اسم التدريسي : زهراء هاشم كريم

اسم المادة : رياضيات

عنوان المحاضرة: Matrices

رقم المحاضرة:4

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Matrices

Matrix is an array of numbers. A matrix with **m** rows and **n** columns is order **m** x **n** and is shown as follows..

$$[A] = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & & \\ & & a_{ij} & \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

1-Matrices addition and Subtraction:.

If two matrices **A** and **B** can be added or subtracted if and only if their dimensions are the same (i.e . both matrices have the same numder of rows and columns).

a-Addition:.

If **A** and **B** above are matrices of the same type then the sum is found by adding the corresponding elements $\mathbf{a_{ij}} + \mathbf{b_{ij}}$.

Example 1:. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 0 & 2 \end{bmatrix}$,$B = \begin{bmatrix} 2 & 1 & 2 \\ 1 & 0 & 3 \end{bmatrix}$, find A+ B.

Solution:. $A+B = \begin{bmatrix} 1+2 & 2+1 & 3+2 \\ 1+1 & 0+0 & 2+3 \end{bmatrix} = \begin{bmatrix} 3 & 3 & 5 \\ 2 & 0 & 5 \end{bmatrix}$.

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b-Subtraction :.

If **A** and **B** above are matrices of the same type then the subtraction is found by subtracting the corresponding elements $\mathbf{a_{ij}} - \mathbf{b_{ij}}$.

Example 2:. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 0 & 2 \end{bmatrix}$,$B = \begin{bmatrix} 2 & 1 & 2 \\ 1 & 0 & 3 \end{bmatrix}$, find A- B.

Solution:. $A - B = \begin{bmatrix} 1-2 & 2-1 & 3-2 \\ 1-1 & 0-0 & 2-3 \end{bmatrix} = \begin{bmatrix} -1 & 1 & 1 \\ 0 & 0 & -1 \end{bmatrix}$.

Example 3:. If $A = \begin{bmatrix} -3 & 0 \\ 7 & -4 \end{bmatrix}$,$B = \begin{bmatrix} 2 & -1 \\ -7 & 4 \end{bmatrix}$ and $C = \begin{bmatrix} -1 & 0 \\ -2 & -4 \end{bmatrix}$,find A-B+C.

Solution:. $A - B+C = \begin{bmatrix} -3-2-1 & 0+1+0 \\ 7+7-2 & -4-4-4 \end{bmatrix} = \begin{bmatrix} -6 & 1 \\ 12 & -12 \end{bmatrix}$.

2- Scalar multiplication:.

We multiply (or divide)each element by the scalar value (a single number).

Example 4:. If $A = \begin{bmatrix} 3 & 1 \\ 7 & -1 \\ 2 & 8 \end{bmatrix}$, find (3A),$(\frac{1}{2}A)$.

Solution:.

$$3A = 3\begin{bmatrix} 3 & 1 \\ 7 & -1 \\ 2 & 8 \end{bmatrix} = \begin{bmatrix} 3x3 & 3x1 \\ 3x7 & 3x-1 \\ 3x2 & 3x8 \end{bmatrix} = \begin{bmatrix} 9 & 3 \\ 21 & -3 \\ 6 & 24 \end{bmatrix}.$$

$$\frac{1}{2}A = \frac{1}{2}\begin{bmatrix} 3 & 1 \\ 7 & -1 \\ 2 & 8 \end{bmatrix} = \begin{bmatrix} \frac{3}{2} & \frac{1}{2} \\ \frac{7}{2} & \frac{-1}{2} \\ \frac{2}{2} & \frac{8}{2} \end{bmatrix} = \begin{bmatrix} \frac{3}{2} & \frac{1}{2} \\ \frac{7}{2} & \frac{-1}{2} \\ 1 & 4 \end{bmatrix}.$$

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3-Matrix multiplication:.

When the number of columns of the first matrix is the same as the number of rows in the second matrix then matrix multiplication can performed. If $\mathbf{A_{ij}}$, $\mathbf{B_{jk}}$ then ($\mathbf{A_{ij}}$ **x** $\mathbf{B_{jk}}$ **=** $\mathbf{C_{ik}}$)

-Here is an example of matrix multiplication for two 2x2 matrices.

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} e & f \\ g & h \end{bmatrix} = \begin{bmatrix} (ae+bg) & (af+bh) \\ (ce+dg) & (cf+dh) \end{bmatrix}.$$

-Here is an example of matrix multiplication for two 3x3 matrices.

$$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} \begin{bmatrix} j & k & l \\ m & n & o \\ p & q & r \end{bmatrix} =$$

$$\begin{bmatrix} (aj+bm+cp) & (ak+bn+cq) & (al+bo+cr) \\ (dj+em+fp) & (dk+en+fq) & (dl+eo+fr) \\ (gj+hm+ip) & (gk+hn+iq) & (gl+ho+ir) \end{bmatrix}.$$

Example5:. If A $= \begin{bmatrix} 2 & 3 \\ 1 & -4 \end{bmatrix}$,B $= \begin{bmatrix} -5 & 7 \\ -3 & 4 \end{bmatrix}$, Find(A×B).

Solution:. A×B $= \begin{bmatrix} 2*-5 + 3*-3 & 2*7 + 3*4 \\ 1*-5 + -4*-3 & 1*7 + -4*4 \end{bmatrix}$

$= \begin{bmatrix} -19 & 26 \\ 7 & -9 \end{bmatrix}$

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Example 6:.If $A=\begin{bmatrix}1 & 4 & 5\\ 2 & 1 & 3\\ 1 & 2 & 4\end{bmatrix}$ $B=\begin{bmatrix}2 & 3 & 1\\ 4 & 2 & 3\\ 1 & 3 & 1\end{bmatrix}$,Find(A×B).

Solution:. A×B=

$$\begin{bmatrix}1*2+4*4+5*1 & 1*3+4*2+5*3 & 1*1+4*3+5*1\\ 2*2+1*4+3*1 & 2*3+1*2+3*3 & 2*1+1*3+3*1\\ 1*2+2*4+4*1 & 1*3+2*2+4*3 & 1*1+2*3+4*1\end{bmatrix}.$$

$$=\begin{bmatrix}23 & 26 & 18\\ 11 & 17 & 8\\ 14 & 19 & 11\end{bmatrix}.$$

Example7:. If $A=\begin{bmatrix}1 & -1\\ 4 & 2\\ 0 & 3\end{bmatrix}$,$B=\begin{bmatrix}1 & 5 & 6 & 7\\ -2 & 4 & 8 & -4\end{bmatrix}$, Find(A×B).

Solution:.

A×B =

$$\begin{bmatrix}1*1+-1*-2 & 1*5+-1*4 & 1*6+-1*8 & 1*7+-1*-4\\ 4*1+2*-2 & 4*5+2*4 & 4*6+2*8 & 4*7+2*-4\\ 0*1+3*-2 & 0*5+3*4 & 0*6+3*8 & 0*7+3*-4\end{bmatrix}$$

$$=\begin{bmatrix}3 & 1 & -2 & 11\\ 0 & 28 & 40 & 20\\ -6 & 12 & 24 & -12\end{bmatrix}$$

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H.W:- Q 1. The matrices A to K are:

$$A=\begin{bmatrix} 3 & -1 \\ -4 & 7 \end{bmatrix},\quad B=\begin{bmatrix} \frac{1}{2} & \frac{2}{3} \\ \frac{-1}{3} & \frac{-3}{5} \end{bmatrix},\quad C=\begin{bmatrix} -1.3 & 7.4 \\ 2.5 & -3.9 \end{bmatrix}$$

$$D=\begin{bmatrix} 4 & -7 & 6 \\ -2 & 4 & 0 \\ 5 & 7 & -4 \end{bmatrix},\quad E=\begin{bmatrix} 3 & 6 & \frac{1}{2} \\ 5 & \frac{-2}{3} & 7 \\ -1 & 0 & \frac{5}{3} \end{bmatrix},\quad F=\begin{bmatrix} 3.1 & 2.4 & 6.4 \\ -1.6 & 3.8 & -1.9 \\ 5.3 & 3.4 & -4.8 \end{bmatrix}$$

$$G=\begin{bmatrix} \frac{3}{4} \\ \frac{7}{5} \end{bmatrix},\quad H=\begin{bmatrix} -2 \\ 5 \end{bmatrix},\quad J=\begin{bmatrix} 4 \\ -11 \\ 7 \end{bmatrix},\quad K=\begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 0 \end{bmatrix}.$$