Matrices operations

=> To manipulate and analyze multidimensional data efficiently.

Main matrix operations:

1) Matrix Addition And Substraction
2) Scalar Matrix Multiplication
3) Matrix Multiplication

1) MATRIX ADDITION AND SUBSTRACTION

Add or substract corresponding elements of 2 matrices of the same dimentions.

→ Store A

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}_{3\times 3}$$

store B

$$B = \begin{bmatrix} 4 & 5 & 6 \\ 7 & 8 & 9 \\ 1 & 2 & 3 \end{bmatrix}_{3\times 3}$$

Dataset

	Prod A	Prod B	Prod C
Day 1	1	2	3
Day 2	4	5	6
Day 3	7	8	9

$$A + B = \begin{bmatrix} 1+4 & 2+5 & 6+3 \\ 4+7 & 8+5 & 6+9 \\ 7+1 & 8+2 & 9+3 \end{bmatrix}$$

$$= \begin{bmatrix} 5 & 7 & 9 \\ 11 & 13 & 15 \\ 8 & 10 & 12 \end{bmatrix}$$

2) SCALAR MULTIPLICATION

Scalar Multiplication involves multiplying every element of a matrix by scalar value

$$B = cA$$

Example Suppose we have a matrix representing product prices in dollars and we want to adjust these prices for inflation by a factor of 1.05

Original

$$P = \begin{bmatrix} 10 & 20 & 30 \\ 15 & 25 & 35 \\ 20 & 30 & 40 \end{bmatrix}$$

Scalar Multiplication

$$P_{adjusted} = 1.05\,P = 1.05 \begin{bmatrix} 10 & 20 & 30 \\ 15 & 25 & 35 \\ 20 & 30 & 40 \end{bmatrix} = \begin{bmatrix} 10.5 & 21 & 31.5 \\ 15.75 & 26.25 & 35.75 \\ 21 & 31.5 & 42 \end{bmatrix}$$

DATASET IT FIRMS

Salarys from 2024			=> 2025 =>	Inflation 6%
Base salary software engineering	Base Salary Human Resourse	Base Salary Accountents		
45k	30k	40k	*	1.06
50k	35k	45k	*	1.06
-	-	-		—

3) Matrix Multiplication

Operation: It involves the dot product of rows of the first matrix with columns of the second matrix.

For 2 matrix A(m x n) and B(n x p), the result matrix C (m x p)

$$\begin{bmatrix} 1 & 2 & 3 \end{bmatrix} \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix} \Rightarrow 1\cdot 2 + 2\cdot 3 + 3\cdot 4 = 2 + 6 + 12 = 20$$

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}_{\substack{2\times 3 \\ m\times n}} \qquad B = \begin{bmatrix} 7 & 9 & 11 \\ 8 & 10 & 12 \end{bmatrix}_{\substack{2\times 3 \\ n\times p}}$$

No posible but

$$B^T = \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix}_{3\times 2}$$

$$C = A\cdot B^T = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix} = \begin{bmatrix} C_{11} & C_{12} \\ C_{22} & C_{22} \end{bmatrix}_{2\times 2} = \begin{bmatrix} 58 & 64 \\ 139 & 154 \end{bmatrix}$$

$$C_{11} = (1\cdot 7 + 2\cdot 9 + 3\cdot 11) = 7 + 18 + 33 = 58$$

$$C_{12} = (1\cdot 8 + 2\cdot 10 + 3\cdot 12) = 8 + 20 + 36 = 64$$

$$C_{21} = (4\cdot 7 + 5\cdot 9 + 6\cdot 11) = 139$$

$$C_{22} = (4\cdot 8 + 5\cdot 10 + 6\cdot 12) = 154$$