

MUKESH PATEL SCHOOL OF TECHNOLOGY MANAGEMENT AND ENGINEERING

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A MINI-PROJECT REPORT

ON

MATHEMATICS I

“Application of Matrices in Computer Engineering”

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Application of Matrices in Computer Engineering

- Objectives
- Introduction
- Application
- Conclusion
- References

Objective

To understand the applications of matrices in the field of computer engineering.

Introduction

What is a Matrix?

In mathematics, a matrix (plural matrices) is a rectangular array of numbers, symbols, or expressions, arranged in rows and columns. Matrices are commonly written in box brackets. The horizontal and vertical lines of entries in a matrix are called rows and columns, respectively. The size of a matrix is defined by the number of rows and columns that it contains. A matrix with m rows and n columns is called an $m \times n$ matrix or m -by- n matrix, while m and n are called its dimensions. Dimensions of the following matrix are 2×2 (read “two by two”), because there are two rows and two columns.

$$A = \begin{bmatrix} 3 & -1 \\ 9 & 2 \end{bmatrix}$$

Historically, it was not the matrix but a certain number associated with a square array of numbers called the determinant that was first recognized. Only gradually did the idea of the matrix as an algebraic entity emerge. The term matrix was introduced by the 19th-century English mathematician James Sylvester, but it was his friend the mathematician Arthur Cayley who developed the algebraic aspect of matrices in two papers in the 1850s. Cayley first applied them to the study of systems of linear equations, where they are still very useful. They are also important because, as Cayley recognized, certain sets of matrices form algebraic systems in which many of the ordinary laws of arithmetic (e.g., the associative and distributive laws) are valid but in which other laws (e.g., the commutative law) are not valid.

The evolution of the concept of matrices is the result of an attempt to obtain compact and simple methods of solving the system of linear equations. The individual items (numbers, symbols or expressions) in a matrix are called its elements or entries. Provided that they are the same size (have the same number of rows and the same number of columns), two matrices can be added or subtracted element by element. The rule for matrix multiplication, however, is that two matrices can be multiplied only when the number of columns in the first equals the number of rows in the second. Any matrix can be multiplied element-wise by a scalar from its associated field.

Applications of Matrices

Matrices have wide applications in not only computer engineering but also physics, economics, and statistics as well as in various branches of mathematics. Matrices, and in general Linear Algebra, are the language and mathematical tools computer scientists constantly use. The following are some of the application in the field of computer science.

In computer graphics, they are used to project a 3-dimensional image onto a 2-dimensional screen. In probability theory and statistics, stochastic matrices are used to describe sets of probabilities; for instance, they are used within the Page Rank algorithm that ranks the pages in a Google search. Graphic data is also held in a matrix structure. And image is a collection of pixels saved on a matrix structure. Because of that, computer vision uses matrices heavily. Rotating, scaling, and moving images are operations on matrixes

Graphic software such as Adobe Photoshop on your personal computer uses matrices to process linear transformations to render images. A square matrix can represent a linear transformation of a geometric object. Matrices play a huge role in graphics, any image is a matrix and each digit represents the intensity of a certain color at a certain grid point.

In encryption, it is used to scramble data for security purpose to encode and to decode this data we need matrices. There is a key which helps encode and decode data which is generated by matrices.

In 3D games, they use it to alter the object, in 3d space. They use the 3d matrix to 2d matrix to convert it into the different objects as per requirement. For example, “The prisoner's dilemma” is popular game that makes use of the concepts of matrices.

In robotics and automation, matrices are the basic components for the robot movements. The inputs for controlling robots are obtained based on the calculations from matrices and these are very accurate movements. Neural Networks rely heavily on matrices and matrix operations.

Many IT companies also use matrices as data structures to track user information, perform search queries, and manage databases. In the world of information security, many systems are designed to work with matrices. Matrices are used in the compression of electronic information, for example in the storage of biometric data in the new Identity Card in Mauritius.

Conclusion

Matrices are a large part of the basics of not only mathematics but also computer science. It is essential that every computer engineer is thorough with the concepts as it later becomes an important part of almost every application that is there related to computers. Matrices are used as a way of providing quick approximations of more complicated calculations. In applications such as image processing and genetic analysis, computers may multiply matrices in order to solve systems of linear equations, therefore they are extremely important in the field of computer engineering.

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