Linear Algebra :-

→ Helps in Optimization.

→ Performs operations on the data.

1. Scalars.

A value which represents something.

All basic arithmetics funtions can be applied to two scalar values (+, -, /, *).. etc.

Eg. 10 + 13 = 23

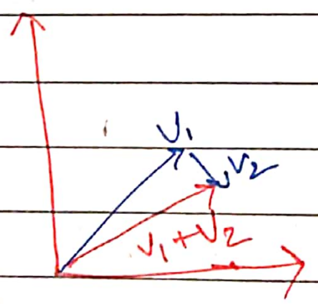
② Vectors :-

(i) Computer Science :- People interpret Vectors as a list of numbers that represent something

Vector operation.

↳ To apply vector operation we first should know which type of ML dataset we are working with & then apply vector operation accordingly.

① Addition.

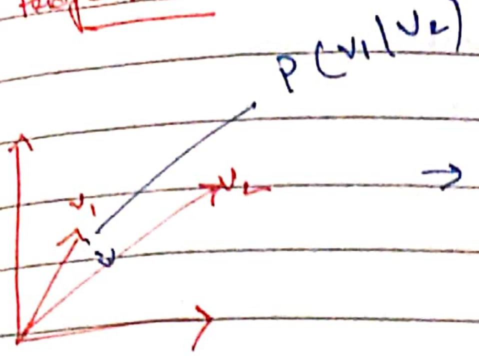


V_1+V_2 = Displacement.

② Scalar Multiplication.

Vector grows with +ve scalar value multiplied & for -ve vice versa.

③ Projection.



Very useful in Deep learning.

→ Suppose I know much about V_2 feature projecting V_1 on V_2 will help me know the unknown features of V_1.

③ Matrix Op

↳ • Composition of number, symbols or expressions in a rectangular array.

• We use Matrices to convert our expressions of the vector form to array.

• We generally do this to make our operations easier & helpful.

Some Basic operation of Matrices such as Addition & Subtraction & Multiplication we already did in +2.

Lets dive but what's Imp. w.r.t. M.L.

Matrix Operations :-

① Transpose :- (i) Interchanging of rows & columns.

- We generally use it to change the dimensionality of the given data / problem.

Eg. $A = \begin{bmatrix} 2 & 2 \\ 4 & 1 \end{bmatrix}$ $A^T \begin{bmatrix} 2 & 4 \\ 2 & 1 \end{bmatrix}$

② Determinant of Matrix.

- It is the scalar value of Matrix.
- It gives you the product of Eigen Values of the Matrix.

Eg. $A = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$

$$Det(A) = a * \begin{vmatrix} e & f \\ h & i \end{vmatrix} - b \begin{vmatrix} d & f \\ g & i \end{vmatrix} + c \begin{vmatrix} d & e \\ g & h \end{vmatrix}$$

~~[illegible]~~

NOTE: Vector as a Matrix L.A.

- Vectors can be easily translate to Matrix.
- We already talked it is easy to apply operations on vector in Data.

ML Pov :-

Known operations such as Scaling, Rotation & Shearing, The above operation can be ~~too~~ applied on our data to better extract information from it.

Eg.

Scaling :-

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} \begin{bmatrix} S_x & 0 \\ 0 & S_y \end{bmatrix}.$$

Shearing :-

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} \begin{bmatrix} 1 & 0 \\ m & 1 \end{bmatrix}$$

Rotation :-

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} \begin{bmatrix} \cos\phi & -\sin\phi \\ \sin\phi & \cos\phi \end{bmatrix}.$$

* Matrices can also help us solve the equations by

→ Inverse Method

→ Row Echelon Method.

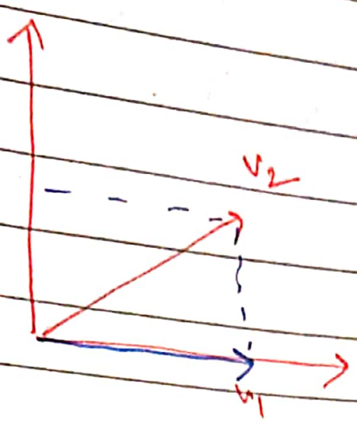
Eigen Vectors (ML Pov)

- It doesn't change direction even if transformation is applied to it.
- These are generally used for analysis of ~~text~~ the data.

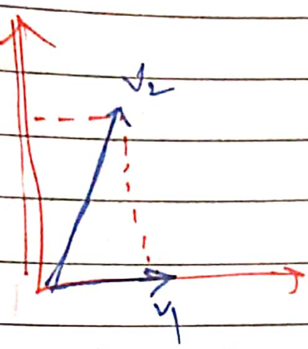
Eg.

$V_1 \rightarrow$ $V_2 \rightarrow$

Before



After Shearing.



My V_2 vector has completely change but my V_1 Vector is been applied with -ve Scalar.

After Shearing we are still able to extract the information that it is rectangle.

Applications of Linear Algebra in ~~ML/AI~~ AI/ML

- PCA for dimensionality reduction.
- Transformation of Pixel data to work corresp with Images.
- Encoding of the Dataset.
- SVD
- Optimizations for DL models.