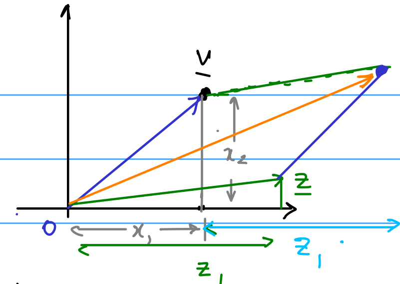
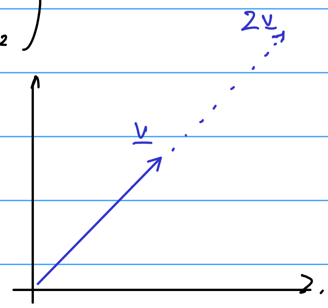
$\underline{v} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$

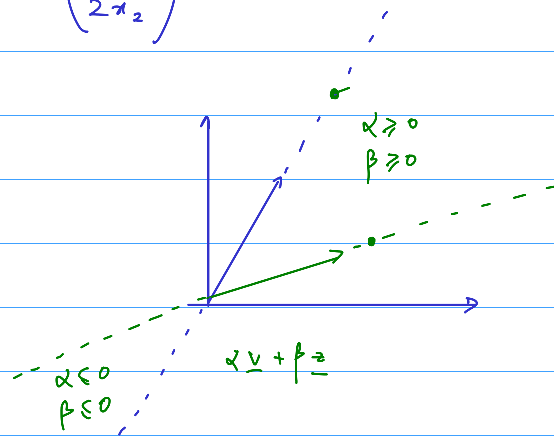
$\underline{v}^T = (x_1 \;\; x_2)$



$\underline{z} = \begin{pmatrix} z_1 \\ z_2 \end{pmatrix}$ $\qquad \underline{v} + \underline{z} = \begin{pmatrix} x_1 + z_1 \\ x_2 + z_2 \end{pmatrix}$



$2\underline{v} = \begin{pmatrix} 2x_1 \\ 2x_2 \end{pmatrix}$



$\alpha \underline{v} + \beta \underline{z}$: Linear combination.

$\alpha_1 \underline{z}_1 + \alpha_2 \underline{z}_2 + \alpha_3 \underline{z}_3$

Inner / Dot Product.

$\underline{v} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} \qquad \underline{z} = \begin{pmatrix} z_1 \\ z_2 \end{pmatrix} \qquad \underline{v} \cdot \underline{z} = x_1 z_1 + x_2 z_2$

* linear in each term

$$(\underline{v}_1 + \underline{v}_2) \cdot \underline{z} = \underline{v}_1 \cdot \underline{z} + \underline{v}_2 \cdot \underline{z}$$

$$(\alpha \underline{v}) \cdot \underline{z} = \alpha (\underline{v} \cdot \underline{z})$$

$$(\alpha_1 \underline{v}_1 + \alpha_2 \underline{v}_2) \cdot \underline{z} = \alpha_1 (\underline{v}_1 \cdot \underline{z}) + \alpha_2 (\underline{v}_2 \cdot \underline{z}).$$

* Symmetry.

$$\underline{v} \cdot \underline{z} = \underline{z} \cdot \underline{v}$$

* $\underline{v} \cdot \underline{v} \geq 0$ with $= 0$ if and only if $\underline{v} = \underline{0}$. (Positive definite).

<u>Orthogonality</u> : $\underline{v}$ is orthogonal to $\underline{w}$ if $\underline{v} \cdot \underline{w} = 0$