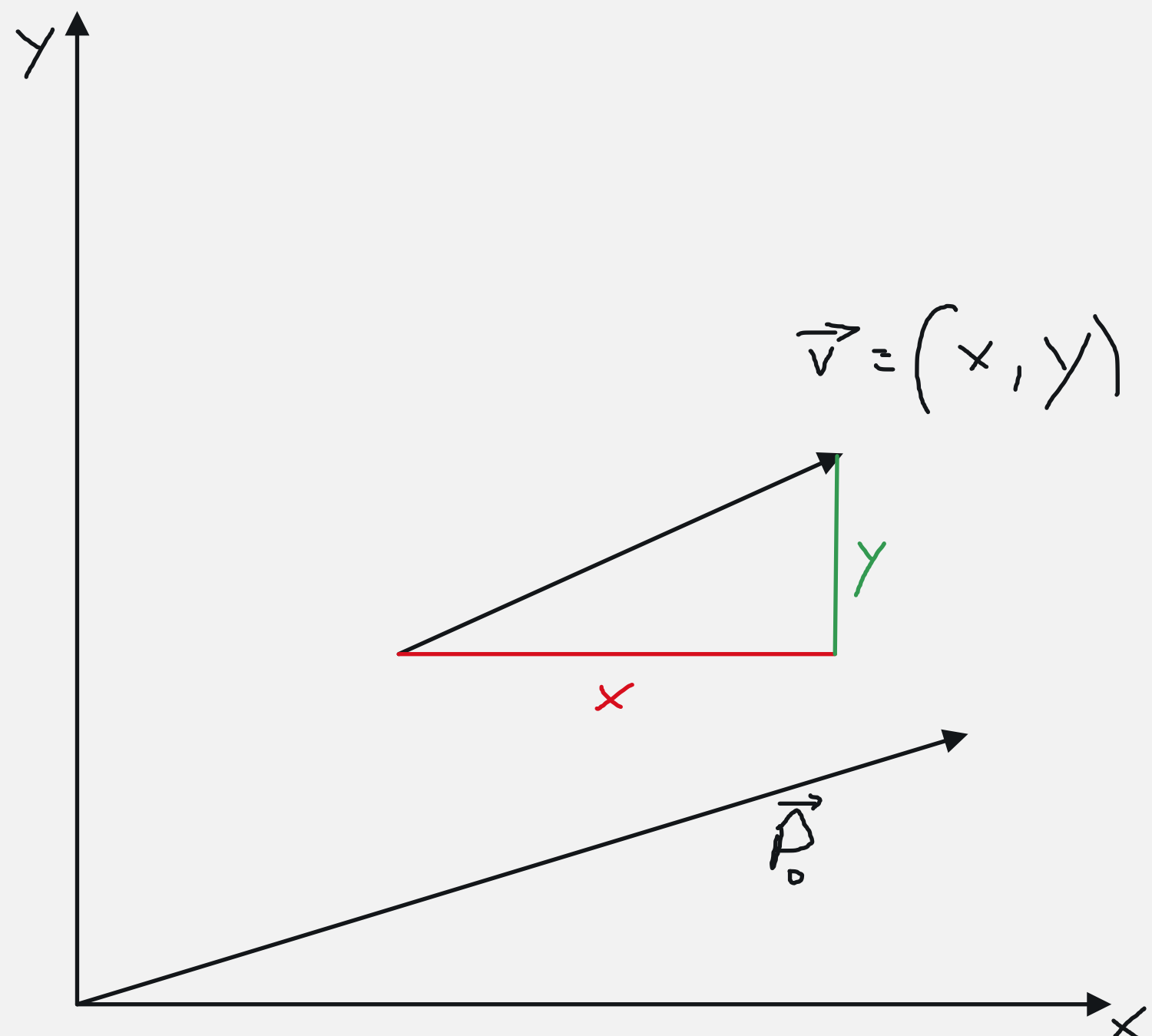


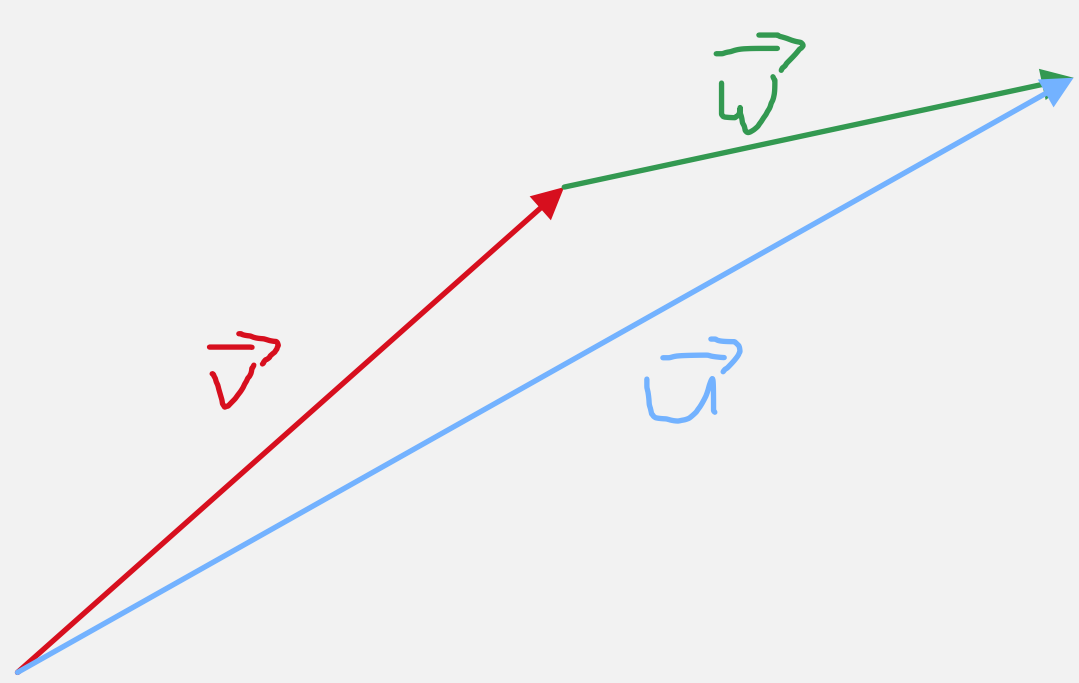


vector - parallel movement
location vector - point (vector from the origin)
direction vector - vector between points (should have a length of one for further using)
unit length vector - vector with a length of one

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

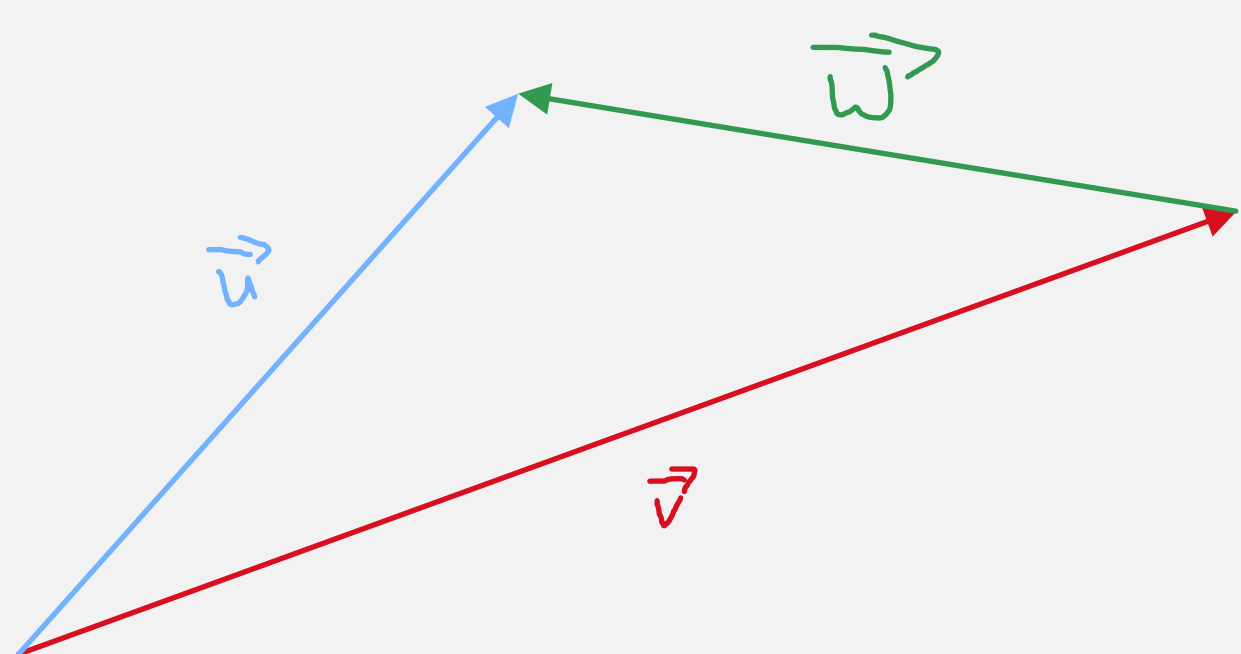
$$||\vec{v}|| = \frac{\vec{v}}{|\vec{v}|} \Rightarrow \text{normalized vector}$$

Addition

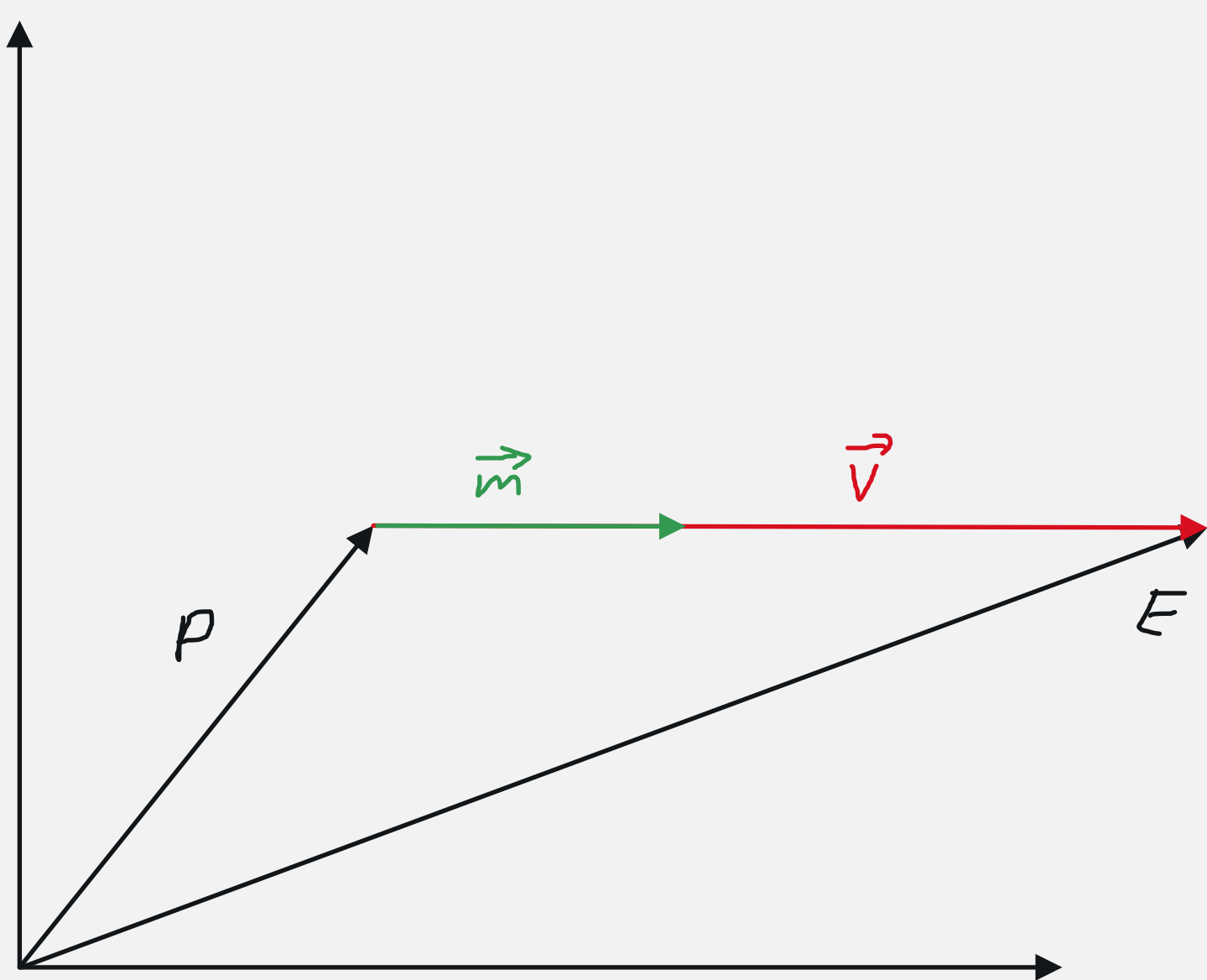


$$\vec{u} = \vec{v} + \vec{w} = \vec{u} + \vec{v} = \begin{pmatrix} v_x + w_x \\ v_y + w_y \end{pmatrix}$$

Subtraction



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



Goal minus Start

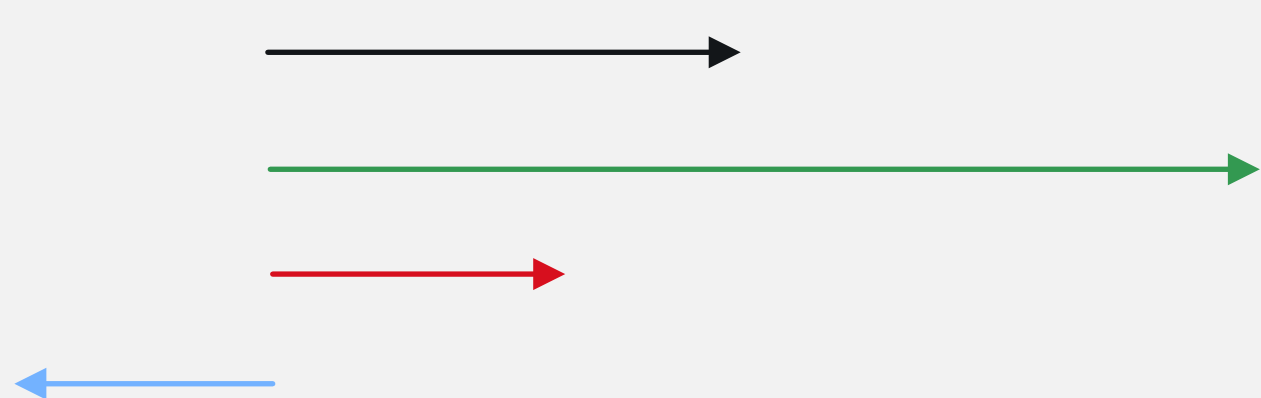
$$\vec{v} = \vec{E} - \vec{P}$$

direction vector

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

movement vector

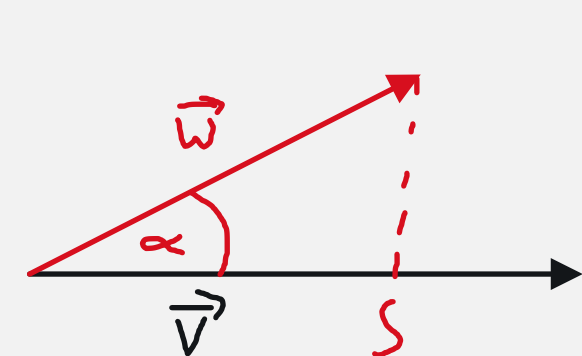
Multiplication with a Scalar



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

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

Dot Product - Scalar Product



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

$$\vec{v} \cdot \vec{w} = |\vec{v}| \cdot |\vec{w}| \cos \alpha \Leftrightarrow \cos \alpha = \frac{\vec{v} \cdot \vec{w}}{|\vec{v}| \cdot |\vec{w}|} \quad \cos^{-1} \quad \arccos \quad \arccos$$

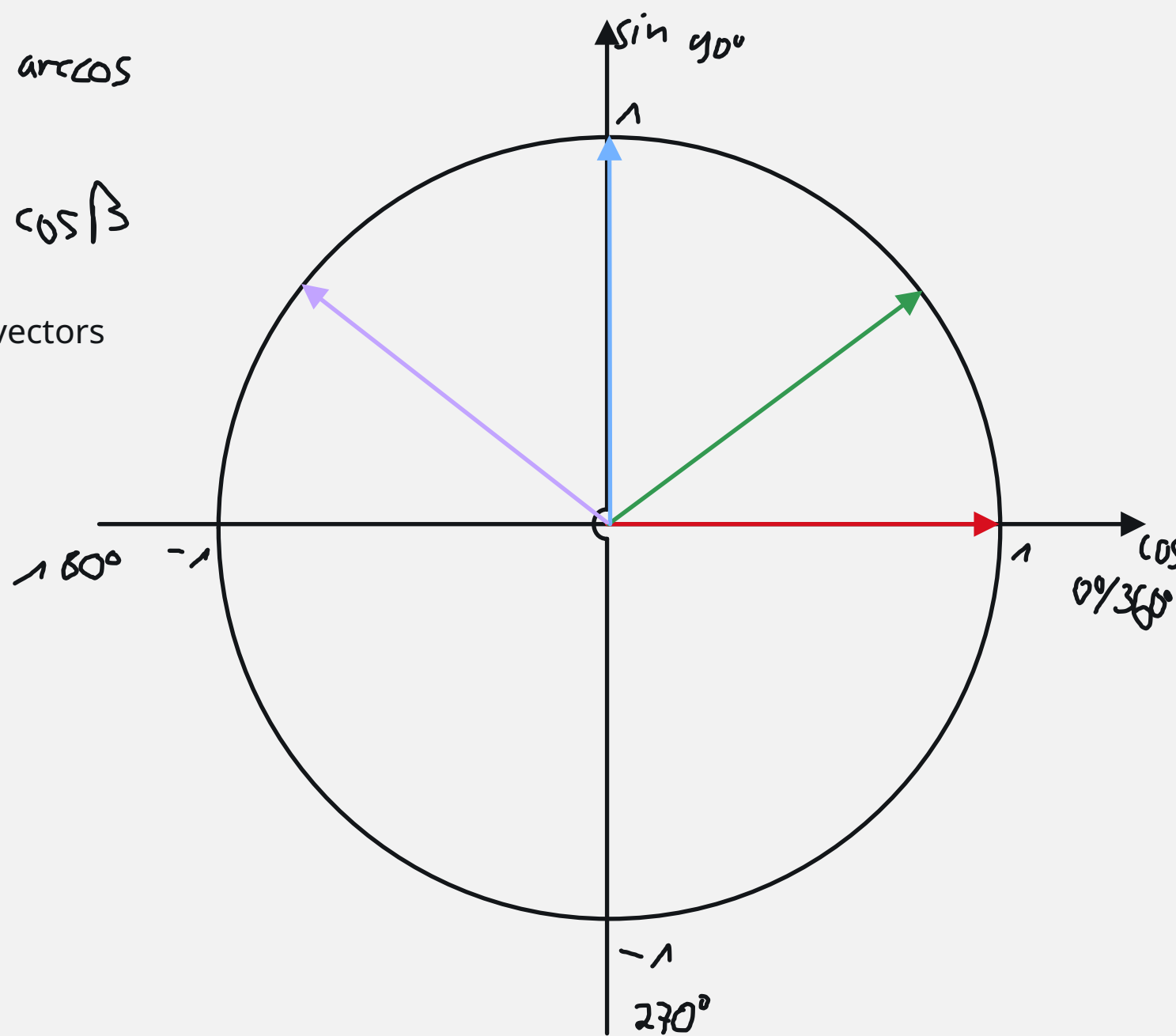
$$\frac{\alpha}{180^\circ} = \frac{x}{\pi}$$

$$\alpha = x \cdot \left(\frac{180^\circ}{\pi} \right) \text{ Rad 2 Deg}$$

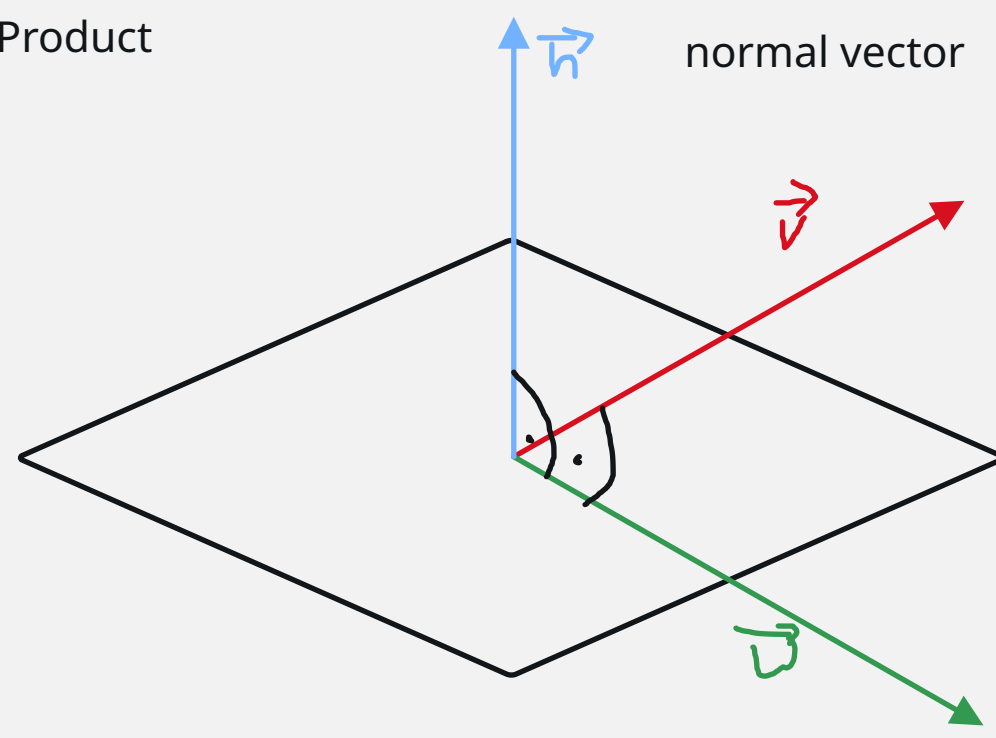
$$x = \alpha \cdot \left(\frac{\pi}{180^\circ} \right) \text{ Deg 2 Rad}$$

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

Alpha - angle between two vectors
Beta - View Angle Threshold

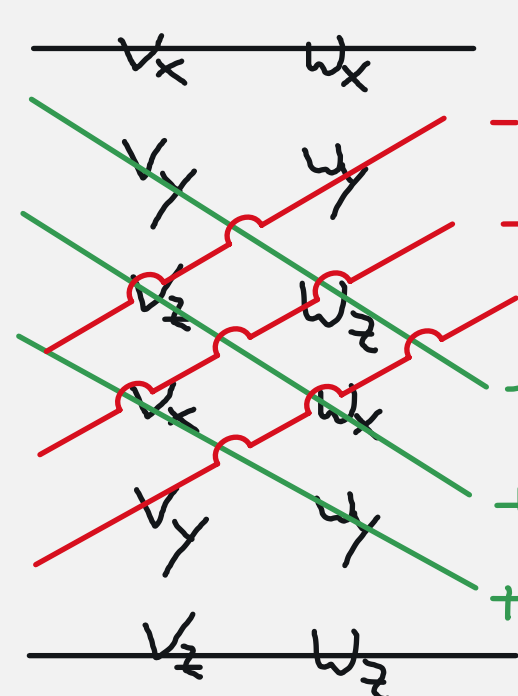


Cross Product

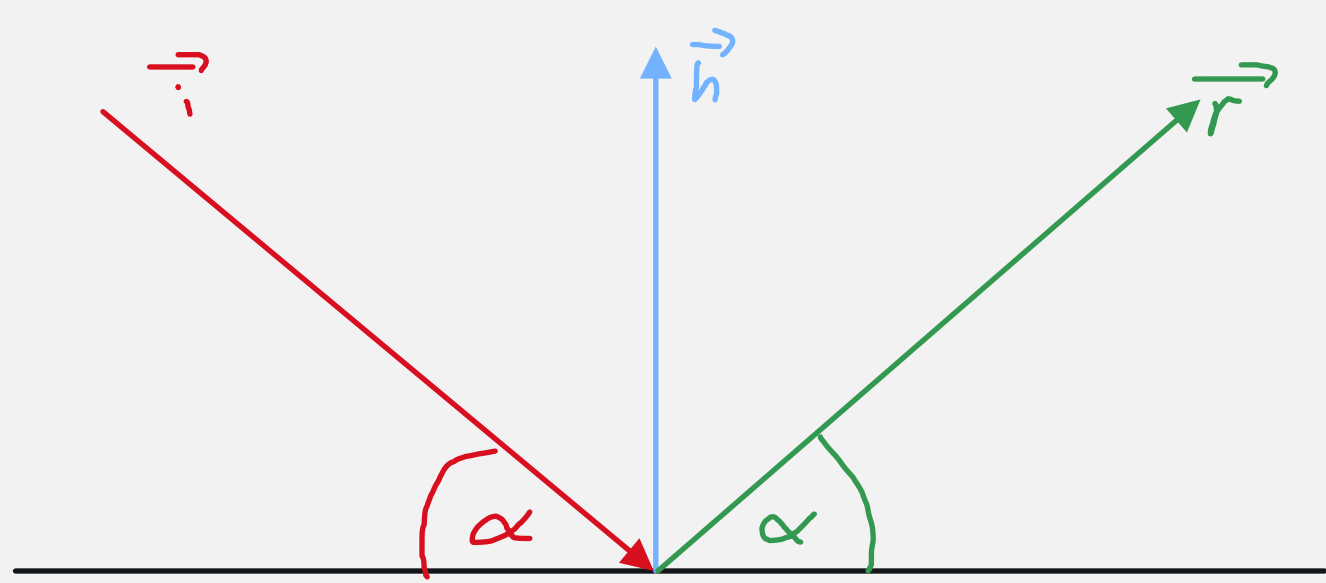


$$\vec{v} \times \vec{w} \neq \vec{w} \times \vec{v}$$

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



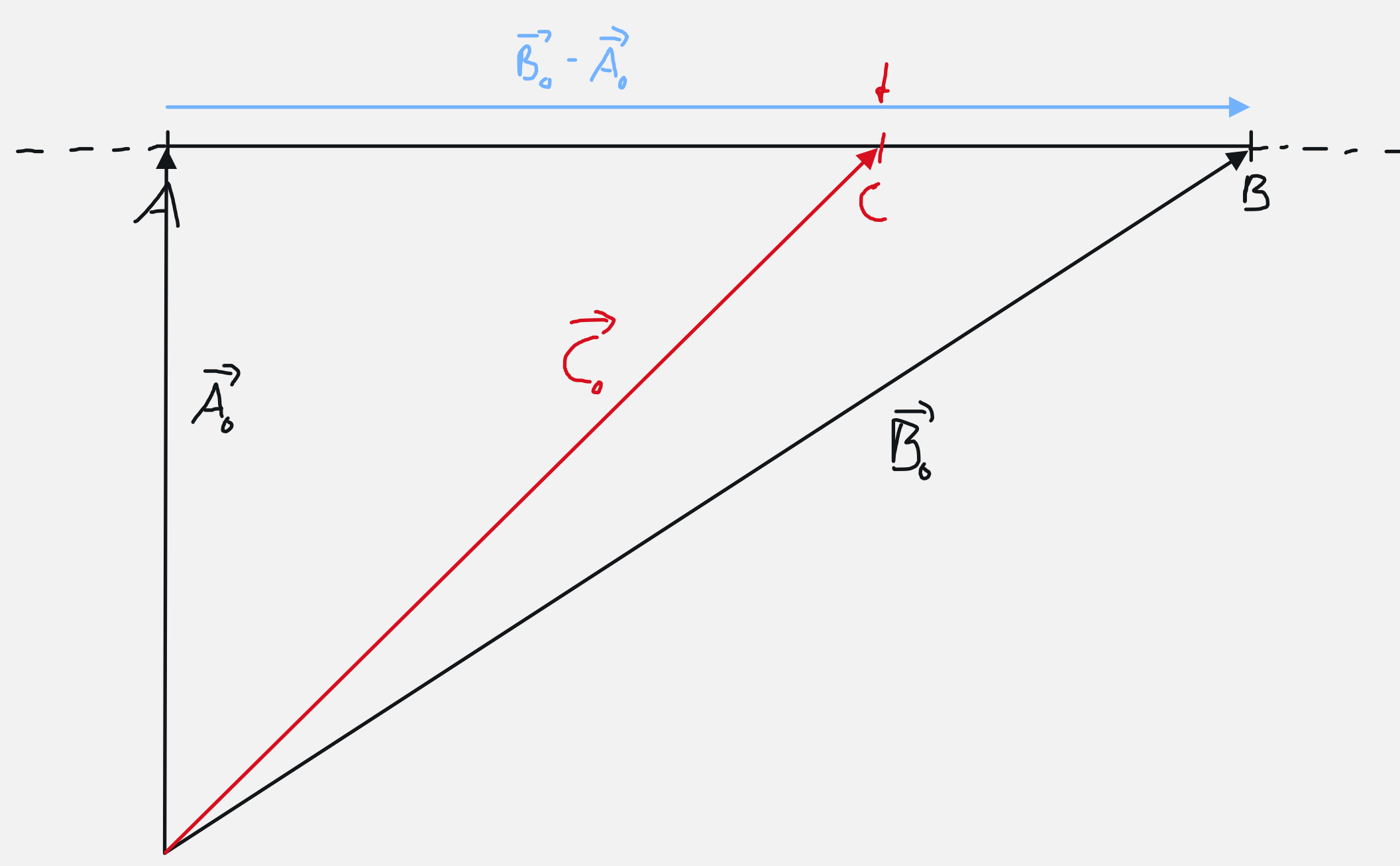
$$\vec{n} = \begin{pmatrix} v_y \cdot w_z - v_z \cdot w_y \\ v_z \cdot w_x - v_x \cdot w_z \\ v_x \cdot w_y - v_y \cdot w_x \end{pmatrix}$$



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

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

Linear Interpolation (lerp)



$$0 \leq t \leq 1$$

$$\vec{C}_t = \vec{A}_0 + t (\vec{B}_0 - \vec{A}_0)$$

t - percentage on way between A & B

Linear Extrapolation (lerpUnclamped)
PingPong

Bezier Curves

linear - first degree



$$B_1(t) = P_0 + t(P_1 - P_0)$$

$$= P_0 + tP_1 - tP_0$$

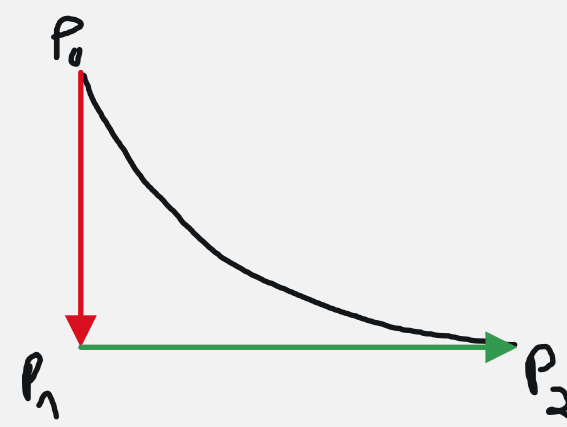
$$= (1-t)P_0 + tP_1$$

quadratic - second degree

$$B_2(t) = (1-t)(B_1(P_0, P_1)) + t(B_1(P_1, P_2)) \quad \text{reuse already existing functions}$$

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

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



cubic - third degree

$$B_3(t) = (1-t)B_2(t, P_0, P_1, P_2) + tB_2(t, P_1, P_2, P_3)$$

reuse already existing functions

$$= (1-t)^3 P_0 + 3(1-t)^2 t P_1 + 3(1-t)t^2 P_2 + t^3 P_3$$

performant

