American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)
ISSN (Print) 2313-4410, ISSN (Online) 2313-4402

http://asrjetsjournal.org/

Introducing a Matrix and its Characteristics

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Abstract

When we take only the real constants of a linear equation or a system of linear equations and make an array then it becomes a matrix. There are different types of matrix which is identified and defined based on the structure consisting elements in different ways and existing in different positions. This research paper will briefly discuss on a matrix different from other types of matrix described in various books and papers. Some important properties and characteristics of this matrix are included in this paper.

Keywords: Matrix; Perimeter Matrix; New type of matrix.

1. Introduction and Reviews

The role of matrices in linear algebra and its application is so huge that it can be said that it is the soul of linear algebra. The applications of matrices cover not only the field of mathematics but also other fields of science and real life such as – Probability Theory and Statistics, Electronics, Engineering, Computer Science, Cryptography, Wireless Communication [1] etc. are some most important fields. Matrix has been used by different mathematicians all over the world from ancient time till now. In this section some reviews of matrices are included.

1.1. Matrix

Writing the real constants of a linear equation or a system of linear equations in rectangular array is a matrix. All the elements of a matrix is called is called entries [2,3].

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Let the following system of linear equations

$$2x + y + 3z = 13$$

$$x + 5z = 16$$

$$7x - 2y + z = 6$$

Then the matrix of the above system of linear equations is

$$\begin{bmatrix} 2 & 1 & 3 & 13 \\ 1 & 0 & 5 & 16 \\ 7 & -2 & 1 & 6 \end{bmatrix}$$

1.2. Order of Matrix

A matrix of m numbers of rows and n numbers of columns is said to be a matrix of order $m \times n$ [3].

Let, A be a matrix of the following forms

$$A = \begin{bmatrix} 2 & 1 & 3 & 13 \\ 1 & 0 & 5 & 16 \\ 7 & -2 & 1 & 6 \end{bmatrix}$$

Here, matrix A has 3 rows and 4 columns. So, matrix A is of order 3×4.

1.3. Square Matrix

An $m \times n$ matrix A is called a square matrix if the numbers of rows m is equal to the number of the columns n $(m = n)$.

Example of a square matrix is as following

$$A = \begin{bmatrix} 5 & 3 & 1 \\ 2 & 3 & 4 \\ 7 & 9 & 6 \end{bmatrix}$$

1.4. Diagonal Matrix

A diagonal matrix is a square matrix, where all the elements other than the diagonal are zero.

Example of a diagonal matrix is as following:

$$A = \begin{bmatrix} 5 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 6 \end{bmatrix}$$

1.5. Identity Matrix

A diagonal matrix is said to be an identity matrix if all the diagonal elements are 1 [4].

The following is an example of an identity matrix

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

1.6. Zero Matrix

The matrix in which all the elements are zero is said to be a zero matrix [5].

As an example of a zero matrix we can consider the following matrix A.

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

2. Main Result

In this section we will define a matrix other than all the matrices defined previously in many other books and papers.

2.1. Definition

Let, A_{ij} be a square matrix of order $m \times m$. Let, $i = 1, \dots, m$ and $j = 1, \dots, m$. Then all the element of A except those whose i-th or j-th element has at least one 1 or m, are zero; construct a new type of matrix.

Consider the following matrix of order 4×4

$$A = \begin{bmatrix} 2 & 6 & 1 & 4 \\ 8 & 0 & 0 & 5 \\ 9 & 0 & 0 & 1 \\ 4 & 5 & 3 & 2 \end{bmatrix}$$

Here, the matrix $A_{4\times4}$ is a square matrix where, $i = 1, \dots, 4$ and $j = 1, \dots, 4$.

All the element of $A_{4\times4}$ which does not have $i = 1 \; or \; 4$ or $j = 1 \; or \; 4$ are

$$a_{22}, a_{23}, a_{32}, a_{33}.$$

And $a_{22} = a_{23} = a_{32} = a_{33} = 0$.

This matrix looks a perimeter of a square. So, roughly we can call it a Perimeter matrix for the convenience to describe it in later sections.

2.2. Properties to be a Perimeter Matrix

- Must be a square matrix of the form $A_{m\times m}$.
- The least value of m is 3.
- All the element of first row and last row, first column and last column must have a value other than 0.
- All the elements other than the third property are 0.

2.3. Theorem

When all other elements except the zero element of a Perimeter matrix of the order $m \times m$, where $m = 1, \dots, n$, are equal then the determinant of the matrix are zero.

Example:

Consider the following matrix

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

Then, determinant of A,

$$\det(A) = 0.$$

2.4. Theorem

If A be a perimeter matrix and I be an identity matrix of same order then

$$\det(A) - \det(I) \neq \det(A - I)$$

3. Conclusion

Matrix theory has great deals with different fields of mathematics and real life sciences. This research paper firstly reviews briefly on some types of matrices. Then this paper introduces a new type of matrix other than the known matrices. Few properties and theorems are included here.

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