وزارة التعليم العالي والبحث العلمي
المعهد التقني / السماوة
قسم المساحة

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اسم المادة : Mathematics and Spherical Triangles

Matrices

MATRICES

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.

A matrix is usually shown by a **capital letter** (such as A, or B)Each entry (or "element") is shown by a **lower case letter** with a "subscript" of **row , column**:

$$A = \begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} \\ a_{2,1} & a_{2,2} & a_{2,3} \end{bmatrix}$$

A Matrix
(This one has 2 Rows and 3 Columns)

TYPES OF MATRIX

1- Row Matrix

Number of columns doesn't matter in a row matrix, the only thing that matters that it should have a single row. If a matrix has just one row, we will call it a row matrix $\begin{pmatrix} 2 & 3 & -1 \end{pmatrix}$

2 - Column Matrix

Column matrix has just one column. It doesn't matter how many rows are there in a column matrix, the only thing that matters is that it should have a single column.

$$\begin{pmatrix} -7 \\ 1 \\ 6 \end{pmatrix}$$

3 - Rectangular Matrix

A rectangular matrix is formed by a different number of rows and columns, and its dimension is noted as .

$$\begin{pmatrix} 1 & 2 & 5 \\ 9 & 1 & 3 \end{pmatrix}$$

4 - SQUARE MATRIX

When the rows and columns are equal then it won't be a rectangular matrix instead it will be a square matrix.

$$\begin{pmatrix} 2 & 4 \\ -1 & -5 \end{pmatrix}$$

5 - Zero Matrix

In a zero matrix, all the elements are zeros.

$$\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$$

6 - Upper Triangular Matrix

To understand the upper triangular matrix, make a diagonal of the given matrix. If all the elements below the diagonal are zero that means you have an upper triangular matrix.

$$\begin{pmatrix} 1 & 7 & -2 \\ 0 & -3 & 4 \\ 0 & 0 & 2 \end{pmatrix}$$

7 - Lower Triangular Matrix

Lower triangular matrix is like the upper triangular matrix but the difference is the positioning of zeros. In the lower triangular matrix, all the elements above the diagonal are zero.

$$\begin{pmatrix} 2 & 0 & 0 \\ 1 & 2 & 0 \\ 3 & 5 & 6 \end{pmatrix}$$

8 - DIAGONAL MATRIX

In a diagonal matrix, all the elements above and below the diagonal are zeros. It is like a combination of an upper triangular matrix and a lower triangular matrix.

$$\begin{pmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 6 \end{pmatrix}$$

9 - Scalar Matrix

A scalar matrix is **like** a diagonal matrix but with a difference. There are two conditions for the scalar matrix. The first one is that all the elements, above as well as below the diagonal should be zero. The second condition is that the diagonal elements should be the same.

$$\begin{pmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{pmatrix}$$

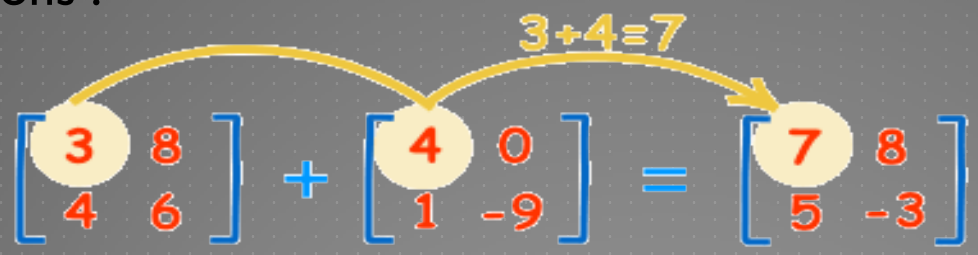
10 -Identity Matrix

An identity matrix is a diagonal matrix in which the diagonal elements are equal to 1.

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Addition of matricrs

To add two matrices: add the numbers in the matching positions :



Two matrices may be added only if they have the same dimension; that is, they must have the same number of rows and columns.

Addition is accomplished by adding corresponding elements

Example: a matrix with **3 rows** and **5 columns** can be added to another matrix of **3 rows** and **5 columns**.

But it could not be added to a matrix with **3 rows** and **4 columns** (the columns don't match in size)

Addition of matricrs

Example: Add the matrices.

$$A=\begin{vmatrix} -3 & 4 & -7 \\ 9 & 5 & 2 \end{vmatrix} \qquad B=\begin{vmatrix} -3 & -5 & 8 \\ -15 & 7 & 4 \end{vmatrix}$$

$$\underline{A}+\underline{B}=\begin{vmatrix} -3 & 4 & -7 \\ 9 & 5 & 2 \end{vmatrix} + \begin{vmatrix} -3 & -5 & 8 \\ -15 & 7 & 4 \end{vmatrix} = \begin{vmatrix} -3-3 & 4-5 & -7+8 \\ 9-15 & 5+7 & 2+4 \end{vmatrix} = \begin{vmatrix} -6 & -1 & 1 \\ -6 & 12 & 6 \end{vmatrix}$$

$$\underline{B}+\underline{A}=\begin{vmatrix} -3 & -5 & 8 \\ -15 & 7 & 4 \end{vmatrix} + \begin{vmatrix} -3 & 4 & -7 \\ 9 & 5 & 2 \end{vmatrix} = \begin{vmatrix} -3-3 & -5+4 & 8-7 \\ -15+9 & 7+5 & 4+2 \end{vmatrix} = \begin{vmatrix} -6 & -1 & 1 \\ -6 & 12 & 6 \end{vmatrix}$$

$$A := \begin{pmatrix} 2 & 3 & 1 \\ 3 & 2 & 2 \\ 4 & 3 & 1 \end{pmatrix} \qquad B := \begin{pmatrix} 2 & 3 & 3 \\ 1 & 2 & 3 \\ 2 & 4 & 5 \end{pmatrix} \qquad A + B = \begin{pmatrix} 4 & 6 & 4 \\ 4 & 4 & 5 \\ 6 & 7 & 6 \end{pmatrix}$$

Addition of Two Matrices

$$A + B = \begin{bmatrix} 1 & 5 \\ 7 & 3 \end{bmatrix} + \begin{bmatrix} 12 & -1 \\ 0 & 9 \end{bmatrix}$$

$$= \begin{bmatrix} 1 + 12 & 5 + (-1) \\ 7 + 0 & 3 + 9 \end{bmatrix}$$

$$= \begin{bmatrix} 13 & 4 \\ 7 & 12 \end{bmatrix}$$

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Subtracting Matricrs

Two matrices may be subtracted only if they have the same dimension; that is, they must have the same number of rows and columns.

subtraction is accomplished by subtracting corresponding elements.

$$3-4=-1$$

$$\begin{bmatrix} 3 & 8 \\ 4 & 6 \end{bmatrix} - \begin{bmatrix} 4 & 0 \\ 1 & -9 \end{bmatrix} = \begin{bmatrix} -1 & 8 \\ 3 & 15 \end{bmatrix}$$

Example: Subtract the matrices :

$$\underline{A} = \begin{vmatrix} 5 & 2 & -3 \\ 4 & 1 & 7 \end{vmatrix} \quad , \quad \underline{B} = \begin{vmatrix} 4 & 7 & -2 \\ 3 & -1 & 6 \end{vmatrix}$$

Subtracting Matricrs

$$\underline{A}-\underline{B}=\underline{A}+(-\underline{B}) = \begin{vmatrix} 5 & 2 & -3 \\ 4 & 1 & 7 \end{vmatrix} + \begin{vmatrix} -4 & -7 & 2 \\ -3 & 1 & -6 \end{vmatrix} = \begin{vmatrix} 5-4 & 2-7 & -3+2 \\ 4-3 & 1+1 & 7-6 \end{vmatrix} = \begin{vmatrix} 1 & -5 & -1 \\ 1 & 2 & 1 \end{vmatrix}$$

$$\underline{B}-\underline{A}=\underline{B}+(-\underline{A}) = \begin{vmatrix} 4 & 7 & -2 \\ 3 & -1 & 6 \end{vmatrix} + \begin{vmatrix} -5 & -2 & 3 \\ -4 & -1 & -7 \end{vmatrix} = \begin{vmatrix} 4-5 & 7-2 & -2+3 \\ 3-4 & -1-1 & 6-7 \end{vmatrix} = \begin{vmatrix} -1 & 5 & 1 \\ -1 & -2 & -1 \end{vmatrix}$$

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

Applying the negative sign to the second matrix:

$$\begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \end{bmatrix} + \begin{bmatrix} -1 & -2 & -3 \\ -4 & -5 & -6 \end{bmatrix} = \begin{bmatrix} 1-1 & 1-2 & 1-3 \\ 2-4 & 2-5 & 2-6 \end{bmatrix} = \begin{bmatrix} 0 & -1 & -2 \\ -2 & -3 & -4 \end{bmatrix}$$

Now we have an addition of matrices, which we know is commutative:

$$\begin{bmatrix} -1 & -2 & -3 \\ -4 & -5 & -6 \end{bmatrix} + \begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \end{bmatrix} = \begin{bmatrix} -1+1 & -2+1 & -3+1 \\ -4+2 & -5+2 & -6+2 \end{bmatrix} = \begin{bmatrix} 0 & -1 & -2 \\ -2 & -3 & -4 \end{bmatrix}$$

$$A := \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix} \qquad B := \begin{pmatrix} 1 & 0 & 0 \\ -1 & -3 & -4 \end{pmatrix}$$

$$A + B = \begin{pmatrix} 2 & 2 & 3 \\ 3 & 2 & 2 \end{pmatrix}$$

$$A - B = \begin{pmatrix} 0 & 2 & 3 \\ 5 & 8 & 10 \end{pmatrix}$$