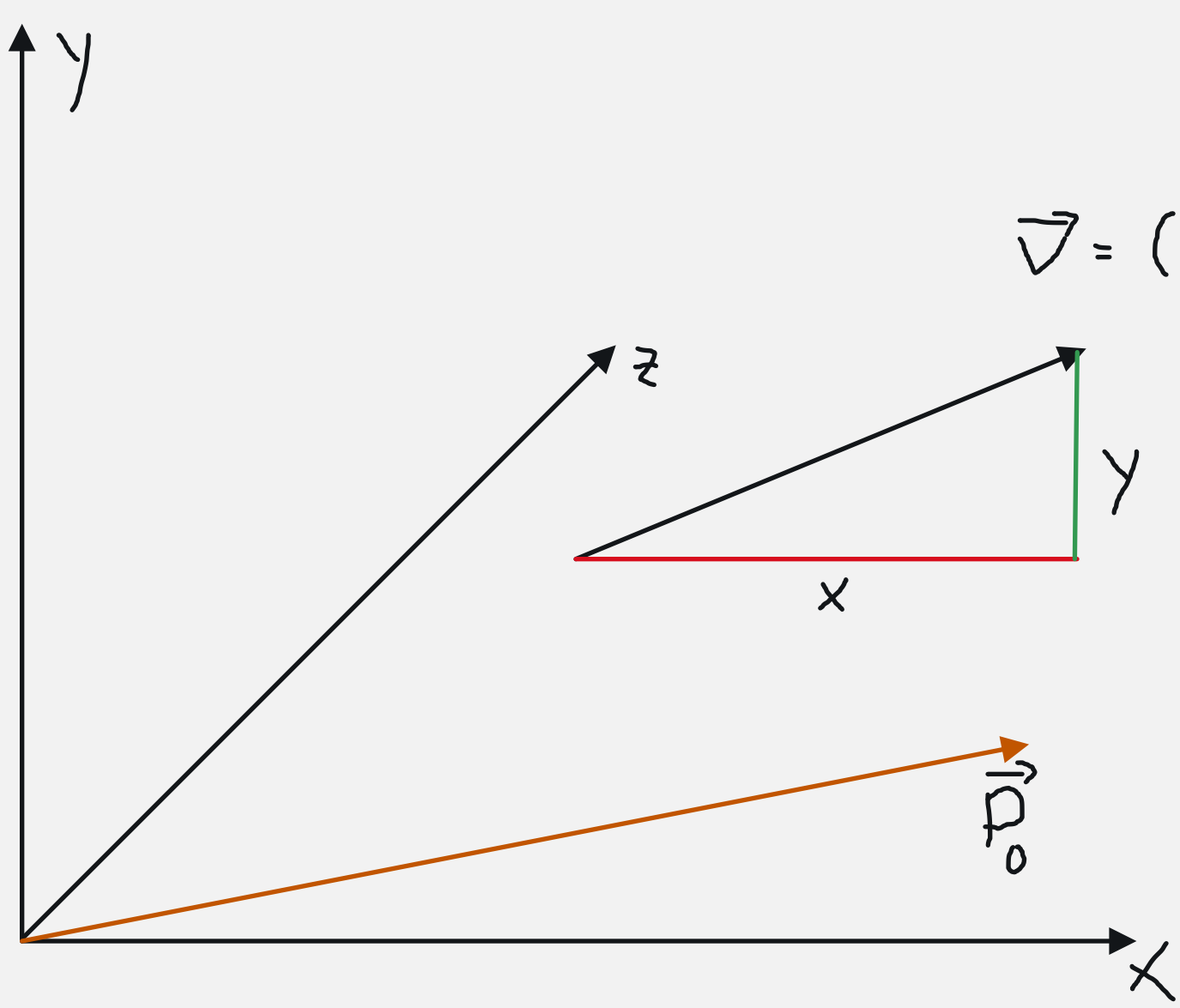
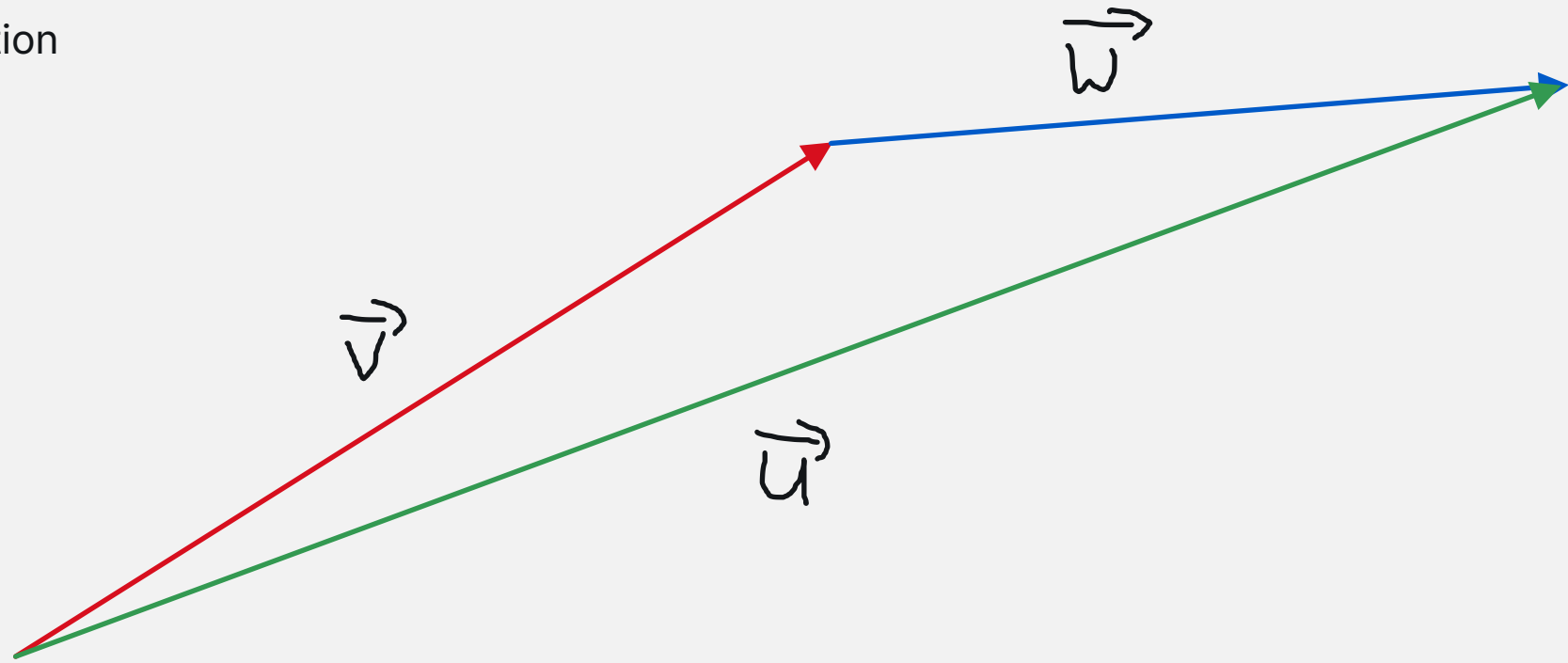


Vektoren



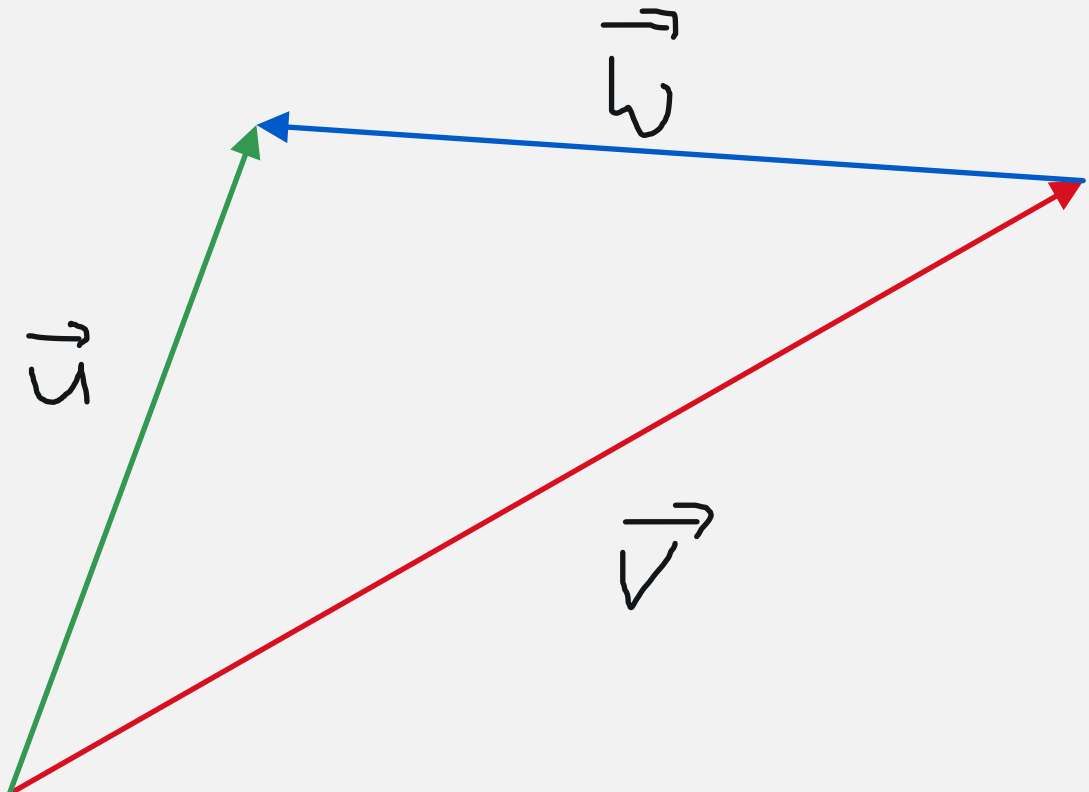
vector - parallel movement
position vector - cartesian point (vector from origin)
direction vector - direction between two vectors (should have a length of 1)
unit length vector - vector with a length of 1
 $|\vec{v}| = \sqrt{x^2 + y^2}$
 $||\vec{v}|| = \frac{\vec{v}}{|\vec{v}|} \Rightarrow$ normalized vector

Addition



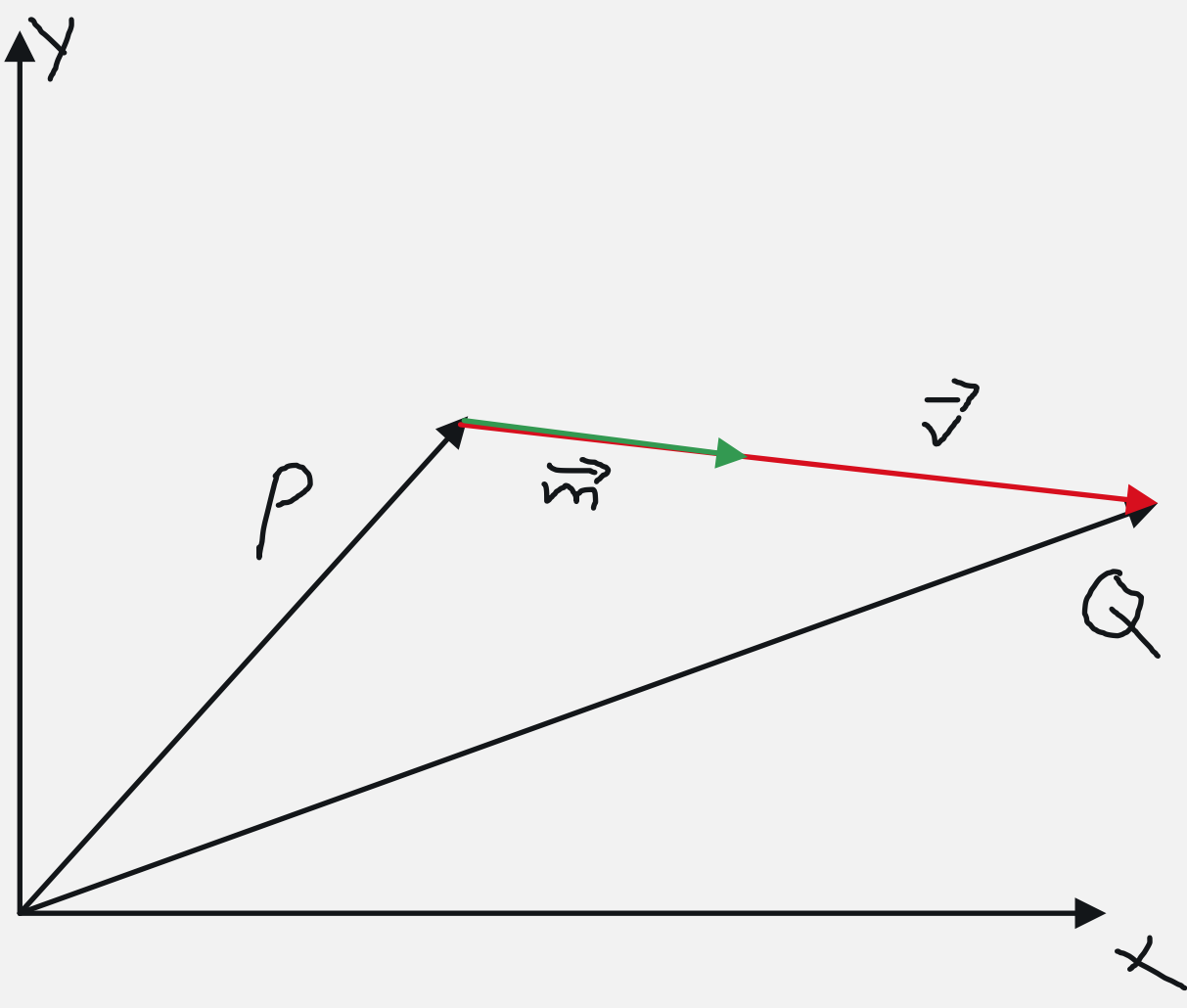
$\vec{u} = \dots + y\vec{w}$

Subtraction



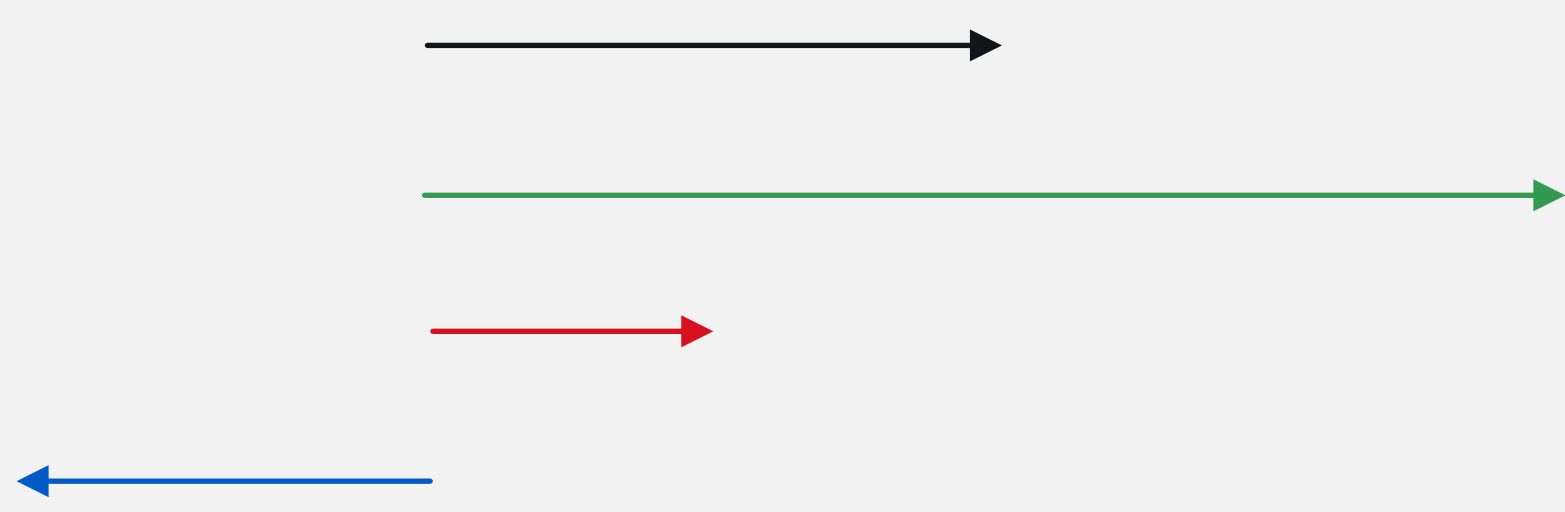
$\vec{u} = \vec{v} - \vec{w} = \vec{v} - \vec{w}$

Direction Vector calculation



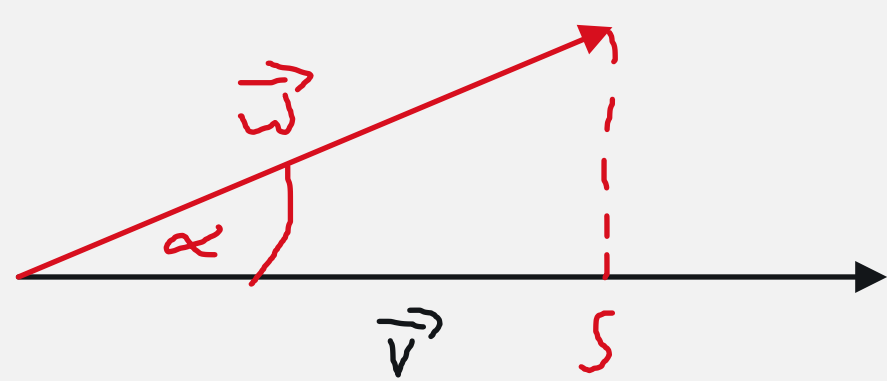
Target minus Start
 $\vec{v} = Q - P$
 $\vec{w} = ||\vec{v}|| \cdot (s \cdot dt)$ $\Rightarrow$ movement vector
s $\rightarrow$ speed
dt $\rightarrow$ delta time

Multiplication with a Scalar



$\vec{v} \cdot a = a \cdot \vec{v} = \begin{pmatrix} x_v \cdot a \\ y_v \cdot a \\ z_v \cdot a \end{pmatrix}$
 $\vec{v} \cdot dt \Rightarrow$ better performance

Dot Product - Scalar Product



$\vec{v} \cdot \vec{w} = x_v \cdot x_w + y_v \cdot y_w + z_v \cdot z_w = s$
 $\vec{v} \cdot \vec{w} = |\vec{v}| \cdot |\vec{w}| \cdot \cos \alpha \Leftrightarrow \cos \alpha = \frac{\vec{v} \cdot \vec{w}}{|\vec{v}| \cdot |\vec{w}|}$

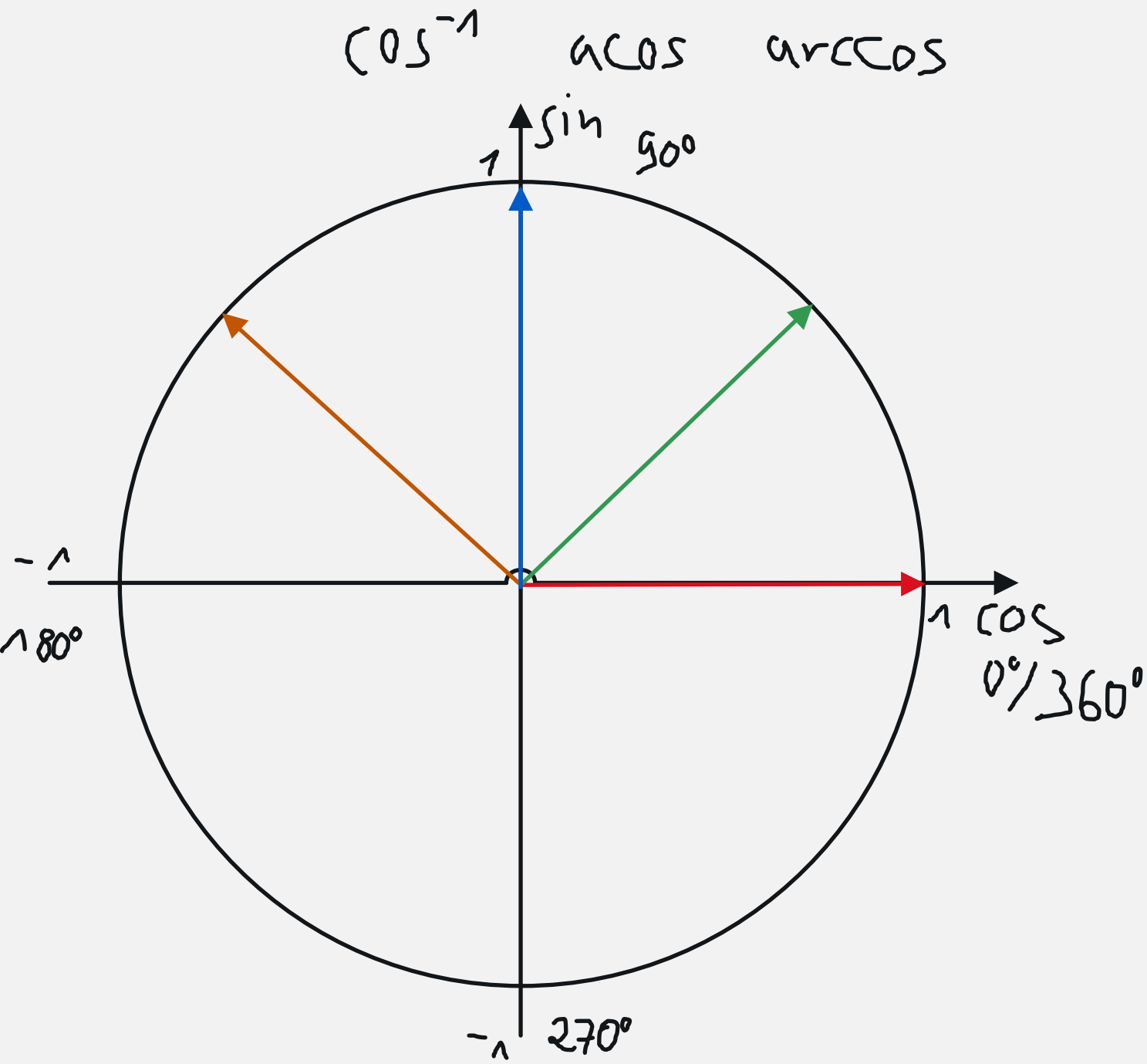
$\alpha < \beta \rightarrow \cos \alpha > \cos \beta$

Alpha $\rightarrow$ angle between two vectors
Beta $\rightarrow$ View Angle Threshold

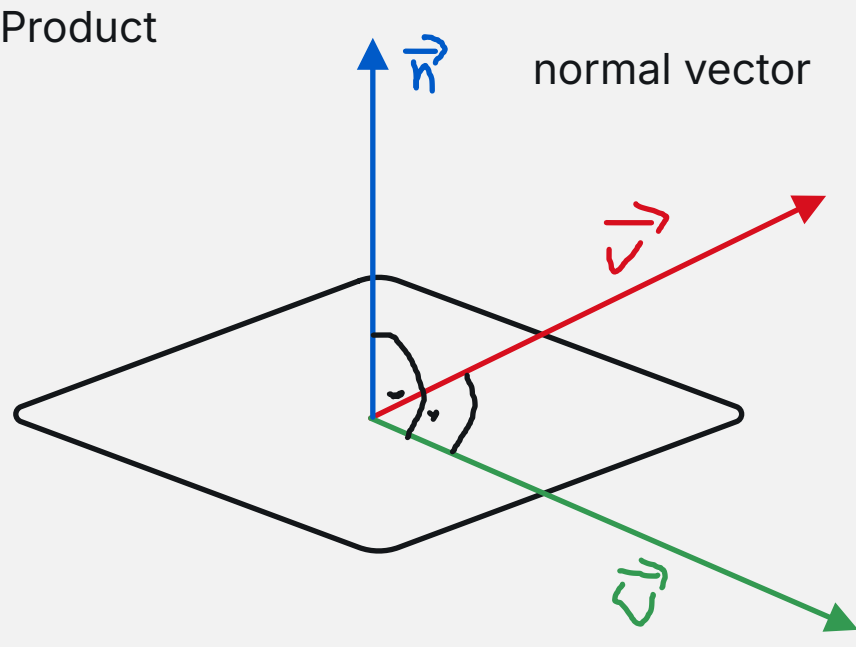
$\frac{\alpha}{180^\circ} = \frac{x}{\pi}$

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

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

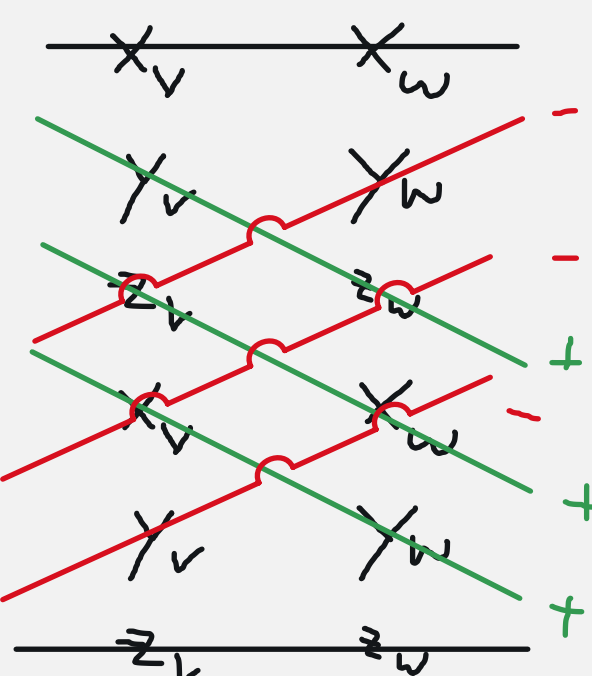


Cross Product

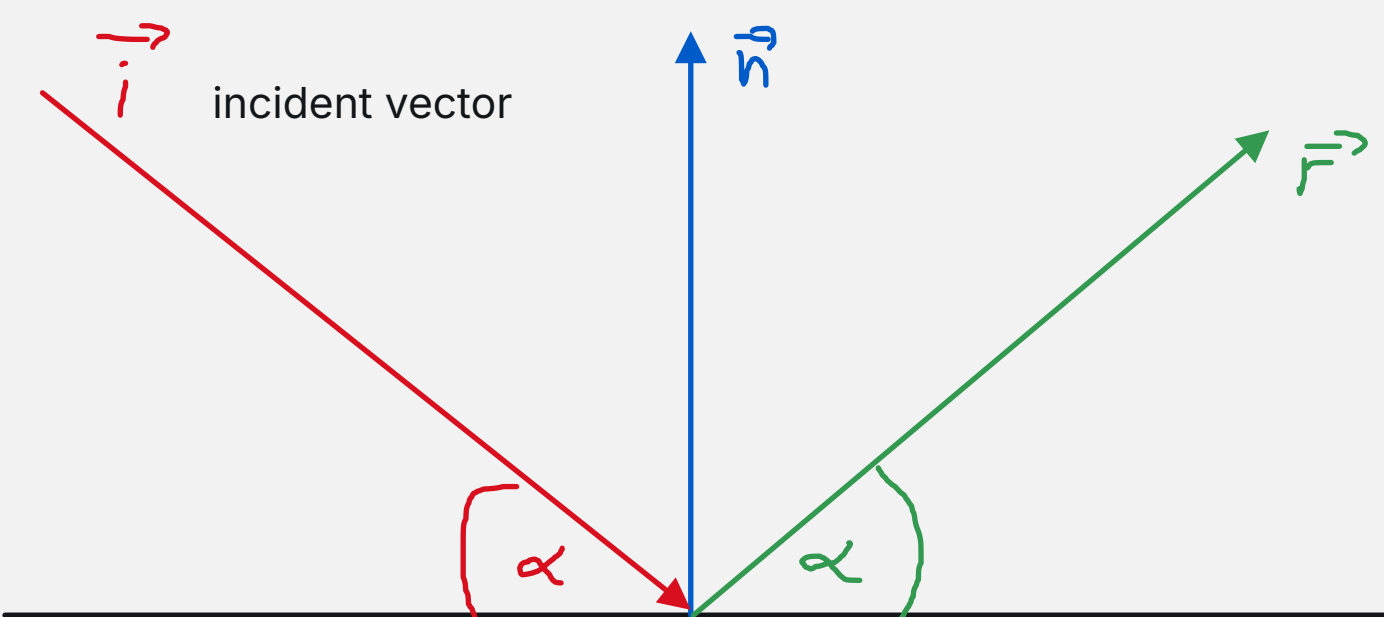


$\vec{v} \times \vec{w} \neq \vec{w} \times \vec{v}$

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



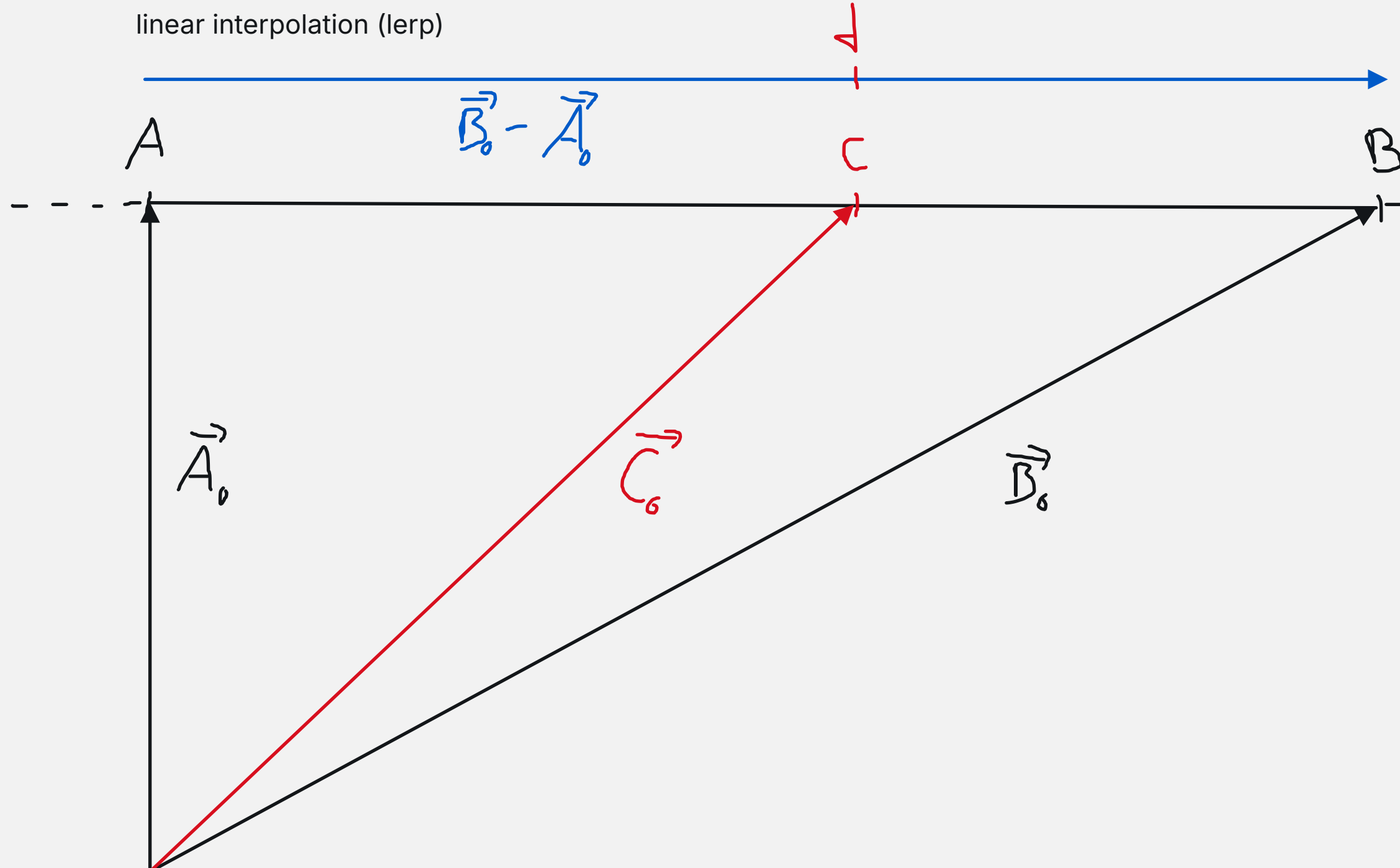
$\vec{n} = \begin{pmatrix} y_v z_w - z_v y_w \\ z_v x_w - x_v z_w \\ x_v y_w - y_v x_w \end{pmatrix}$



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

Interpolations

linear interpolation (lerp)



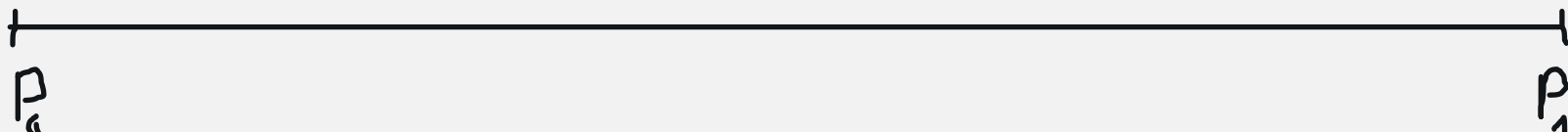
$0 \leq t \leq 1$

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

t - percentage of the way between A & B

linear extrapolation (lerpUnclamped)
PingPong

Bezier curves
linear - first degree



$B_L(t) = P_0 + t(P_1 - P_0)$
 $= P_0 + tP_1 - tP_0$

$= (1-t)P_0 + tP_1$

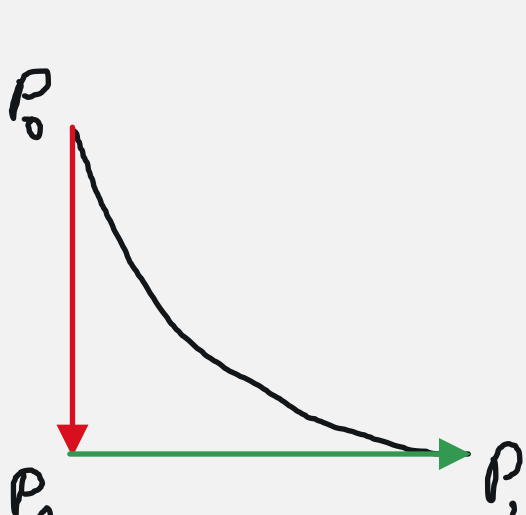
quadratic - second degree

$B_Q(t) = (1-t) \left(B_{L,P_0,P_1}(t) \right) + t \left(B_{L,P_1,P_2}(t) \right)$

reuse already existing functions

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

performant version



cubic - third degree