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A Review Paper on Matrices and Its Application

Prachi Sharma[a)], Harvinder Singh[b)]
[a)]M.E Student Department of Electrical Engineering, Chandigarh University, Mohali, Punjab. India 140413
[b)] Assistant Professor Department of Electrical Engineering, Chandigarh University, Mohali, Punjab. India 140413

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ABSTRACT: -Vector algebra, differential calculus, integration, discrete mathematics, matrices, and determinants are the future classifications for mathematics. Matrix mathematics is used in a variety of scientific fields as well as in differential mathematics. In matrix, we must learn about matrix addition, subtraction, and multiplication. Matrices theory is used to answer economic challenges involving the most economical technique of producing commodities. Very sensitive information must be encoded and decoded. We also covered the 3*3 linear system of equations utilising the row deduction approach in the matrix equation. This paper also discusses matrices and how they are used. Matrix theories are used to discover economic challenges involving the technique by which things can be produced effectively and correctly. The influence of matrices in the mathematical world is wide because it provides an important foundation for many of the principles and practises. To unravel the history of matrices and their applications, the influence of matrices in the mathematical world is wide because it provides an important base for many of the principles and practises. This paper also discusses about future development and we use this concept in our everyday life. In this paper we solve matrix problem by using software which is MATLAB to show this by programming method. This paper also discusses in field of physics, zoology, and animation.

Keywords: matrix, determinant, linear system, matrix algebra, MATLAB.

I. INTRODUCTION

Matrices is a rectangular arrangement of any number of elements in certain number of rows and columns within a parenthesis or square bracket.[1]

Matrix order: If a matrix has 'n' columns and 'm' rows, its order is m*n.

Example

$$\begin{bmatrix} 1 & 3 \\ 7 & 5 \end{bmatrix}_{2*2}$$

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 6 \\ 4 & 11 & 2 \end{bmatrix}_{3*3}$$

Transpose of a matrix: The transpose of a matrix is A= (a_{ij})m*n and is denoted as a^T that is, a^T = (a_{ij})n*m. [2]

Example:

$$A= \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}_{2*3} A^T = \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix}_{3*2}$$

II. OPERATION WITH MATRICES

SUM: If A and B have the same dimension, the sum, A+B, can be calculated by adding the respective entries. (A+B) = aij + bij in symbols. [3]

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}_{2*2} \quad B = \begin{bmatrix} p & q \\ r & s \end{bmatrix}_{2*2}$$

$$A+B = \begin{bmatrix} a+p & b+q \\ c+r & d+s \end{bmatrix}_{2*2}$$

Example: -

$$A= \begin{bmatrix} 7 & 8 & 9 \\ 6 & 8 & 9 \end{bmatrix}_{2*3}$$

$$B= \begin{bmatrix} 5 & 4 & 8 \\ 3 & 2 & 9 \end{bmatrix}_{2*3}$$

$$A+B= \begin{bmatrix} 12 & 12 & 17 \\ 9 & 10 & 18 \end{bmatrix}_{2*3}$$

MATLAB coding: -

```
>> clear all
>> close all
>> x1 = [7 8 9; 6 8 9]
x1 =
    7    8    9
    6    8    9
>> x2 = [ 5 4 8;3 2 9]
x2 =
    5    4    8
    3    2    9
>> x3 = x1+x2
```

x3 =
12 12 17
9 10 18

DIFFERENCE: If A and B have the same dimensions, the difference between them, A-B, is calculated by subtracting the corresponding entries. (A-B)ij = aij - bij in symbols. [4]

$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}_{2*2}$ $B = \begin{bmatrix} p & q \\ r & s \end{bmatrix}_{2*2}$

$A - B = \begin{bmatrix} a-p & b-q \\ c-r & d-s \end{bmatrix}_{2*2}$

Example: - $A = \begin{bmatrix} 2 & 4 & 6 \\ 3 & 4 & 5 \end{bmatrix}_{2*3}$ $B = \begin{bmatrix} 2 & 3 & 4 \\ 1 & 2 & 3 \end{bmatrix}_{2*3}$

$A - B = \begin{bmatrix} 0 & 1 & 2 \\ 2 & 2 & 2 \end{bmatrix}_{2*3}$

MATLAB coding: -

```
>> clear all
>> close all
>> X1 = [2 4 6; 3 4 5]
X1 =
     2     4     6
     3     4     5
>> X2 = [2 3 4; 1 2 3]
X2 =
     2     3     4
     1     2     3
>> X3 = X1-X2
X3 =
     0     1     2
     2     2     2
```

SCALAR MULTIPLICATION: If A = (a_{ij})m*n be any matrix and 'r' be any scalar then scalar multiplication of 'A' is denoted as A = r$[a_{ij}]$m*n.

$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}_{2*2}$

$rA = \begin{bmatrix} ra & rb \\ rc & rd \end{bmatrix}_{2*2}$

Example: - $A = \begin{bmatrix} 2 & 3 & 4 & 5 \\ 4 & 5 & 6 & 6 \\ -6 & 0 & -1 & -2 \end{bmatrix}_{3*4}$

r = 5

$rA = \begin{bmatrix} 10 & 15 & 20 & 25 \\ 20 & 25 & 30 & 30 \\ -30 & 0 & -5 & -10 \end{bmatrix}_{3*4}$

MATLAB Coding: -

```
>> clear all
>> close all
>> matrix1 = [2 3 4 5; 4 5 6 6; -6 0 -1 -2]
matrix1 =
     2     3     4     5
     4     5     6     6
    -6     0    -1    -2
>> 5*matrix1
Ans =
    10    15    20    25
    20    25    30    30
   -30     0    -5   -10
```

PRODUCT: If A has dimension k*m and B has dimension m*n, then the product AB is defined, and has dimensions k*n. The entry $(AB)_{ij}$is obtained by multiplying corresponding entries together and then adding the result i.e.,[5]

$$(a_{i1}\, ai_2 \ldots\ldots\ldots\, a_{im}) \begin{matrix} b_{1j} \\ b_{2j} \\ M \\ B_{mj} \end{matrix} = a_{i1}b_{1j} + a_{i2}b_{2j} + \ldots\ldots + a_{im}b_{mj}$$

Example: $-A = \begin{bmatrix} 5 & 3 & 2 \\ 4 & 6 & 8 \\ 7 & 2 & 1 \end{bmatrix}_{3*3}$ $B = \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix}_{3*2}$

$A*B = \begin{bmatrix} 54 & 67 \\ 116 & 140 \\ 48 & 60 \end{bmatrix}_{3*2}$

MATLAB Coding: -

```
>> clear all
>> close all
>> X1 = [5 3 2; 4 6 8; 7 2 1]
X1 =
     5     3     2
     4     6     8
     7     2     1
>> X2 = [4 5; 6 8; 8 9]
X2 =
     4     5
     6     8
     8     9
>> X3 = X1*X2
X3 =
    54    67
   116   140
    48    60
```

III. LAWS OF MATRIX ALGEBRA

The matrix addition, subtraction, scalar multiplication and matrix multiplication, have the following properties. [6]

- **ASSOCIATIVE LAWS:**

P + (Q + R) = (P+ Q) + R
(PQ) R = P (QR)

- **COMMUTATIVE LAW FOR ADDITION:**

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P + Q = Q + P

- **DISTRIBUTIVE LAWS:**

P (Q + R) = PQ + PR

(P + Q) R = PR + QR

IV. DETERMINANT OF MATRIX

The element is a square array of numbers, and the determinant is a square array of numbers. The number of rows in the determinant is always equal to the number of columns. [7] Is the sum of the selected products of the matrix's elements, each product multiplied by +1 or -1?

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}_{2*2} = ad - bc$$

Example: $A = \begin{bmatrix} 1 & 2 & 3 \\ 7 & 3 & 1 \\ 1 & 6 & 2 \end{bmatrix}_{3*3}$

```
>> clear all
>> close all
>> A = [1 2 3; 7 3 1; 1 6 2]
A =
    1    2    3
    7    3    1
    1    6    2
>> det(A)
ans =
   91
```

V. INVERSE OF A MATRIX

A unique matrix matching the connection is an inverse matrix A-1 that can only be found given a square and a non-singular matrix A.

A-1A = AA-1 = I

The formula for calculating the inverse is as follows:

A^{-1} = adj A/ det A

Calculation Of Inverse Using Determinants In MATLAB

```
>> clear all
>> close all
>> A = [8 5; 6 9]
A =
   8    5
    6    9
>> det(A)
ans =
   42
>>inv(A)
ans =
   0.2143   -0.1190
  -0.1429    0.1905
```

VI. MATRIX FORM USED IN SYSTEM EQUATION

The matrix form in system equation is: -

AX=B

- If B/ = 0 then the system is not homogenous system.
- If B = 0 then the system is homogenous system

Example:

```
>> clear all
>> close all
>> A = [2 3 5; 3 4 7; 1 1 1]
A =
    2    3    5
    3    4    7
    1    1    1
>> B = [5; 10; 13]
B =
    5
   10
   13
>>inv(A)*B
ans =
  18.0000
   3.0000
  -8.0000
```

VII. REAL LIFE PROBLEM IN MATRICES AND ITS APPLICATION

In our daily life matrices are play a very important role while we doing any work like computer graphics software such as inscape, photoshop or zimp or any such software when you render images in this software actually the software performs linear transformation on the images actually the linear transformation is to perform on matrix that stores the data related to the images. [8]

In physics and allied fields, such as various branches of engineering, matrices are used to investigate electrical circuits in order to research quantum mechanics, and in optics, matrices are used to solve various branches such as KCL and KVL in electrical circuits. [9] However, in quantum mechanics, it is critical to note that quantum mechanics can sometimes evolve into matrix mechanics. [10] Engineers utilise matrices to represent physical systems and conduct precise calculations for complicated mechanics in aeroplanes and spacecraft electronics networks. [11]

All of the calculations in chemical engineering require correctly calibrated computations, which are obtained by transforming matrices. Because they manage significant amounts of data, medical imaging is becoming a popular use matrix in hospitals and research institutes. [12]

In programming for coding and scrambling different messages is a key device s. in mechanical technology and in mechanization networks are the essential parts for our robot development. [13] The contributions for controlling robots are gotten dependent on computation through networks and they are exceptionally exact minutes and it likewise utilized in different IT organizations for information construction to follow client data and it additionally perform such questions and deal with the databases. [14]

In the universe of data security numerous frameworks are intended to work with lattices and it additionally utilized in the pressure of electronic data for instance in an account of biometric information in some countries.[15]

In geography grids are utilized for making the seismic overviews there utilized for plotting charts measurements and to do logical investigations and examination in nearly characterize fields. Frameworks are likewise utilized in addressing this present reality information like the number of inhabitants in individuals, baby death rate. For plotting the diagram or review it is exceptionally helpful technique to tackle the issue. [16] In economics very large matrices are used for optimization problems for example in making the best use of such Veda labor, traits, survey or capital in the manufacturing of a product and managing very large supply and it also used for calculating the GDP in best way.[17]

In the field of animation matrices are used to design the 3D software and operation tools. [18]

VIII. CONCLUSIONS

Matrices is valuable and integral asset in the numerical examination and gathering information. Other than the concurrent conditions, the qualities of the lattices are helpful in the programming where we placing in cluster that is a grid additionally to store the information. Finally, the frameworks are assuming vital part in the software engineering, applied science, quantum physical science and mechanical technology. So, we can oversee well of grid, then, at that point, we can play simple in software engineering however the network isn't straightforward.

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