To explain dot products require linear transformation

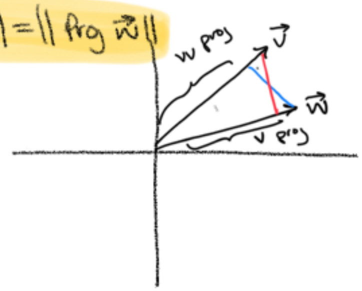
$$\begin{bmatrix} 2 \\ 4 \end{bmatrix} \cdot \begin{bmatrix} 1 \\ 0 \end{bmatrix} = 2 \cdot 4 + 1 \cdot 0 = 8$$

$$= (\text{length of projected } \vec{w}) \cdot (\text{length of } \vec{v})$$

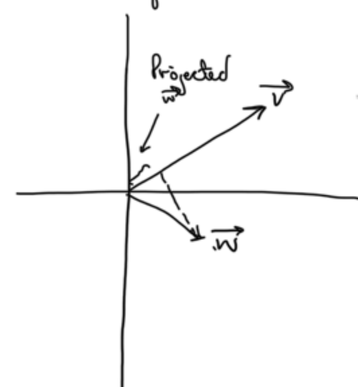
A Symmetrical Approach.

$\|\vec{v}\| = \|\vec{w}\|$

$\|Proj\ \vec{v}\| = \|Proj\ \vec{w}\|$



A Projection,



No Symmetry

Asymmetric Dot Products work because there is independence between the projection and the other asymmetric vector.

Therefor,

$$(2\vec{v}) \cdot \vec{w} = 2(\vec{v} \cdot \vec{w})$$

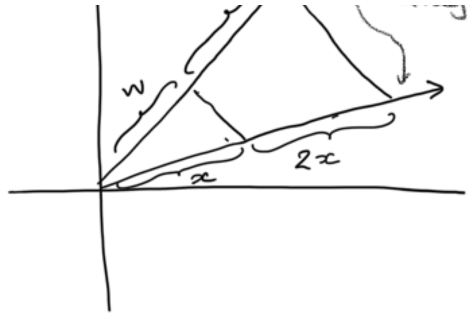
In this case the $\vec{w}$ projection doesn't change length; although

Asymmetry doesn't matter. You are either just scaling the projection or the vector which you are projecting on too which are equal.

Only when alligned, $\vec{v}$ $\vec{w}$

2w

2x hypo → 2x adj.



Can do proof using perpendicular vectors because projection is 0.

the $\vec{v}$ vector which it is projecting on to does. The effect is doubled.

Similarily, projecting a doubled vector $\vec{v}$ onto the original vector is equal to doubling the original product. → this is because the hypotenuse grows proportionate to the adjacent line segment.

Reconciling Euclidean Distance Commutative Vector Projection

$$\begin{bmatrix} u_x & u_y \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = u_x \cdot x + u_y \cdot y$$

$$\begin{bmatrix} u_x \\ u_y \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = u_x \cdot x + u_y \cdot y$$

THE DOT PRODUCT IS THE SAME AS APPLYING THE VECTOR AS A LINEAR TRANSFORMATION.

↳ The columns making up the vector are transformations of the original vectors basis vectors.

Point of Dot.

A geometric tool for
- understanding projections
- testing orientation

With more meaning, dotting is the collapse of a vector onto the real number line (of the original vector).