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Practical linear algebra. A geometry toolbox. 3rd ed.

Boca Raton, FL: CRC Press (ISBN 978-1-4665-7956-9/hbk; 978-1-4665-7959-0/ebook). xvi, 498 p. (2014).

The original edition of this book appeared in 2004 and was reviewed in [Zbl 1064.15001]. The current edition appears to be about 25% longer than the first, but the general comments on the earlier edition remain true. The first half of the book describes vector geometry in two and three dimensions over $\mathbb{R}$, well-illustrated with graphics and hand-drawn sketches. Determinants are introduced as signed areas or volumes, affine maps are defined and described geometrically, eigenvalues and eigenvectors computed for 2×2 matrices, and various forms of matrices such as rotations and shears are described. The next quarter of the book considers spaces of more general dimensions (still over $\mathbb{R}$) and describes algorithms such as LU-factorization, iterative solution of systems of linear equations, the power method to find the largest eigenvalue of a nonnegative matrix, and the singular value decomposition (SVD) with applications to least squares. The last quarter of the book discusses the classification of conics and topics in computational geometry such as triangulation of a surface and fitting Bézier curves. In the second half of the book, there are some good descriptions of how linear algebra is applied. In the reviewer's opinion the more successful of these are: determining light and shading of surfaces in computer graphics, page ranking by Google using eigenvector computations, and image compression using SVD; each of these sections explains the application and gives a reasonable outline of what mathematics is involved. The authors claim: "[By replacing] mathematical proofs with motivations, examples, or graphics … the book covers all of undergraduate-level algebra in the classical sense." Unfortunately, the attempt at a wide coverage and the informal style means that some concepts introduced, particularly in the later parts of the book, are imprecise, and some assertions leave a suspicion that the authors may not be clear about the underlying mathematics themselves. For example, the statements that "repeated eigenvalues reduce the number of eigenvectors" (p. 327), (nonparallel) eigenvectors of a (real) symmetric matrix are always orthogonal (p. 137), and that the eigenvalues of a (real) symmetric 2×2 matrix with positive determinant are both positive (p. 456) will confuse a thoughtful student who considers the matrix $-I$. In the reviewer's opinion, this book would not be a good choice for mathematics majors, but might well be useful for a class (such as students in computer graphics) whose primary interest is an intuitive working knowledge of vector geometry in low dimensions. *John D. Dixon (Ottawa)*

Classification: H65 G75 N35 P25 R65
Keywords: vector geometry; determinant; affine map; eigenvalue; eigenvector; algorithm; LU-factorization; power method; nonnegative matrix; singular value decomposition; least squares; computational geometry; triangulation of a surface; fitting Bézier curve; computer graphics; page ranking; image compression