Linear Algebra

1. Scalars

A scalar is a single number (0-dimensional quantity).

Operations:

- Addition: a + b
- Multiplication: a * b
- Division: a / b

Scalars are used as elements of vectors, matrices, and tensors.

2. Vectors

A vector is a **1D array** of numbers (magnitude and direction).

Basic Operations:

a = [1,2,3,4]

b= [1,2,3,4]

- Addition : a +b
- Subtraction : a-b
- Scalar Multiplication : 2* a
- Dot product : a* b

3. Matrices

A matrix is a **2D array** of numbers, arranged in rows and columns.

A = np.array([[1, 2], [3, 4]])

B = np.array([[5, 6], [7, 8]])

Basic Operations:

Matrix Addition: A + B

Matrix Multiplication: A*B # np.dot(A, B)

Transpose:A.T

Determinant: #np.linalg.det(A)

Inverse: np.linalg.inv(A)

4. Tensors

A tensor is a **generalization of vectors and matrices to more dimensions**:

5. Gradients

The gradient is a **vector of partial derivatives** of a function with respect to its variables.

Numerical Gradient Example:

For a function $f(x)=x^2$

Linear Algebra in ML/AI

- **Scalars:** Learning rate, loss values.
- **Vectors:** Features of a single data point.
- **Matrices:** Dataset representation (rows = samples, columns = features).
- **Tensors:** Image datasets (e.g., 28×28×3 RGB images).
- **Gradients:** Used in optimization (e.g., gradient descent).