

Linear Algebra

Lecture #1

Introduction to Linear Algebra, Vectors
and Matrices.



Definition:

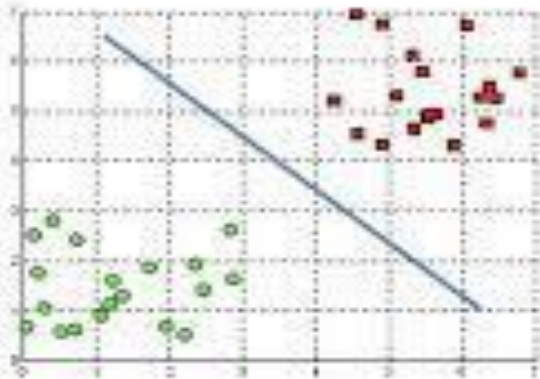
A linear algebra is a field of mathematics that could be called mathematics of data.

Example:- Linear algebra plays a key role in data modeling, computational modeling and etc.

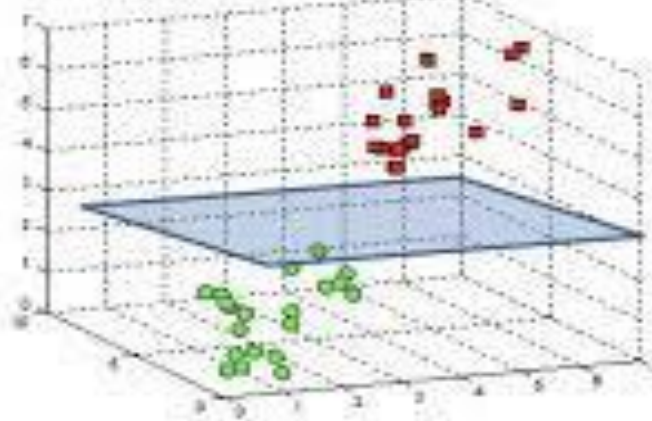
To understand the linear algebra

Let we take example of 2D and 3D elements.

A hyperplane in \mathbb{R}^2 is a line



A hyperplane in \mathbb{R}^3 is a plane



Let we take 2D elements means we have two types of elements

- One of green colors -
- One of Red colors-

What if we want to make two different groups for that hyperplane can be used for categorization of making two groups. i.e Hyperplane is considered as plane

Example:-As it is same as classification problems

So, now we will see to locate the point or vector in 2D, 3D, 4D and nD

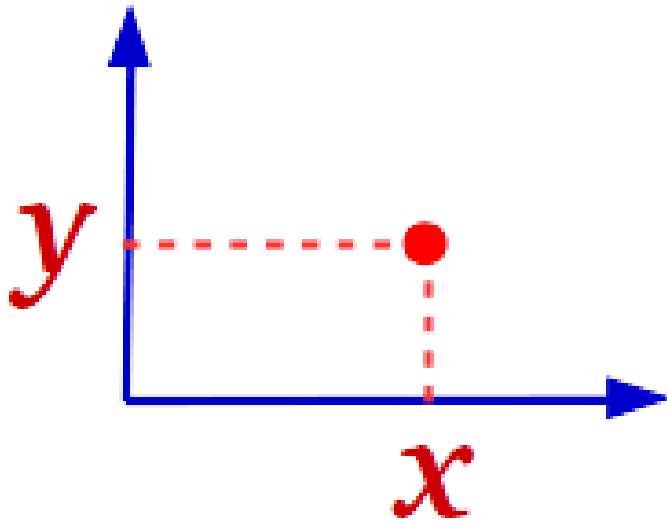


Fig. 2D

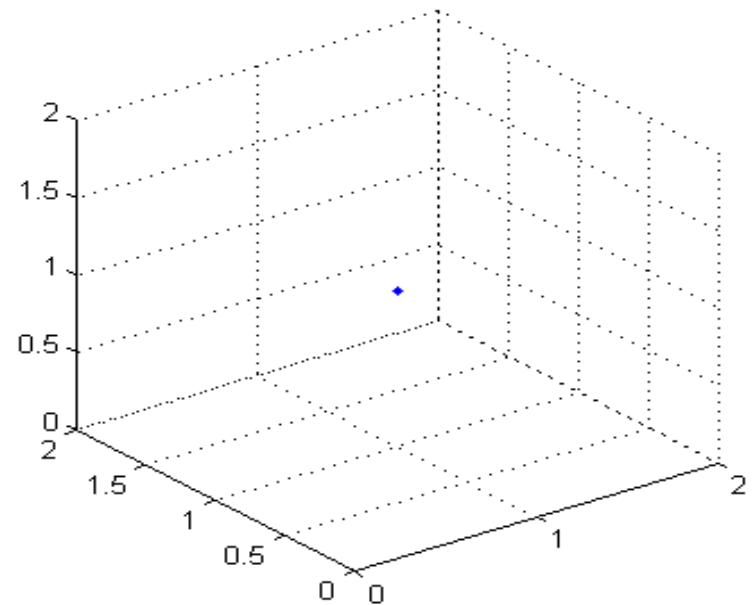


Fig. 3D

What if When we need to find the distance from the origin.

Origin is that where the x and y axis will meet that is (0,0) or
When $x=0$ and $y=0$

And we can find the distance by the help of the distance formula
As I am taking this (4,5) point as (a,b) for the simplicity purpose

Distance formula

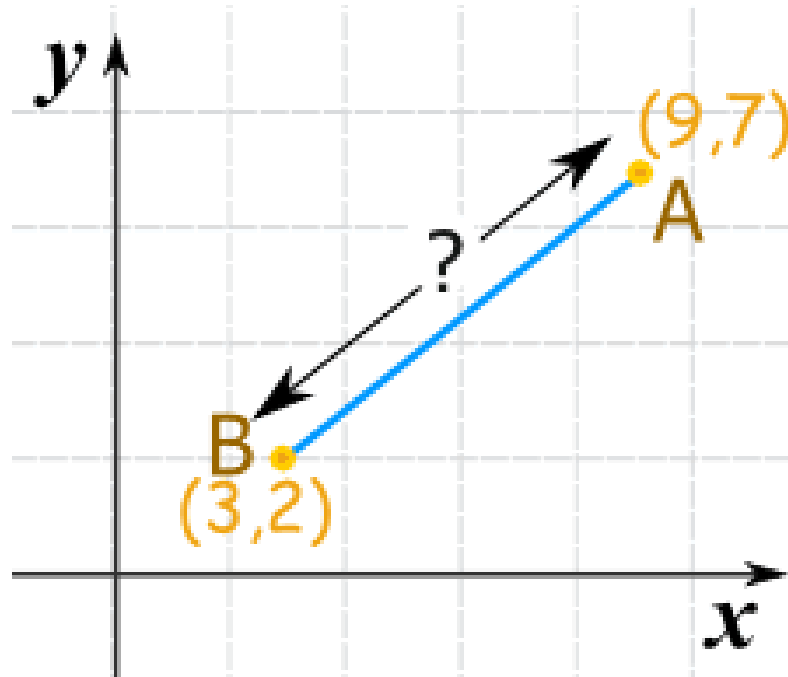
Squareroot of a^2+b^2

Note: This is the distance from the origin to that point as I have taken it (4,5)

As it will work in case of 3D or nD

Squareroot of $a^2+b^2+.....n^2$

What we can do to solve the problem if we will have two points ?



Distance formula to

Squareroot of $(a_1-b_1)^2 + (a_2-b_2)^2$

VECTORS

There are 2 types of vectors are

1. Row vector
2. Column vector

It is like a list as you have created in python

$A = [a_1, a_2, a_3, a_4, a_5]$

Is an example of row vector

$A =$



Column vector

Matrix

It is called list of lists means there will be multiple lists

Q1. What if we want to fetch the particular no. from the matrix.

$$\begin{matrix}
 & \begin{matrix} 1 & 2 & \dots & n \end{matrix} \\
 \begin{matrix} 1 \\ 2 \\ 3 \\ \vdots \\ m \end{matrix} & \left[\begin{array}{cccc}
 a_{11} & a_{12} & \dots & a_{1n} \\
 a_{21} & a_{22} & \dots & a_{2n} \\
 a_{31} & a_{32} & \dots & a_{3n} \\
 \vdots & \vdots & \vdots & \vdots \\
 a_{m1} & a_{m2} & \dots & a_{mn}
 \end{array} \right]
 \end{matrix}$$

Suppose If we want this 12 no. For this we need of row number and column no. that is A₄₃ to get this no.

TRANSPONSE OF MATRIX

This concept, we will use in machine learning.

Example:- It will be converted from row vector to column vector and vice versa.

$$A=A^T$$

VECTOR OPERATIONS

1. ADDITION
2. SUBTRACTION
3. SCALAR PRODUCT
4. INNER PRODUCT
5. OUTER PRODUCT

Q1.How do you apply these operations?

Q2.How do you multiply the scalar to the vector?

Q3.What is inner product and how to do product?

Addition and subtraction of two vector results in new vector.

Let we understand with the help of example

$$A=(x_1,y_1)$$

$$B=(x_2,y_2)$$

$$A+B=(x_1+x_2,y_1+y_2)$$

$$A-B=(x_1-x_2,y_1-y_2)$$

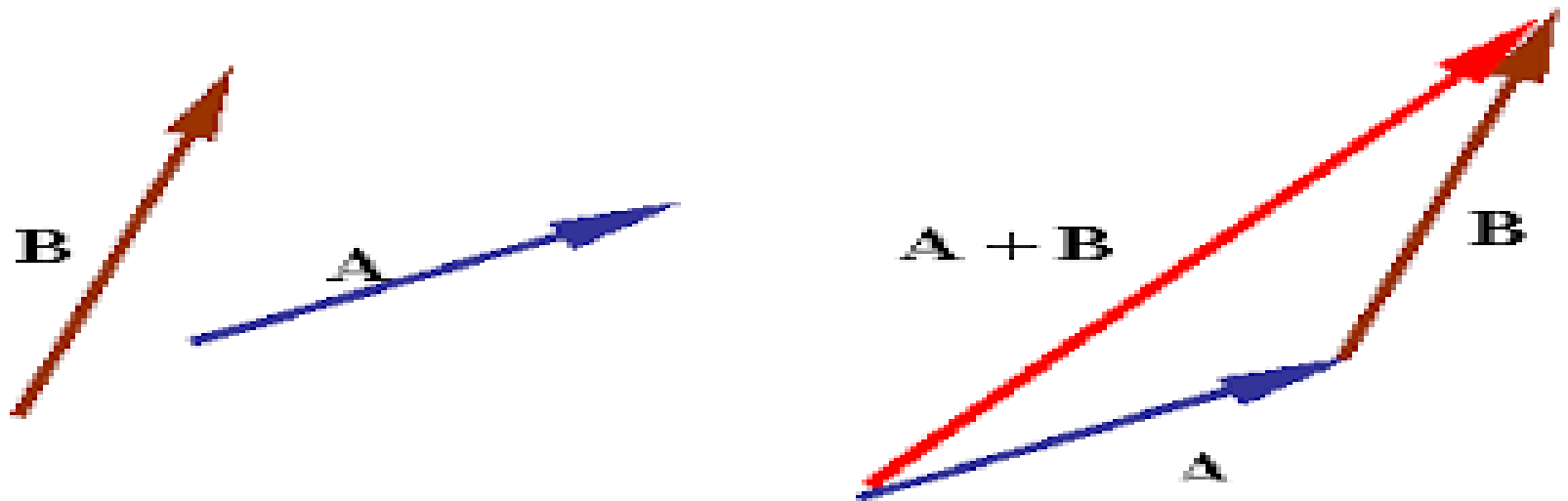
So, no. to apply to the addition and subtraction and any other operation vector must be 2 Dimensional space and size.

Here, in this case both are in of same dimensions and we can say they are compatible.

Let understand graphically

So initially how do we apply addition operation

So we position these vectors such that what will initial end of b in that we can say like placed at the terminal end of a vector.



SUBTRACTION

If b vector is the given vector and so how we can get $-b$ vector. For that it is with same magnitude, but in a reverse direction. So now B and $-B$ are represented.

