Dot Product

Definition

$$\vec{A} \cdot \vec{B} = \frac{\left\|\vec{A} + \vec{B}\right\|^2 - \left\|\vec{A} - \vec{B}\right\|^2}{4}$$

Alternate Definition

$$\vec{A} \cdot \vec{B} = \left\|\vec{A}\right\| \left\|\vec{B}\right\| \cos\theta$$

Distance Definition

$$\vec{A} \cdot \vec{A} = \left\|\vec{A}\right\|^2$$

Angle Definition

$$\theta = \cos^{-1}\left(\frac{\vec{A} \cdot \vec{B}}{\sqrt{\vec{A} \cdot \vec{A}}\sqrt{\vec{B} \cdot \vec{B}}}\right)$$

Commutative Property

$$\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{A}$$

Scalar Multiplication

$$\left(c\vec{A}\right) \cdot \left(d\vec{B}\right) = cd\left(\vec{A} \cdot \vec{B}\right)$$

Distributive Property

$$\vec{A} \cdot \left(\vec{B} + \vec{C}\right) = \vec{A} \cdot \vec{B} + \vec{A} \cdot \vec{C}$$

Cartesian Form

$$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$$

Product Rule for Differentiation

$$\frac{d}{dt}\left(\vec{A} \cdot \vec{B}\right) = \frac{d\vec{A}}{dt} \cdot \vec{B} + \vec{A} \cdot \frac{d\vec{B}}{dt}$$