

1 Matrices

(Note: see also the additional sheet of Matrix examples for this module.)

1.1 What is a matrix?

1.1.1 Definitions and Notation

Engineering analysis often produces very large systems of simultaneous equations, sometimes more than 1,000 equations in 1,000 unknowns. To solve these systematically, we need a method of recording and calculating that can be programmed on a computer.

A **matrix** is a rectangular array of numbers, or symbols representing numbers or other quantities.

As a first, simple example, here are three equations in variables x, y, z :

$$\begin{array}{rclcl} 2x & +3y & & +4z & = & 1 \\ 3x & & -y & & = & 2 \\ x & +2y & & +1.5z & = & 3 \end{array} \quad (1)$$

We can write this in the form:

$$\begin{bmatrix} 2 & 3 & 4 \\ 3 & -1 & 0 \\ 1 & 2 & 1.5 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} \quad (2)$$

This is a 3×3 *square matrix* (i.e. 3 rows and 3 columns), and two 3×1 matrices, also called *column matrices* or *column vectors*. Note the way they combine to produce the equations.

Here's some more examples of matrices of various shapes and sizes, with descriptions:

$$\begin{array}{l} \begin{pmatrix} 2 & 5 & -1 \\ 0 & 3 & 2 \end{pmatrix} \text{ - a } 2 \times 3 \text{ rectangular matrix} \\ \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} \text{ - a } 2 \times 2 \text{ square matrix, which is also a zero matrix (all entries zero).} \\ \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix} \text{ - a } 3 \times 3 \text{ diagonal matrix.} \end{array} \quad (3)$$

Note: we can use either (.) brackets or [.] brackets. Square brackets are clearer for large matrices.

Vectors And Matrices Exam Notes

Didier Musso



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Table of Contents Vectors And Matrices Exam Notes

1. Understanding the eBook Vectors And Matrices Exam Notes
 - The Rise of Digital Reading Vectors And Matrices Exam Notes
 - Advantages of eBooks Over Traditional Books
2. Identifying Vectors And Matrices Exam Notes
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Vectors And Matrices Exam Notes
 - User-Friendly Interface
4. Exploring eBook Recommendations from Vectors And Matrices Exam Notes
 - Personalized Recommendations
 - Vectors And Matrices Exam Notes User Reviews and Ratings
 - Vectors And Matrices Exam Notes and Bestseller Lists
5. Accessing Vectors And Matrices Exam Notes Free and Paid eBooks

- Vectors And Matrices Exam Notes Public Domain eBooks
 - Vectors And Matrices Exam Notes eBook Subscription Services
 - Vectors And Matrices Exam Notes Budget-Friendly Options
6. Navigating Vectors And Matrices Exam Notes eBook Formats
 - ePub, PDF, MOBI, and More
 - Vectors And Matrices Exam Notes Compatibility with Devices
 - Vectors And Matrices Exam Notes Enhanced eBook Features
 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Vectors And Matrices Exam Notes
 - Highlighting and Note-Taking Vectors And Matrices Exam Notes
 - Interactive Elements Vectors And Matrices Exam Notes
 8. Staying Engaged with Vectors And Matrices Exam Notes
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Vectors And Matrices Exam Notes
 9. Balancing eBooks and Physical Books Vectors And Matrices Exam Notes
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Vectors And Matrices Exam Notes
 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
 11. Cultivating a Reading Routine Vectors And Matrices Exam Notes
 - Setting Reading Goals Vectors And Matrices Exam Notes
 - Carving Out Dedicated Reading Time
 12. Sourcing Reliable Information of Vectors And Matrices Exam Notes
 - Fact-Checking eBook Content of Vectors And Matrices Exam Notes
 - Distinguishing Credible Sources
 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development

- Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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