# Length

# Length: True or False?

For any vector $\mathbf{a}$, we have that $\mathbf{a} \cdot \mathbf{a}$ equals the length of $\mathbf{a}$.

# Length: components

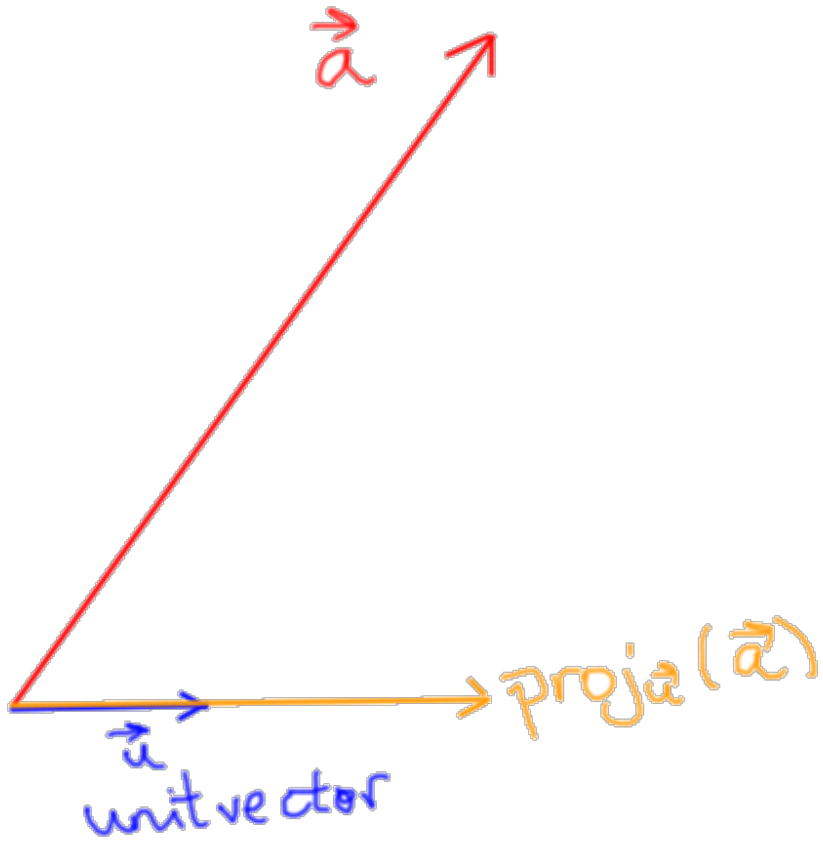
Suppose $\mathbf{u}$ is a unit vector (i.e., a vector of length $1$). Then for any vector $\mathbf{a}$, the new vector

$$\text{proj}_{\mathbf{u}}(\mathbf{a}) = (\mathbf{a} \cdot \mathbf{u})\mathbf{u}$$

gives the projection of $\mathbf{a}$ onto $\mathbf{u}$.

The number $\mathbf{a} \cdot \mathbf{u}$ is called the component of $\mathbf{a}$ in the direction of $\mathbf{u}$.

# Example



# Practice

- Let $\mathbf{u}$ be a unit vector in the same direction as $\langle 1, 1, 1 \rangle$. Find $\mathbf{u}$ and compute the projection

$$\mathbf{c} = \text{proj}_{\mathbf{u}}(\langle 3, 4, 5 \rangle).$$

- Does the difference vector

$$\langle 3, 4, 5 \rangle - \mathbf{c}$$

have endpoint in the plane $x + y + z = 0$?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