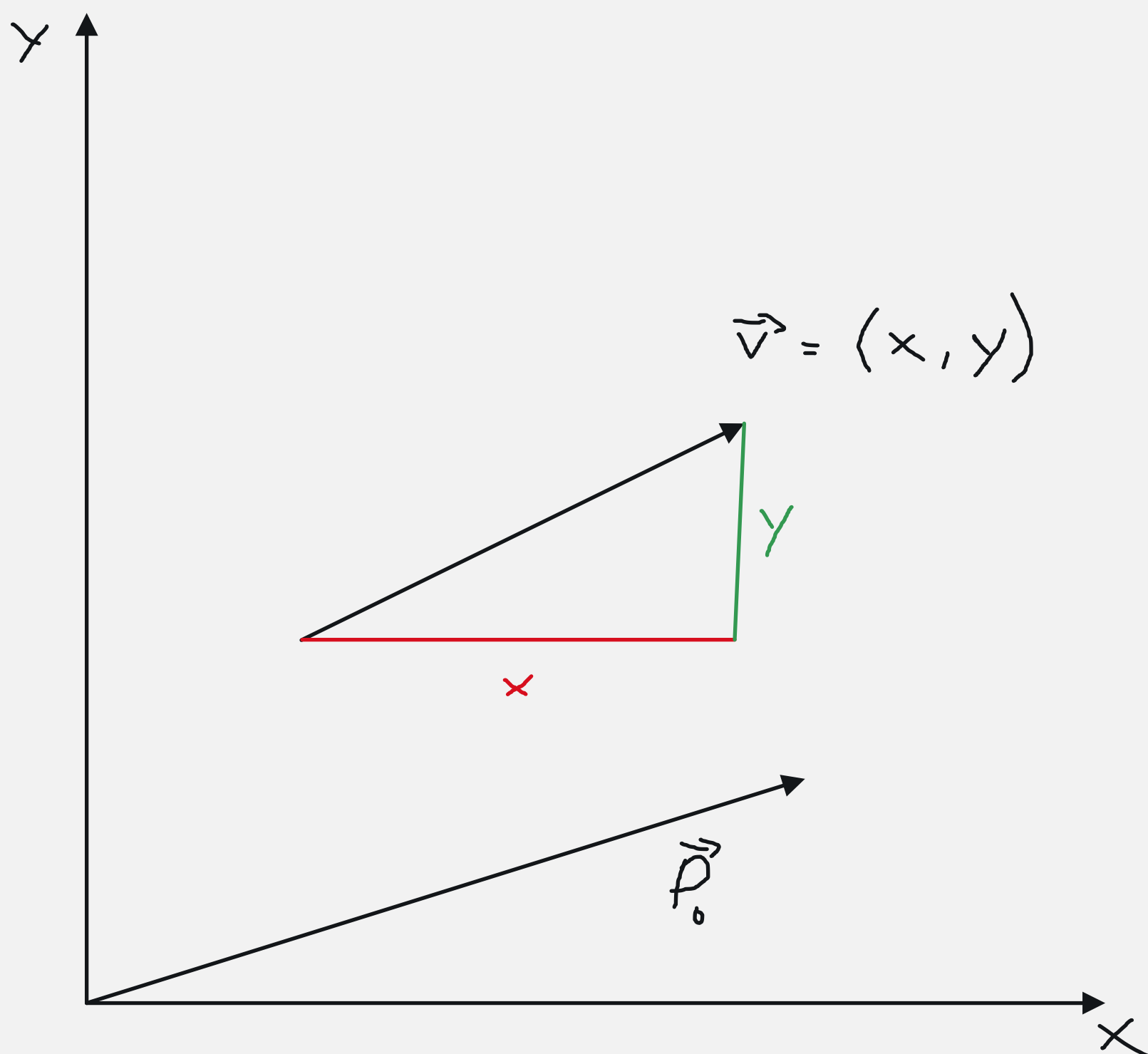


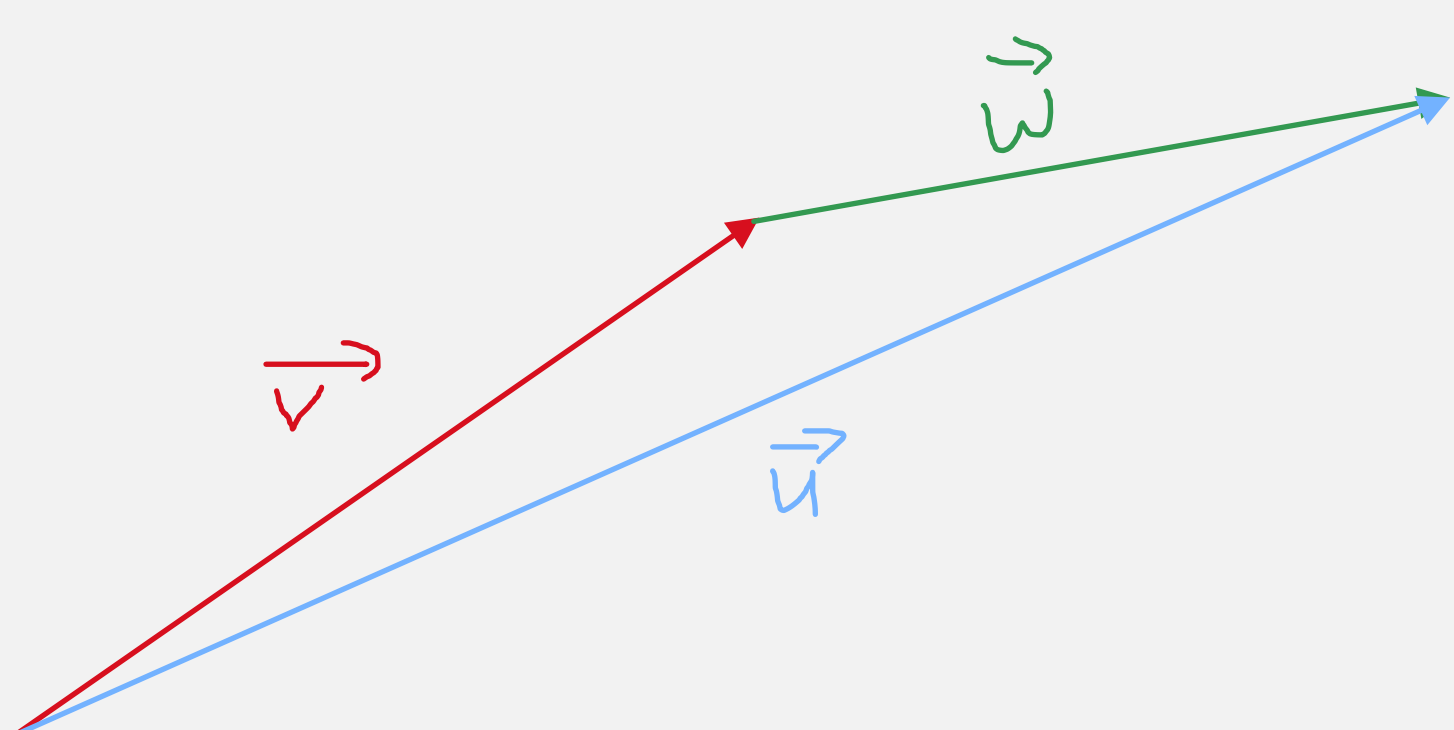


vector - parallel movement
 position vector - cartesian point (vector from origin)
 direction vector - direction between two vectors (should have length of 1 for further calculations)
 unit length vector - vector with a length of 1

$$|\vec{v}| = \sqrt{x^2 + y^2}$$

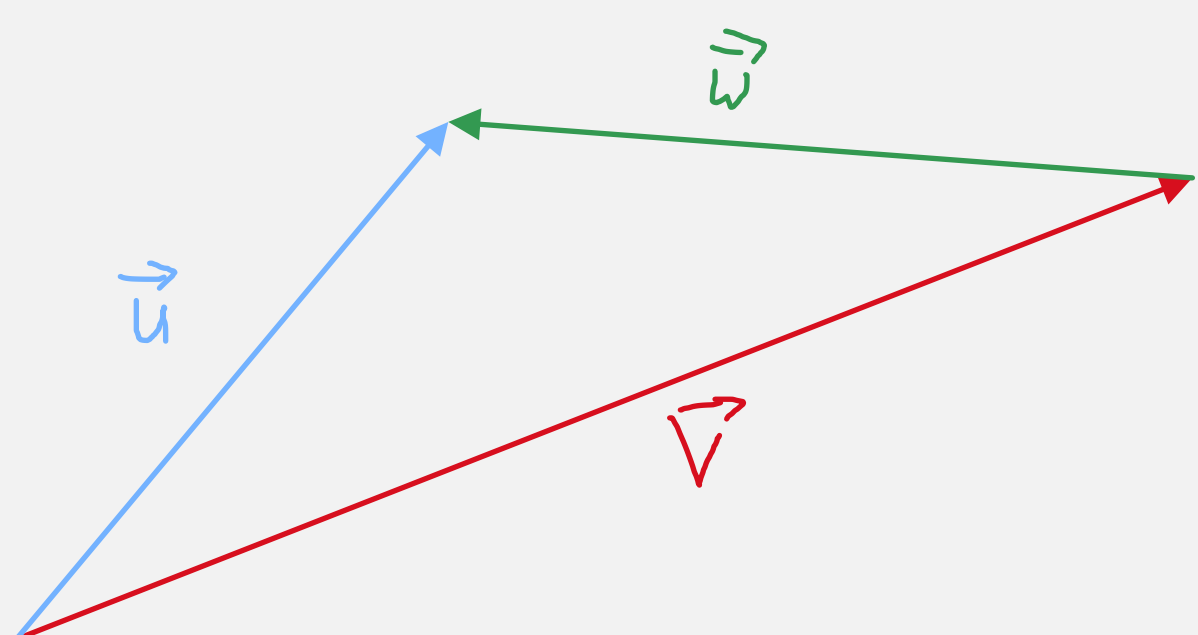
$$||\vec{v}|| = \frac{\vec{v}}{|\vec{v}|} \Rightarrow \text{normalized Vector}$$

Addition

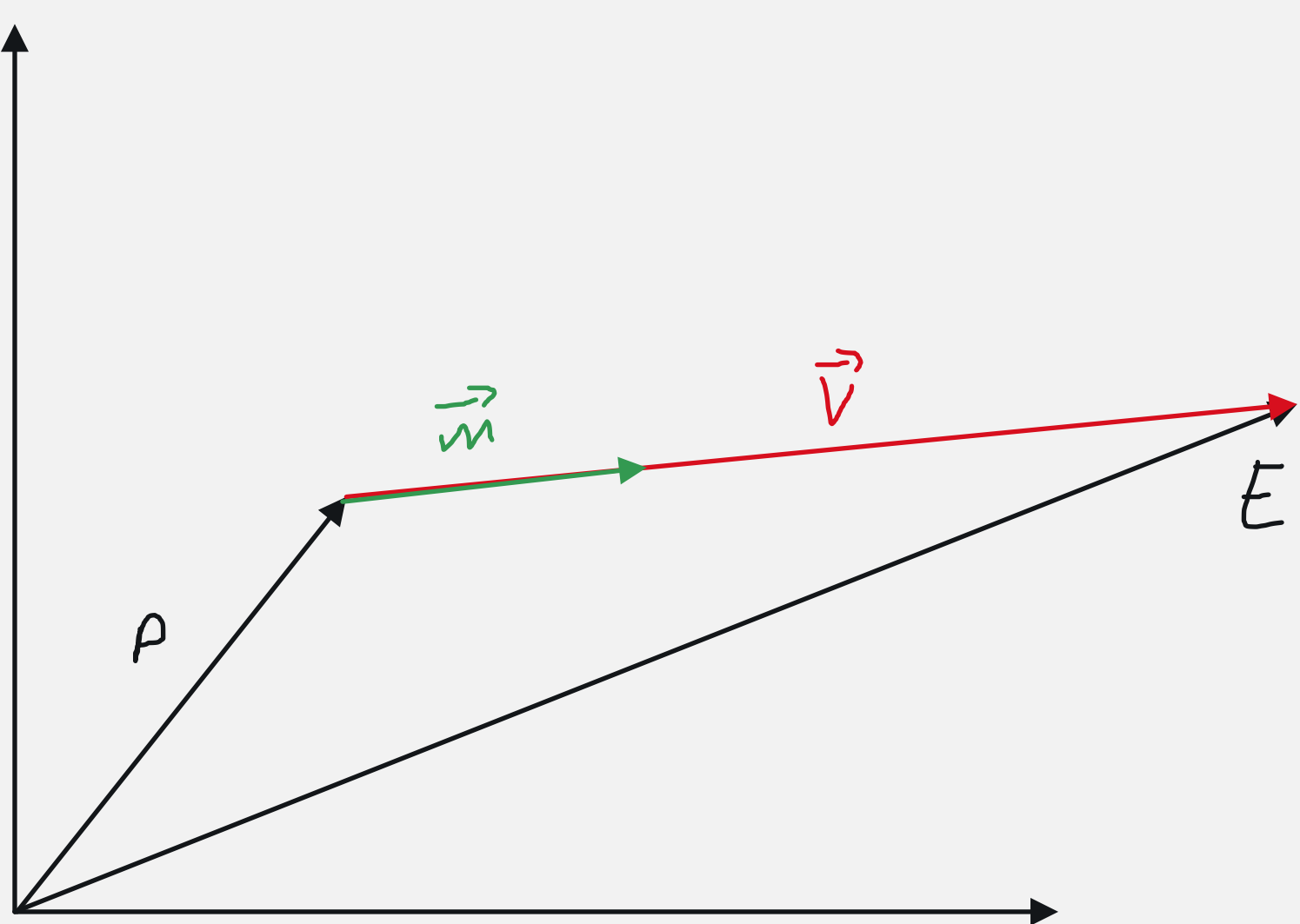


$$\vec{u} = \vec{v} + \vec{w} = \begin{pmatrix} v_x + w_x \\ v_y + w_y \end{pmatrix}$$

Subtraction



$$\vec{u} = \vec{v} - \vec{v} = \vec{v} + (-1 \cdot \vec{v})$$

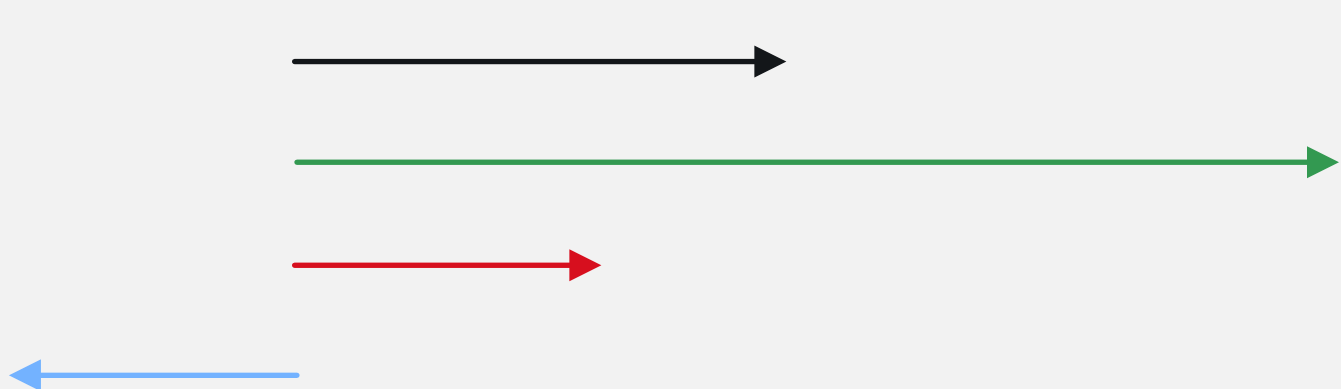


Goal minus Start

$$\vec{v} = \vec{E} - \vec{p}$$

$$\vec{m} = ||\vec{v}|| \cdot s \cdot dt \quad \text{Movementvector}$$

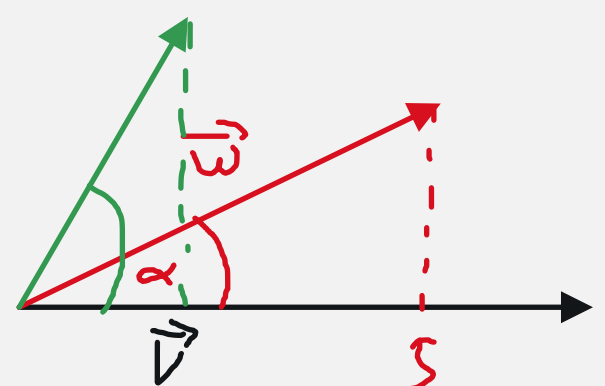
Multiplication with a Scalar



$$\vec{v} \cdot a = a \cdot \vec{v} = \begin{pmatrix} v_x \cdot a \\ v_y \cdot a \\ v_z \cdot a \end{pmatrix}$$

$$\vec{v} \cdot (s \cdot dt) \quad \text{better performance}$$

Dot Product - Scalar Product



$$\vec{v} \cdot \vec{w} = v_x \cdot w_x + v_y \cdot w_y + v_z \cdot w_z$$

$$\vec{v} \cdot \vec{w} = |\vec{v}| \cdot |\vec{w}| \cdot \cos \alpha \Leftrightarrow \cos \alpha = \frac{\vec{v} \cdot \vec{w}}{|\vec{v}| \cdot |\vec{w}|}$$

$\cos^{-1}$ $\arccos$ $\arccos$

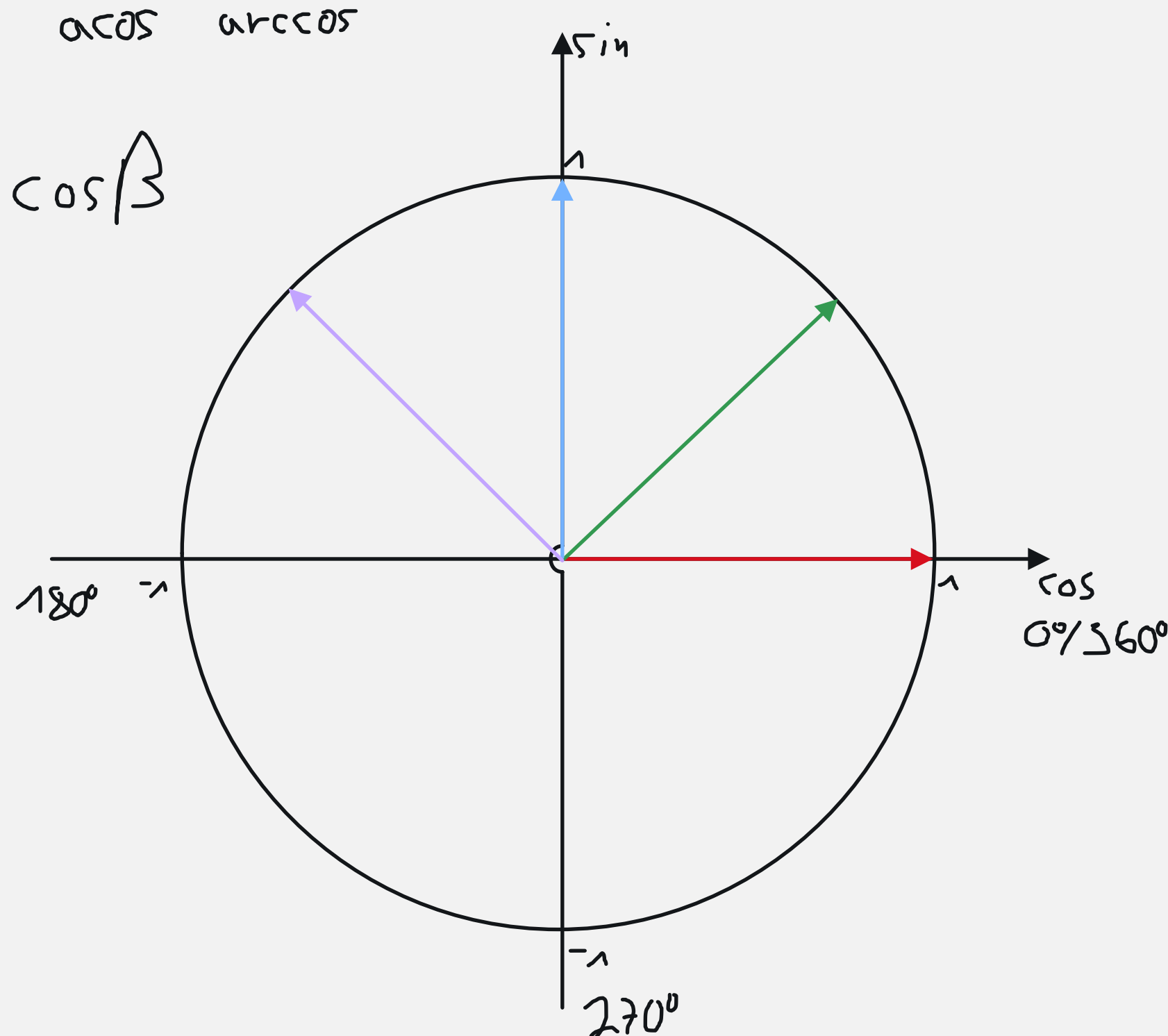
$$\frac{\alpha}{180^\circ} = \frac{x}{\pi}$$

$$\alpha = x \cdot \left(\frac{180^\circ}{\pi} \right) \quad \text{Rad2Deg}$$

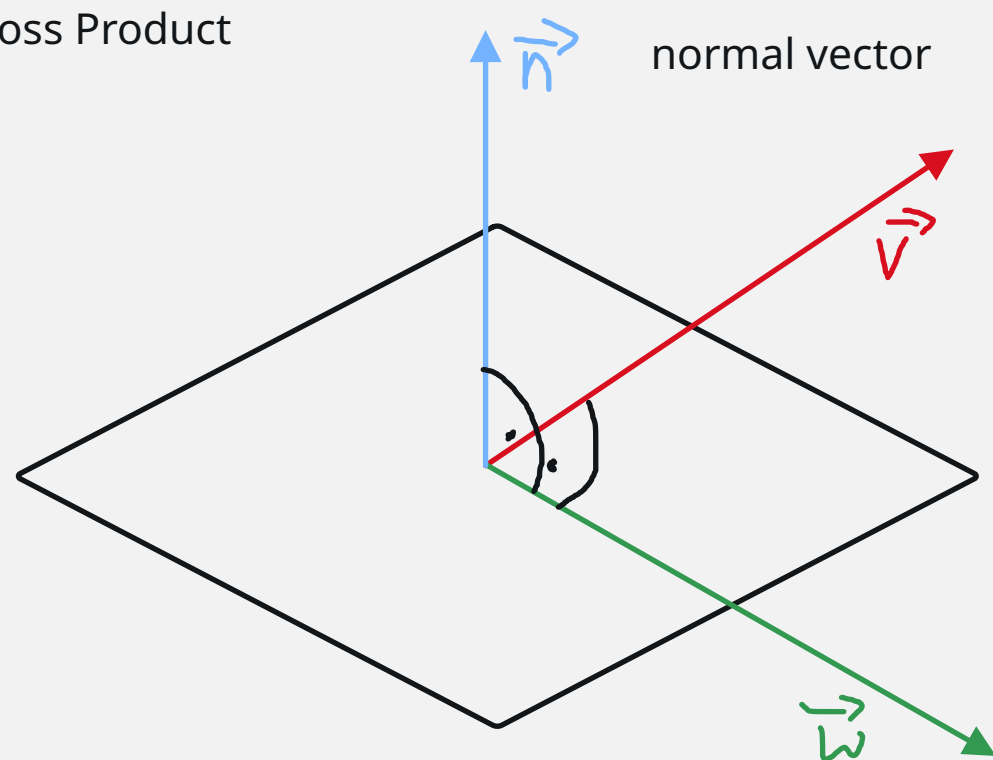
$$x = \alpha \cdot \left(\frac{\pi}{180^\circ} \right) \quad \text{Deg2Rad}$$

Alpha -> angle between two vectors
 Beta -> View Angle Threshold

$$\alpha < \beta \rightarrow \cos \alpha > \cos \beta$$

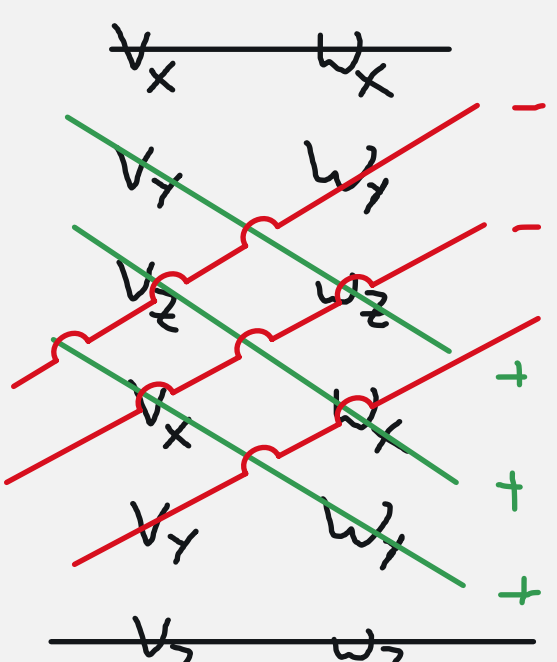


Cross Product

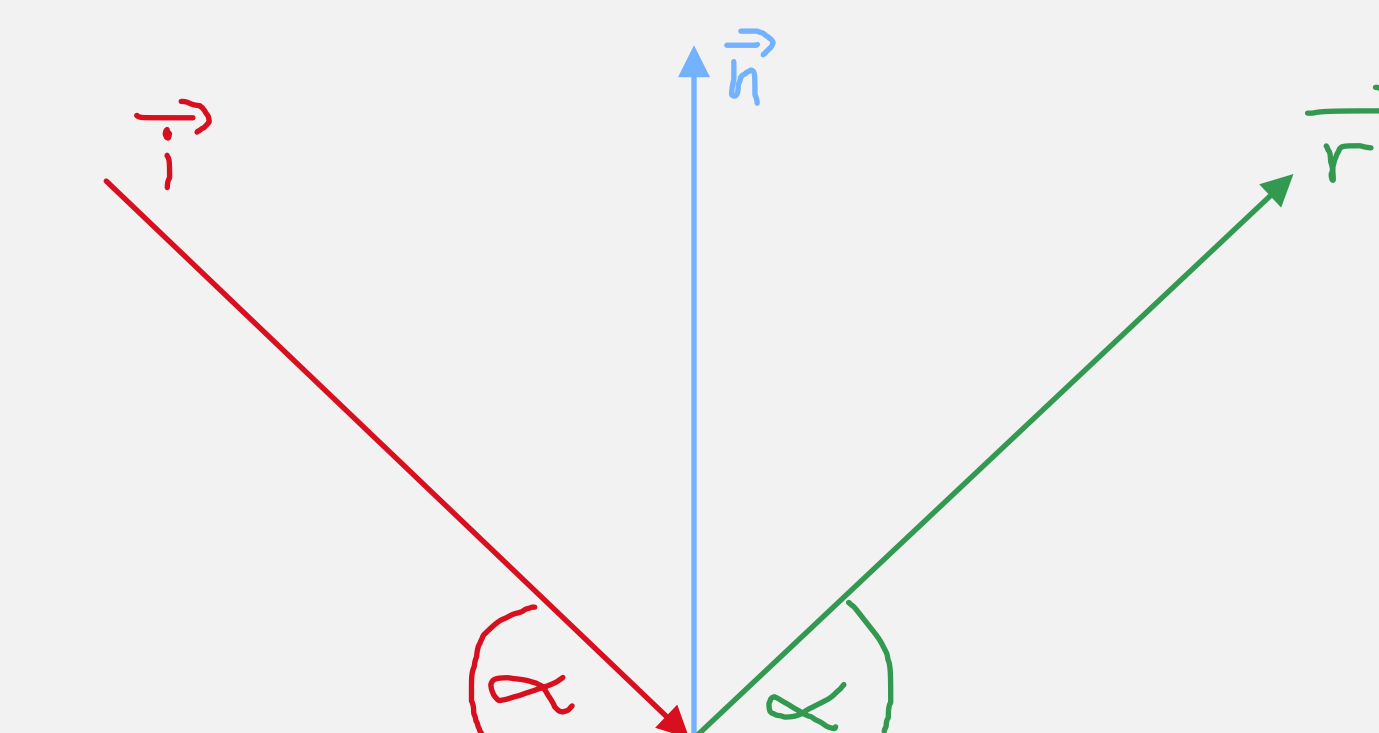


$$\vec{v} \times \vec{w} \neq \vec{w} \times \vec{v}$$

$$\vec{n} = \vec{v} \times \vec{w} \quad -\vec{n} = \vec{w} \times \vec{v}$$



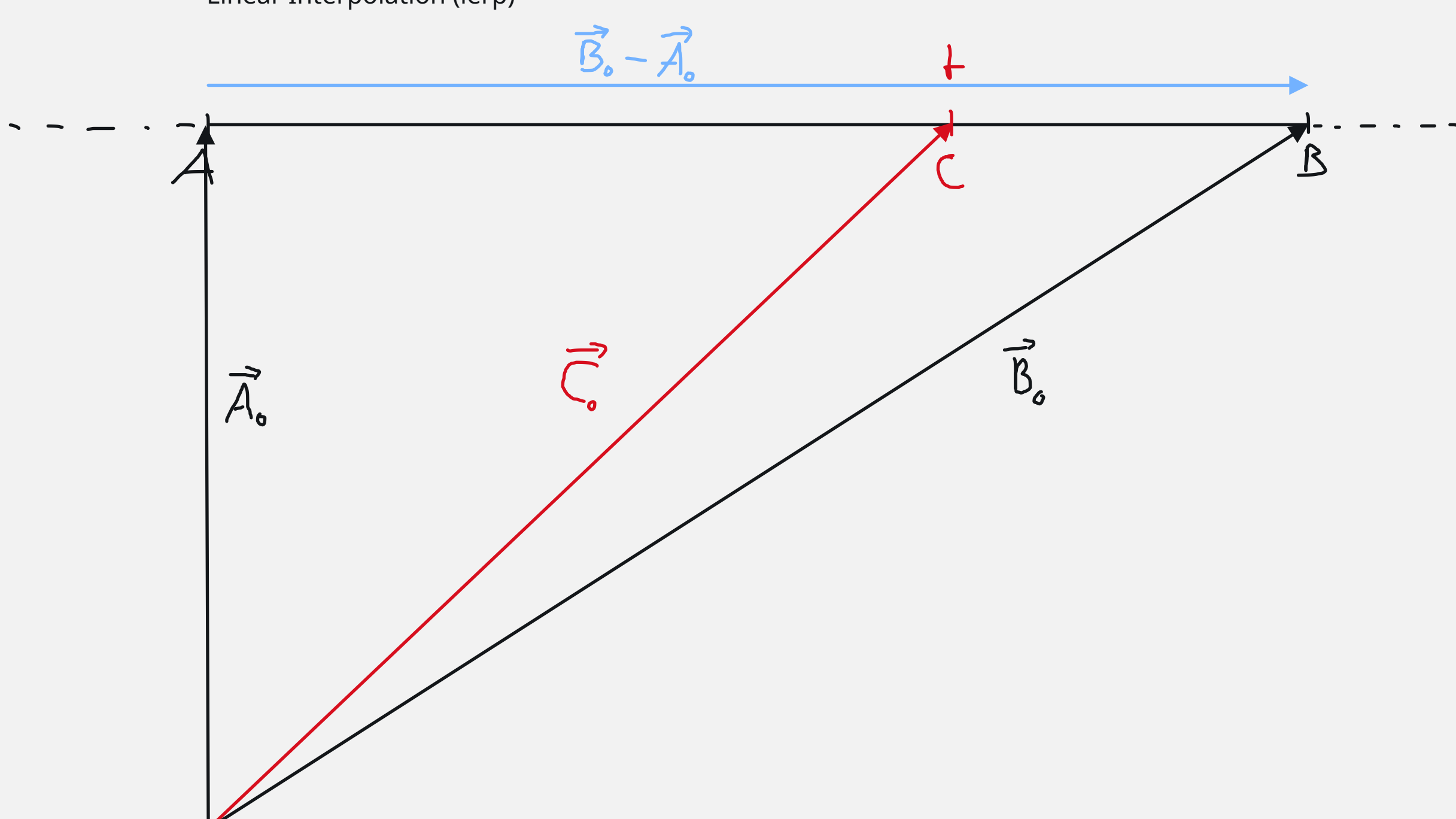
$$\vec{n} = \begin{pmatrix} v_y w_z - v_z w_y \\ v_z w_x - v_x w_z \\ v_x w_y - v_y w_x \end{pmatrix}$$



$$\vec{r} = \vec{i} + 2 \cdot (\vec{n} \cdot \vec{i}) \cdot \vec{n}$$

$$(\vec{r} = \vec{i} - 2 \cdot (\vec{n} \cdot \vec{i}) \cdot \vec{n} \quad \text{bei } -\vec{i})$$

Linear Interpolation (lerp)



$$0 \leq t \leq 1$$

$$\vec{C} = \vec{A} + t(\vec{B} - \vec{A})$$

t - percentage on way between A & B

Linear Extrapolation (lerpUnclamped)
 PingPong

Bezier Curves

linear - first degree



$$B_L(t) = P_0 + t(P_1 - P_0)$$

$$= P_0 + tP_1 - tP_0$$

$$= (1-t)P_0 + tP_1$$

quadratic - second degree

$$B_Q(t) = (1-t)(B_{L,P_0}) + t(B_{L,P_1}) \quad \text{reuse already existing functions}$$

$$= (1-t)((1-t)P_0 + tP_1) + t((1-t)P_1 + tP_2)$$

$$= (1-t)^2 P_0 + 2(1-t)t P_1 + t^2 P_2 \quad \text{performant}$$

