MULTIPLICATION OF VECTORS

3 TYPES:

1) Dot Products (Inner Product)
2) Element wise multiplication
3) Scalar multiplication

1) Dot Product

Definition: The dot product of 2 vectors results in a scalar and is calculated as the sum of the products of their corresponding components.

$A = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$ $B = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$

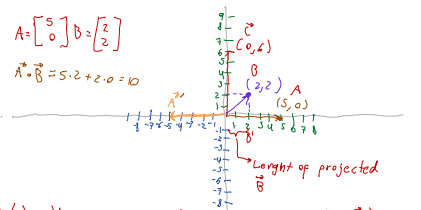
$A \cdot B = 2 \cdot 4 + 3 \cdot 5 = 23$ ← scalar Value

$A \cdot B^T = \begin{bmatrix} 2 \\ 3 \end{bmatrix} \cdot [4 \ 5]$

$= 2 \cdot 4 + 3 \cdot 5 = 23$ ← scalar value

$A = \begin{bmatrix} 5 \\ 0 \end{bmatrix}$ $B = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$

$\vec{A} \cdot \vec{B} = 5 \cdot 2 + 2 \cdot 0 = 10$



$\vec{A} \cdot \vec{B} = (\text{length of projected } \vec{B}) \cdot (\text{length of vector } \vec{A})$

$(2) \cdot (5) = 10$ positive the direction is same

$\vec{A'} = \begin{bmatrix} -5 \\ 0 \end{bmatrix}$ $\vec{B} = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$ $\vec{A'} \cdot \vec{B} = (-5 \cdot 2) + (0 \cdot 2) = -10$

negative value the direction is distinct

$C = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$ $C \cdot A' = (0 \cdot (-5)) + 5 \cdot 0 = 0$

project the vector to the origin

APPLICATION OF THE DOT PRODUCT IN DATA SCIENCE

Gen IA App => RAG

1) Cosine similarity : Definition It is a measure used to determine how similar 2 vectors are. Its calculate the cosine of the angle between 2 vectors, providing a similarity score that range -1 (dissimilar) to 1 (completed similar).

$\cos\theta = \frac{A \cdot B}{\|A\| \cdot \|B\|}$

Recommendation System:

Netflix Account -> Action Movie
-> Recommendation of other action movies

AVENGERS => [1, 2, 0, 3, 1] The vector of avengers represent the dimentions of the features

Action Comedy Romance Scifi Terror

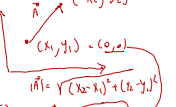
B => [2, 0, 1, 1, 1] Who determine the recommendation?

If this movie is similary netflix would you recommend this movie, if its oppositive netflix wouldn't recommended this.

Step 1) Dot product of $A \cdot B$

$A \cdot B = 1 \cdot 2 + 0 \cdot 2 + 1 \cdot 0 + 1 \cdot 3 + 1 \cdot 1$

$A \cdot B = 6$



Step 2) Magnitud of A and B

$\|A\| = \sqrt{1^2 + 2^2 + 0^2 + 3^2 + 1^2} = \sqrt{15} \approx 3.872$

$|\vec{A}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$\|A\| = \sqrt{x_2^2 + y_2^2}$

$\|B\| = \sqrt{2^2 + 0^2 + 1^2 + 1^2 + 1^2} = \sqrt{7} \approx 2.645$

$\cos\theta = \frac{6}{3.872 \cdot 2.645} \approx 0.586$ is almost 1

then recommended