Linear Algebra

Vector

Vector is basically a one-dimensional array, vector stores the magnitude and direction of a potential change to the point.
Suppose we have [3, -2]:

- 3 = represents go right : 3
- -2 = represents go down: 2

One Dimensional : [Param1 Param2]

R +	T +	R= Right, L= Left
L -	B -	T= Top, B= Bottom

Notation

Vectors can be represented in any way, but that doesn't mean the meaning will also change, it will remain same.

Example:

$$v = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} = [1 \quad 2 \quad 3]$$

Scalar Operations

In a scalar operation there is one vector and one number, We can modify the existing vector by doing arithmetic operations on it.

[2 2 2] + 1 = [3 3 3]

Elementwise Operations

In elementwise operations we do arithmetic operations on corresponding elements of two vectors, It is necessary that both dimensions must have the same dimension to perform any operation

[1 2 3] x [2 5 4] = [(1x2) (2x5) (3x4)] => [2 10 12]
Vec1 Vec2 New Vec

Dot Product

In a dot product you actually multiply two vectors and then add them together so at the end you end up with scalar.

<u>Note: Dot product is not similar to Cross product.</u>

[a1 a2 ….. an] . [b1 b2 ….. Bn] = ||a|| ||b|| Cos θ

||a|| = √(a1.a1) (a2.a2) ….

||b|| = √(b1.b1) (b2.b2) ….

Hadmard Product

In Hamdard product we do the multiplication of corresponding elements in the vectors.

Note: We do only multiplication in hadmard production

[a1 a2] [b1 b2]
[a3 a4] [b3 b4]

= [a1.b1 a2.b2 a3.b3 a4.b4]

Differentiation Formulas

- $\frac{d}{dx} 1 = 0$ // differentiation of constant will be 0;
- $\frac{d}{dx} x = 1$ // differentiation of x with respect to x will be 1;
- $\frac{d}{dx} x^2 = 2x$ // by $x^n : n.x^{n-1}$
- $\frac{d}{dx} (1+x^2) = 2x$ // 1 is constant so it becomes 0, & x^2 is 2x
- $\frac{d}{dx} (1-x^2) = -2x$ // same as above just minus will be add on.

- $\frac{d}{dx}(x^n) = n.x^{n-1}$ // this is a formula for differentiation of x^n

- $\frac{d}{dx}(e^x) = e^x$ // differentiation of exponential will remain same

  Note: (but we will differentiate the power of exponential)

- $\frac{d}{dx}\sin x = \cos x$

- $\frac{d}{dx}\cos x = -\sin x$

- $\frac{d}{dx}\tan x = \sec^2 x$

- $\frac{d}{dx}\tan^{-1}x = \frac{1}{1 + x^2}$

- $\frac{d}{dx}\sin^{-1}x = \frac{1}{\sqrt{1 - x^2}}$

- $\frac{d}{dx}\cos^{-1}x = -\frac{1}{\sqrt{1 - x^2}}$