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Algebra of Matrices

Transpose of matrix

ex: $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}_{2\times 3}$

- Interchanging row by column
- Transpose of any matrix is always denoted by, $A^T = \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix}_{3\times 2}$

Symmetric matrix
$A = A^T$

Skew-symmetric matrix
$A = -A^T$

Addition or Substraction of two matrice

it happens only if the order of two matrices are equal

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

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

$A+B = \begin{bmatrix} 1 & 1 & 6 \\ 6 & 6 & 2 \end{bmatrix}_{2\times 3}$

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

$= \begin{bmatrix} 1 & 3 & 0 \\ 2 & 4 & 10 \end{bmatrix}_{2\times 3}$

Scaler multiplication

eg = $A = \begin{bmatrix} 1 & 2 \\ 4 & 3 \end{bmatrix}_{2\times 2}$

Find $4A = 4 \begin{bmatrix} 1 & 2 \\ 4 & 5 \end{bmatrix}$

$= \begin{bmatrix} 4 & 8 \\ 16 & 20 \end{bmatrix}$

$A_g = g \begin{bmatrix} 1 & 2 \\ 4 & 5 \end{bmatrix}$

$= \begin{bmatrix} 1g & 2g \\ 4g & 5g \end{bmatrix}$

Equallity of two matrices

$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}_{2\times 2}$ $B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}_{2\times 2}$

$A = B$

$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}_{2\times 2}$ $B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}_{2\times 2}$

$A = B$

It means $a = 1, b = 2$
$c = 3, d = 4$

Multiplication of two matrices.

- If $A = [a_{ij}]_{m\times n}$ & $B = [b_{ij}]_{n\times p}$
- Then only multiplication happens or performed (It means no. of col. of First matri = No. of row of 2^{nd} matri.)

1^{st} matrix column = 2^{nd} matrix row.

And the multiplied answer is of orde
$A \times B = [ab_{ij}]_{m\times n}$

eg: $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}_{2\times 2}$ $B = \begin{bmatrix} 0 & 1 & 3 \\ 4 & 2 & -1 \end{bmatrix}_{2\times 3}$

$\rightarrow A \times B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}_{2\times 2} \times \begin{bmatrix} 0 & 1 & 3 \\ 4 & 2 & -1 \end{bmatrix}$

$= [\cancel{(1\times 0) + (2\times 4)}]$

$= \begin{bmatrix} (1\times 0)+(2\times 4) & (1\times 1)+(2\times 2) & (1\times 3)+2(-1) \\ (3\times 0)+(4\times 4) & (3\times 1)+(4\times 2) & (3\times 3)(4(-1)) \end{bmatrix}$

$= \begin{bmatrix} 0+8 & 1+4 & 3-2 \\ 0+16 & 3+8 & 9-2 \end{bmatrix}$

$$= \begin{bmatrix} 8 & 5 & 1 \\ 16 & 11 & 5 \end{bmatrix}_{2 \times 3}$$