Module-02, Basic Mathematics and Statistics

Mathematics (Linear Algebra)

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Scalars and vectors

Scalar The simple numbers are consider as scalar like 2, 4, 6 so on, just at magnitude only used to represent time, speed, distance,length,mass work,power,area,volume, and so on.

Vectors Vectors have its directions and its magnitude as well as many dimensions.

- Vectors are denoted as V $=[x_1, x_2, x_3, ...x_n]$.

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Linear Combination of Vectors

To, develop a better understanding, we will break down multiplication of matrix A and vector x. It is easiest to think of it as Linear Combination of vectors.

- Multiplication,

$$\begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} a_1x_1 & b_1x_2 & c_1x_3 \\ a_2x_1 & b_2x_2 & c_2x_3 \\ a_3x_1 & b_3x_2 & c_3x_3 \end{bmatrix}$$

$$= x_1 \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} + x_2 \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} + x_3 \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix}$$

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Vector Operation

- There is another very important vector operation called the dot product, which is a types of multiplication. let's take two arbitrary vectors R^2, v and w and find its dot product, like

$$\mathrm{v} = \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} \text{ and } \mathrm{w} = \begin{bmatrix} w_1 \\ w_2 \end{bmatrix}$$

- The following is the dot product,

$$v.w = v_1 w_1 + v_2 w_2 \tag{1}$$

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Vector Operation

- let's continue using the same vectors R^2, v and w. We deal with before as follows,

$$v = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \text{ and } w = \begin{bmatrix} -2 \\ 1 \end{bmatrix}$$

- And by taking their dot product,

$$v.w = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \cdot \begin{bmatrix} -2 \\ 1 \end{bmatrix}$$

$$= -2 + 2 = 0 \tag{2}$$

- We get zero,which tells us that the two vectors are perpendicular.

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Metric Space

A metric on a set s is defined as function d: $s \times s \mid R$ and satisfies the following criteria,

- $d(x,y) \geq 0$ and when $x = y$ then $d(x,y) = 0$
- $d(x,y) = d(y,x)$
- $d(x,z) = d(x,y) + d(y,z)$ known as triangular
- For all,x,y,z belong to set s.

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How to calculate Distance

let's supposed , we have two points (x_1, y_1) and (x_2, y_2) then the distance between then can be calculated as follows,

- d(x,y) $= \sqrt{(x_2 - x_1)^2 + (y_2 - y_2)^2}$
- As we can extend this to find the distance of pints in R^n as follow,
- d(x,y) $= \sqrt{\sum_i^n (x_i - y_i)^2}$
- Home task, explore Norms and its types.

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Great Job
Thank you