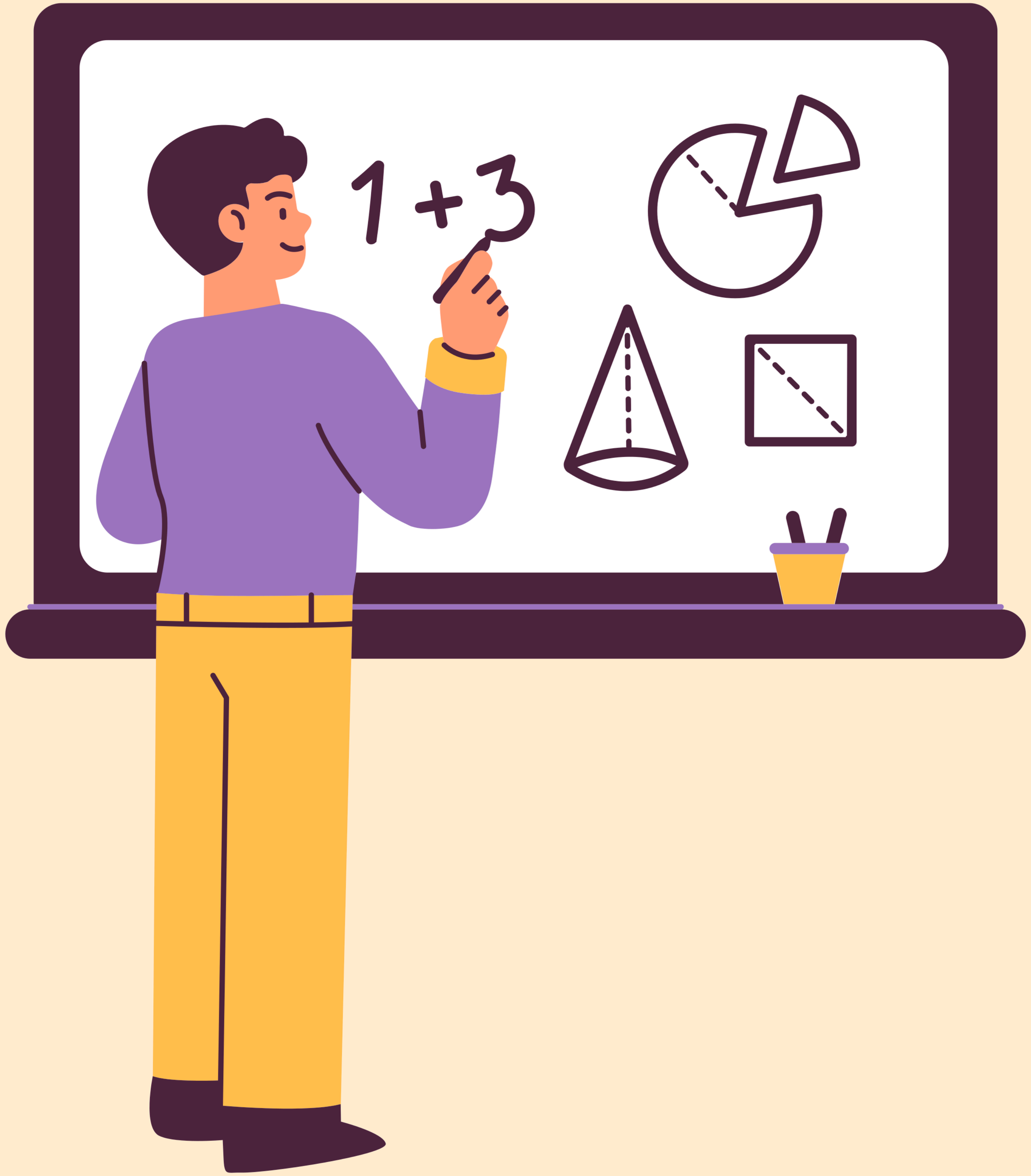


LINEAR ALGEBRA FOR

MACHINE LEARNING

WHY LINEAR ALGEBRA IS IMPORTANT FOR ML?

It's a language of Machine learning.
We Work with:
Datasets → Stored as Matrices
Features of data → represented as a vector
Model calculations → done using matrix operations

EXAMPLE

model → for → House price prediction

↓ features

[Size, No. of rooms, Location score]

VECTOR

↓

Collect data for 100 houses.

MATRIX (100X3)

WHAT IS "WEIGHTS"

A numberthat tellsthemodel howimportanta feature is when making a prediction

Size (Sq)	No. of rooms	Location Score
1000	2	8

→ [1000, 2, 8]

Input Vector

Now, the model applies weights to each of these feature:

weights : [0.5, 10000, 20000]

Next Step is :

= (1000 × 0.5) + (2 × 10000) + (8 × 20000)

= 500 + 20000 + 160000

= ₹ 180,500 — predicted price.

each weight tells how much that feature contributes to the final prediction.

real-world Analogy :

final exam mark = (Assignment × 20%) + (Quiz × 30%) + (project × 50%)

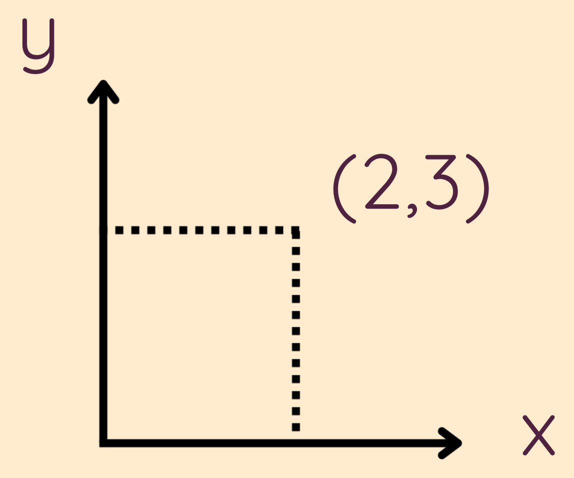
20%, 30%, 50% — weights.

IN MACHINE LEARNING:

- Weights are learned automatically during training.
- The model adjusts weights so that predictions become more accurate.
- If a weight is small → the feature is less important.
- If a weight is large → the feature is very important.

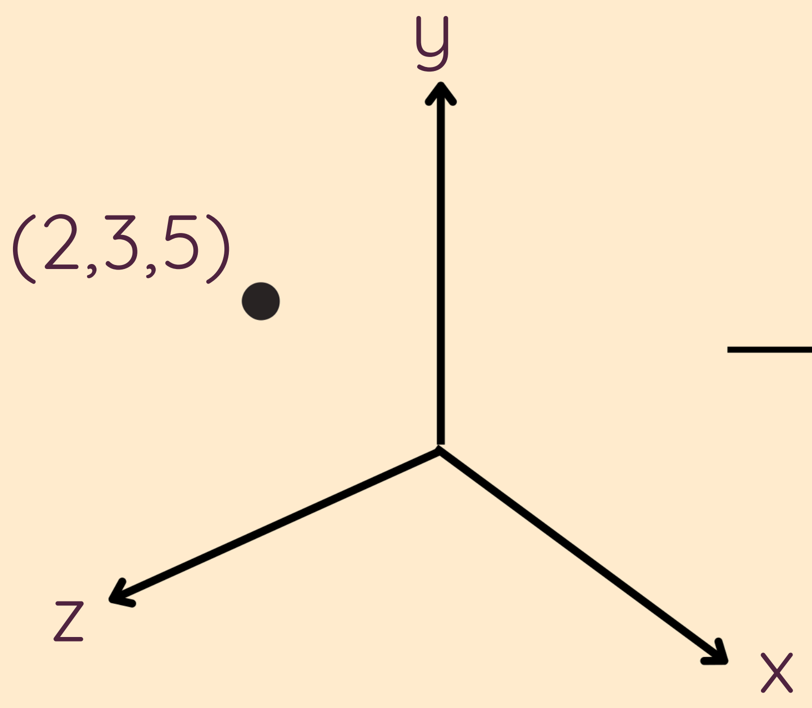
Data = matrix
feature = vector
Calculations = matrix operations
ML = built on linear algebra

HIGH DIMENSIONS INTERPRETATION



(2,3) → 2 dimension vector

(2,3,6,7,8,1) → 5 dimension vector



(2,3,5) → 3 dimension vector

SCALARS

Single numerical values.

ML: It is used to adjust things like weights in a model or the learning rate during training.

OPERATIONS IN LINEAR ALGEBRA

1.ADDITION & SUBRACTION

$$u = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix}, \quad v = \begin{bmatrix} 3 \\ 0 \\ 2 \end{bmatrix}$$

addition $\Rightarrow$ $u + v = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix} + \begin{bmatrix} 3 \\ 0 \\ 2 \end{bmatrix}$

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

Subtraction $\Rightarrow$ $u - v = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix} - \begin{bmatrix} 3 \\ 0 \\ 2 \end{bmatrix}$

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

OPERATIONS IN LINEAR ALGEBRA

1.SCALAR MULTIPLICATION

Scalar $k = 3$ Vector $V = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix}$

$$k \cdot V = 3 \cdot \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix} = \begin{bmatrix} 3 \cdot 2 \\ 3 \cdot -1 \\ 3 \cdot 4 \end{bmatrix}$$

$$= \begin{bmatrix} 6 \\ -3 \\ 12 \end{bmatrix}$$

OPERATIONS IN LINEAR ALGEBRA

1.DOT PRODUCT & CROSS PRODUCT

Dot product (Scalar product).

→ row vector

$u = [u_1, u_2, u_3]$ $v = [v_1, v_2, v_3]$

dot product → $u \cdot v = u_1 \cdot v_1 + u_2 v_2 + u_3 v_3$

Cross product (Vector product)

$$u \times v = \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} \times \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix}$$

$$= \begin{bmatrix} u_2 v_3 - u_3 v_2 \\ u_3 v_1 - u_1 v_3 \\ u_1 v_2 - u_2 v_1 \end{bmatrix}$$

TRANSPOSE

– flip the matrix over its diagonal.

Rows become Columns and columns become rows.

eg:

$$A = [\,[1, 2, 3],\; [4, 5, 6]\,] \longrightarrow 2 \times 3$$

rows

colum

$$A^T = [\,[1, 4],\; [2, 5],\; [3, 6]\,] \longrightarrow 3 \times 2$$

Thank you