6	14	10
7,8	11, review	15	11, review

Of course there are many other ways to spend time in a linear algebra course. Some instructors may spend more time on determinants, or abstract vector spaces, or some of the topics in Chapter 9. We have tried to provide you with the resources to easily customize your course to meet the needs of your students. As noted in [The Linear Algebra Curriculum Study Group \(LACSG 2.0\) Recommendations](#), “Depending upon the clientele, courses offered should find a balance between abstraction, concrete matrix manipulations, and application.”

References

Stewart, S., Axler, S., Beezer, R., Boman, E., Catral, M., Harel, G., McDonald, J., Strong, D., Wawro, M. (2022). The Linear Algebra Curriculum Study Group (LACSG 2.0) Recommendations, Notices of American Mathematical Society, 69(5), 813-819. DOI: <https://dx.doi.org/10.1090/noti2479>

4 How to Use this Text

How to Use this Text

In this section we will cover some technical aspects of using this text. In particular, you will learn about the following features:

- Machine-graded exercises.
- Using GeoGebra interactives.
- Using Octave cells.

Machine-Graded Exercises

Machine-graded exercises on the XIMERA platform are designed to help you learn without penalizing you for not getting the right answer the first time. You can enter answers until you get it right.

Question 1 Try typing 5 in the answer cell below, then answer the question correctly.

$$2 + 2 = \dots$$

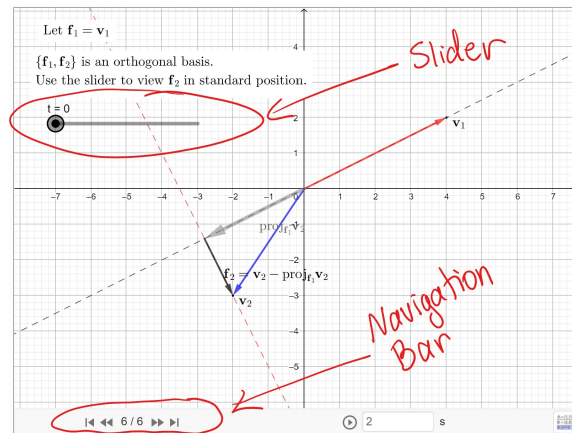
You can enter answers in fraction or in decimal form, as long as your answers are exact. For example, the following answers are considered equivalent: $\frac{10}{4} = \frac{5}{2} = 2.5$. However, $\frac{1}{3} \neq 0.333$.

GeoGebra Interactives

GeoGebra interactives are one of the most exciting features of this text. They are designed to give you valuable geometric insights by helping you interact with mathematical objects in three dimensions, and by letting you animate processes. For example, you can visualize two planes and a point in $\mathbb{R}^3$ by rotating the following figure. RIGHT-CLICK and DRAG to rotate the figure for a better view. Try it!

GeoGebra link: <https://www.geogebra.org/m/unceva9g>

The following screenshot highlights the *navigation bar* and the *slider*. Both tools are used to guide you through constructions and algorithms, one step at a time. Start by using the *navigation bar*. Click the arrows to advance slides. When the *slider* appears, you can use it to animate the perpendicular vector.



Try it out below:

GeoGebra link: <https://www.geogebra.org/m/xtqppyav>

GeoGebra offers many more features. Make sure to read the directions in each interactive!

Octave Cells

Please refer to the [Octave Tutorial](#) for more information on how to use Octave and Octave Cells.

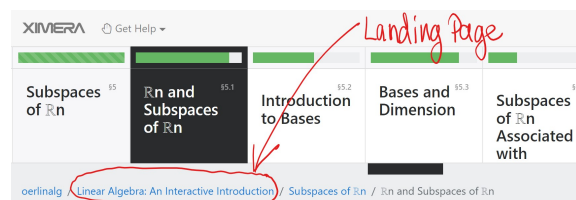
Keeping Track of Progress

XIMERA does not require a log-in. Your answers will be saved automatically, and XIMERA will remember your progress.

Warning 1. You will lose your work if you clear out your cookies. You will also lose your work if you switch to a different computer.

Instructors may require that students submit a proof of completion. This is easy to do.

- Go to the landing page for the course.



- Scroll to the bottom of the page and click on the Certificate button.

Complex Matrices

\$12.3

INDEX

\$12.4

You can download a

Certificate

as a record of your successes.

- Your instructor may ask you to submit a screenshot of your completion summary.

XIVIERA

Get Help

Search for...

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