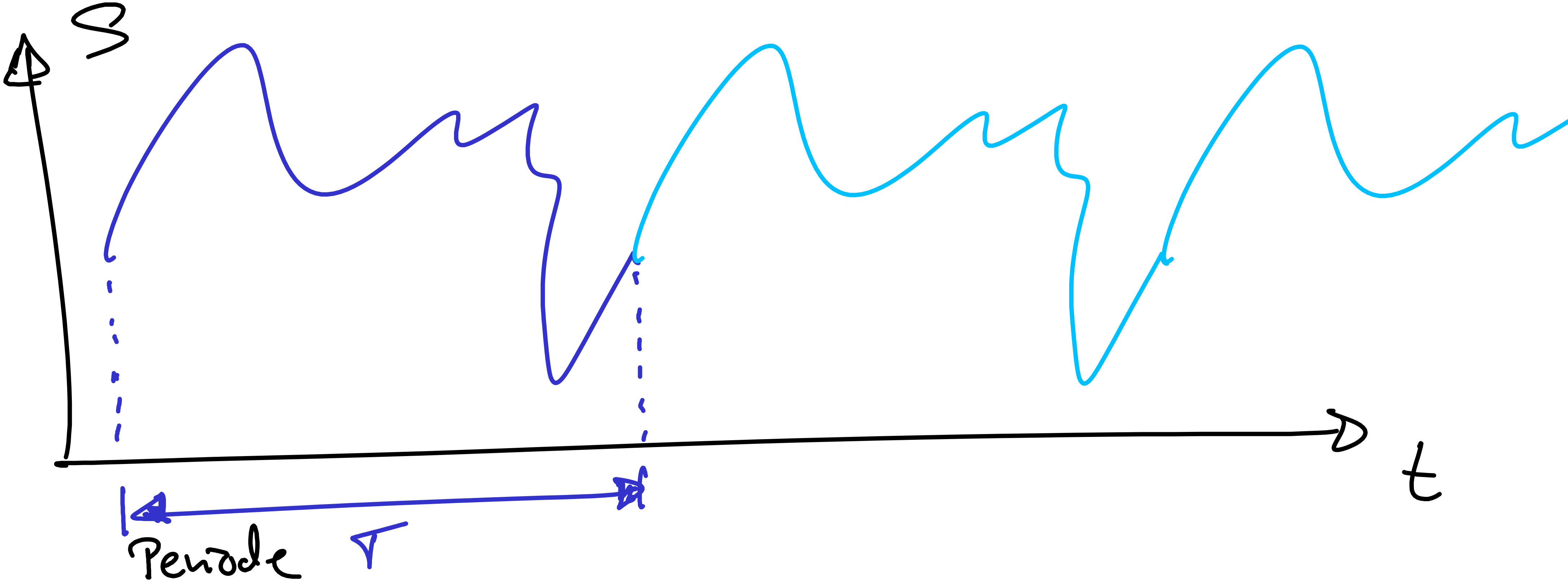


S
t
Periode
T

$$S(t) = c \sin(\omega t + \alpha)$$

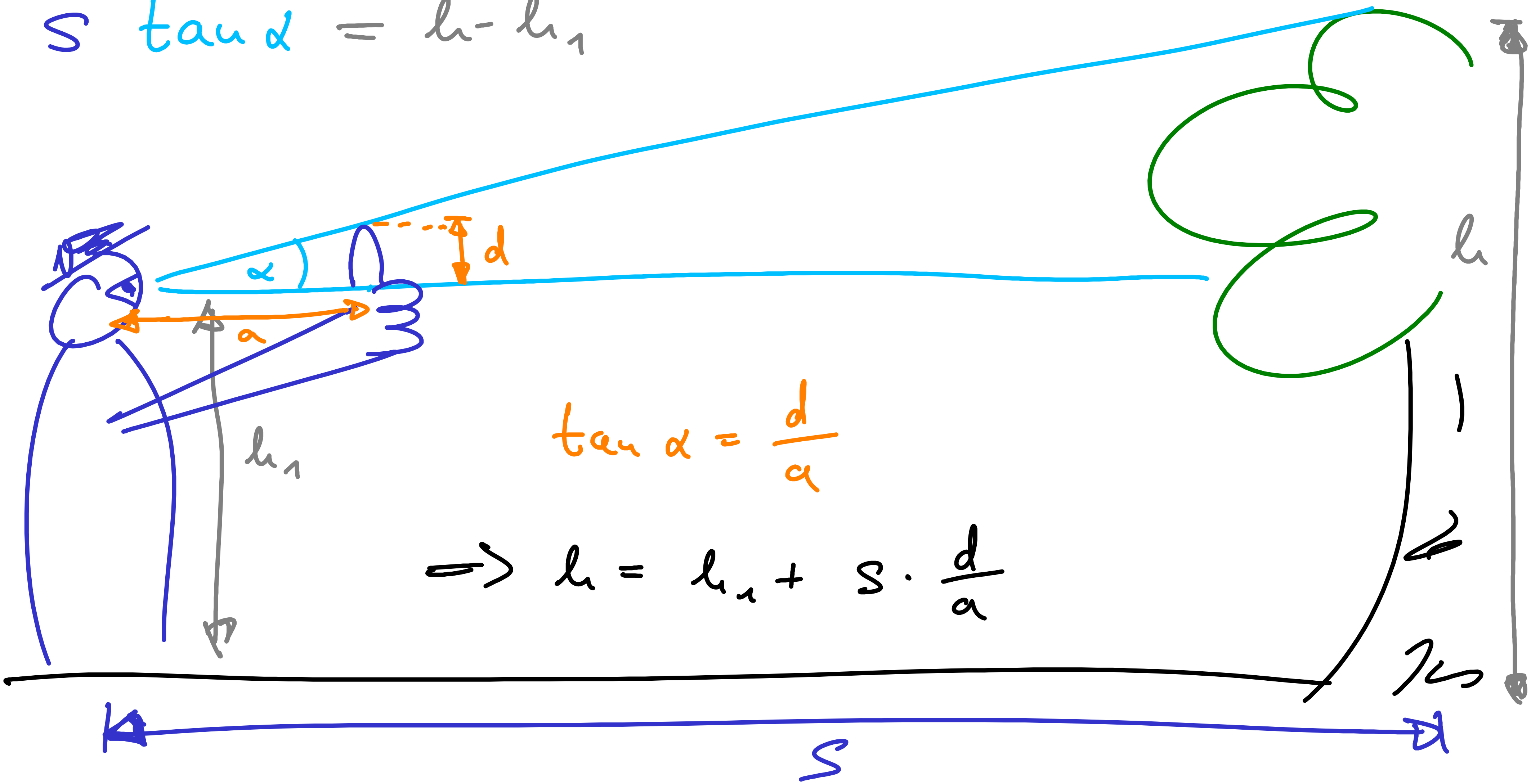
$$S(t+T) = c \sin(\omega t + \omega T + \alpha)$$

$$T = \frac{2\pi}{\omega}$$

$$= c \sin(\omega t + \alpha + \underline{\underline{2\pi}})$$

$$= c \sin(\omega t + \alpha) = S(t)$$

$$s \tan\alpha = h - h_1$$

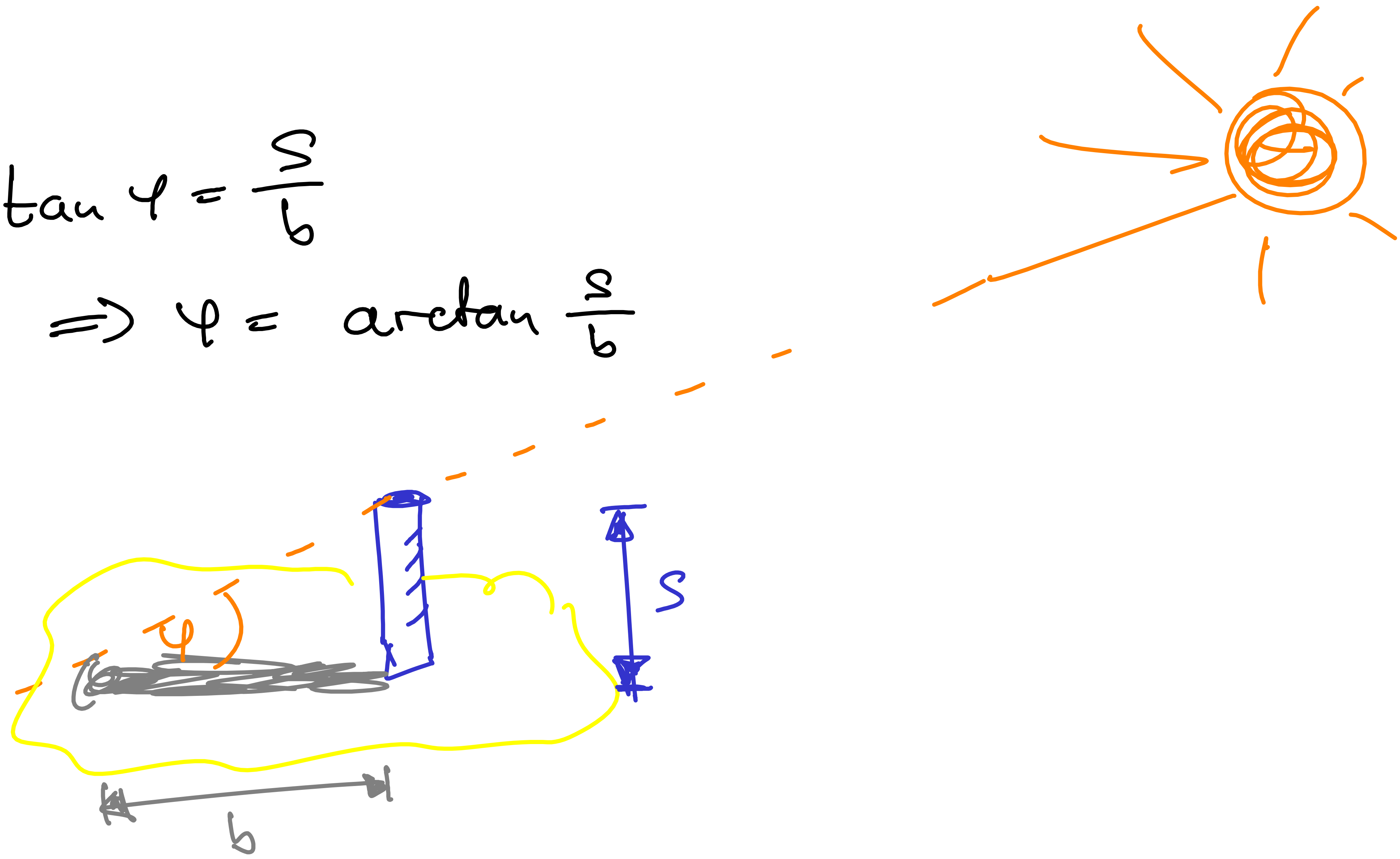


$$\tan\alpha = \frac{d}{a}$$

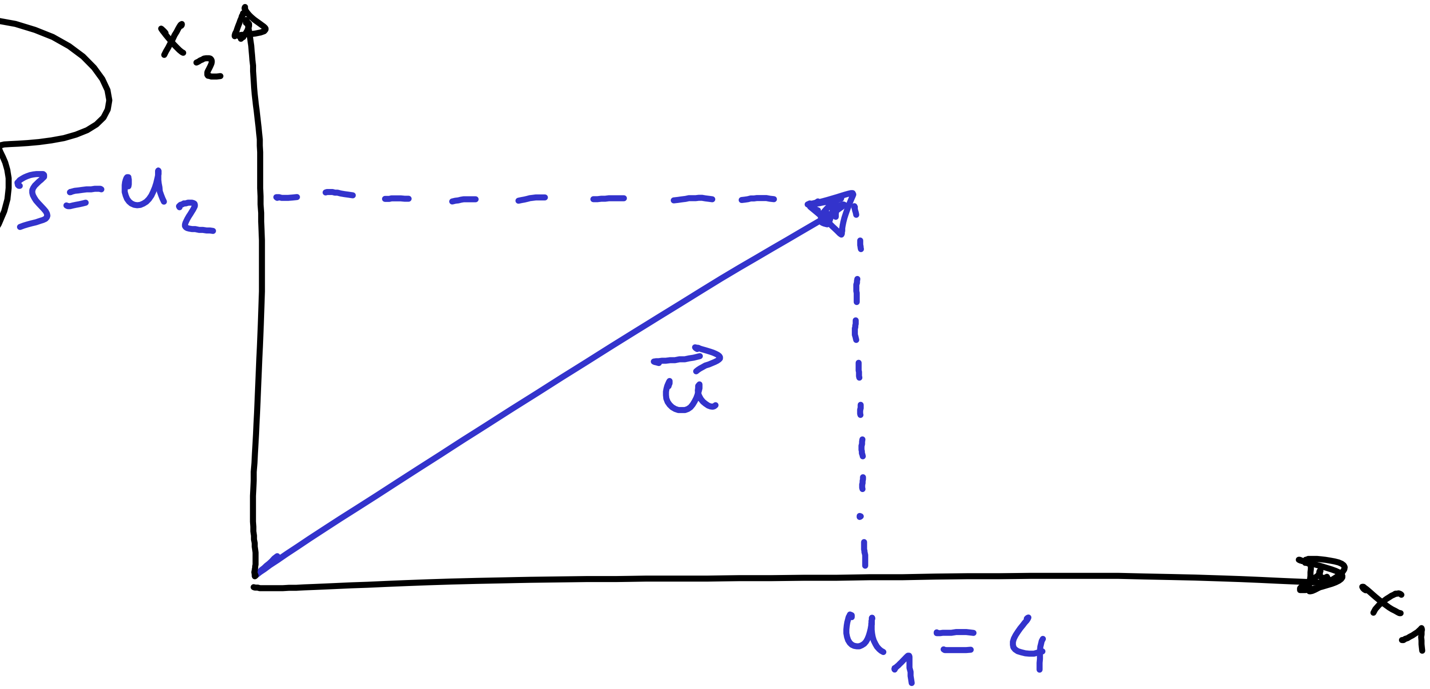
$$\Rightarrow h = h_1 + s \cdot \frac{d}{a}$$

$$\tan \varphi = \frac{s}{b}$$

$$\Rightarrow \varphi = \arctan \frac{s}{b}$$

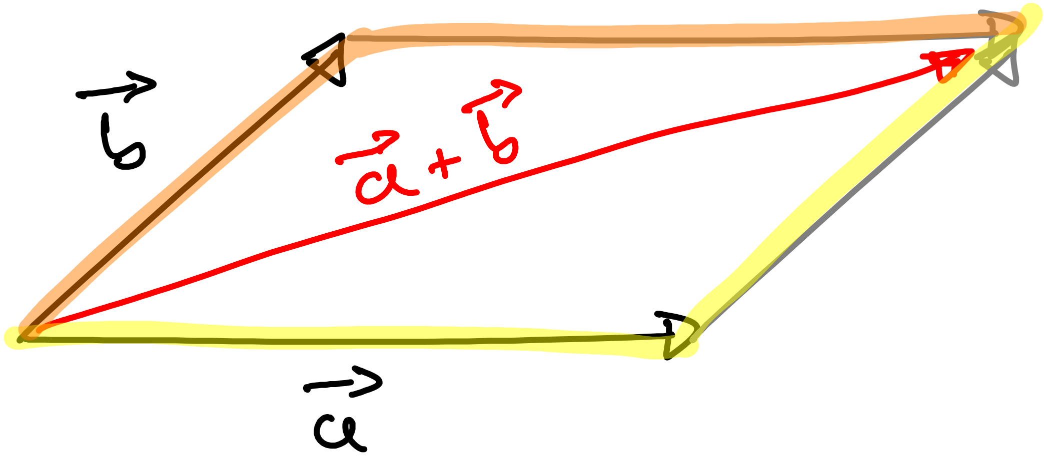


Vektoren



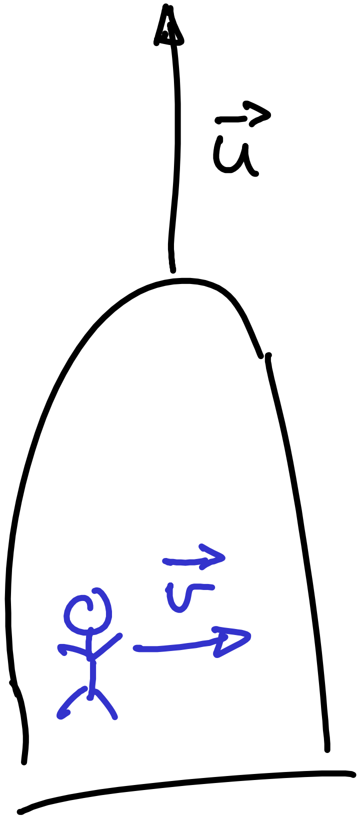
$$\vec{u} = \begin{pmatrix} u_1 \\ u_2 \end{pmatrix} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$$

$$\|\vec{u}\| = \sqrt{16 + 9} = 5$$ (Länge 5, Pythagoras)



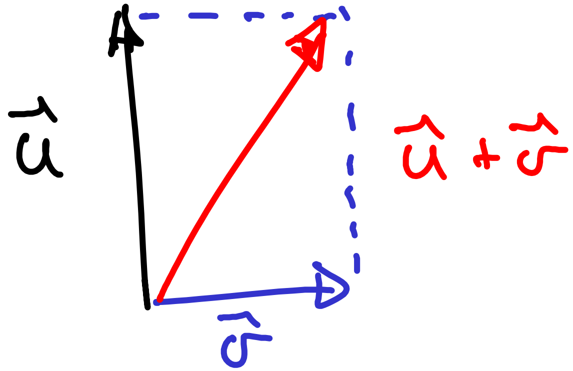
$$\vec{a}+\vec{b} = \vec{b}+\vec{a}$$

$$\vec{a} = \begin{pmatrix}4\\0\end{pmatrix}, \quad \vec{b} = \begin{pmatrix}2\\2\end{pmatrix} : \quad \vec{a}+\vec{b} = \begin{pmatrix}4+2\\2\end{pmatrix} = \begin{pmatrix}6\\2\end{pmatrix}$$

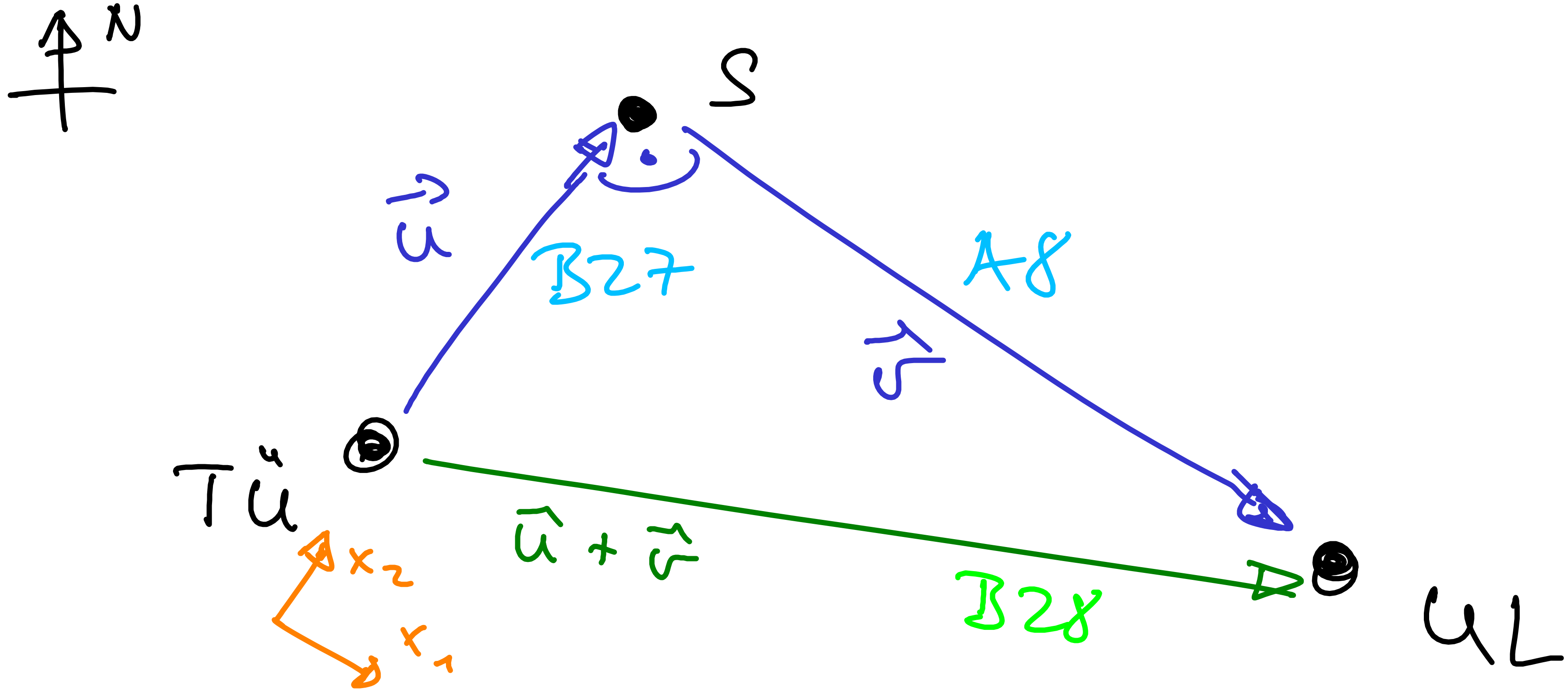


$\vec{u}$: Geschw. Schiff (bzgl. Wasser)

$\vec{v}$: Geschw. Person (bzgl. Schiff)



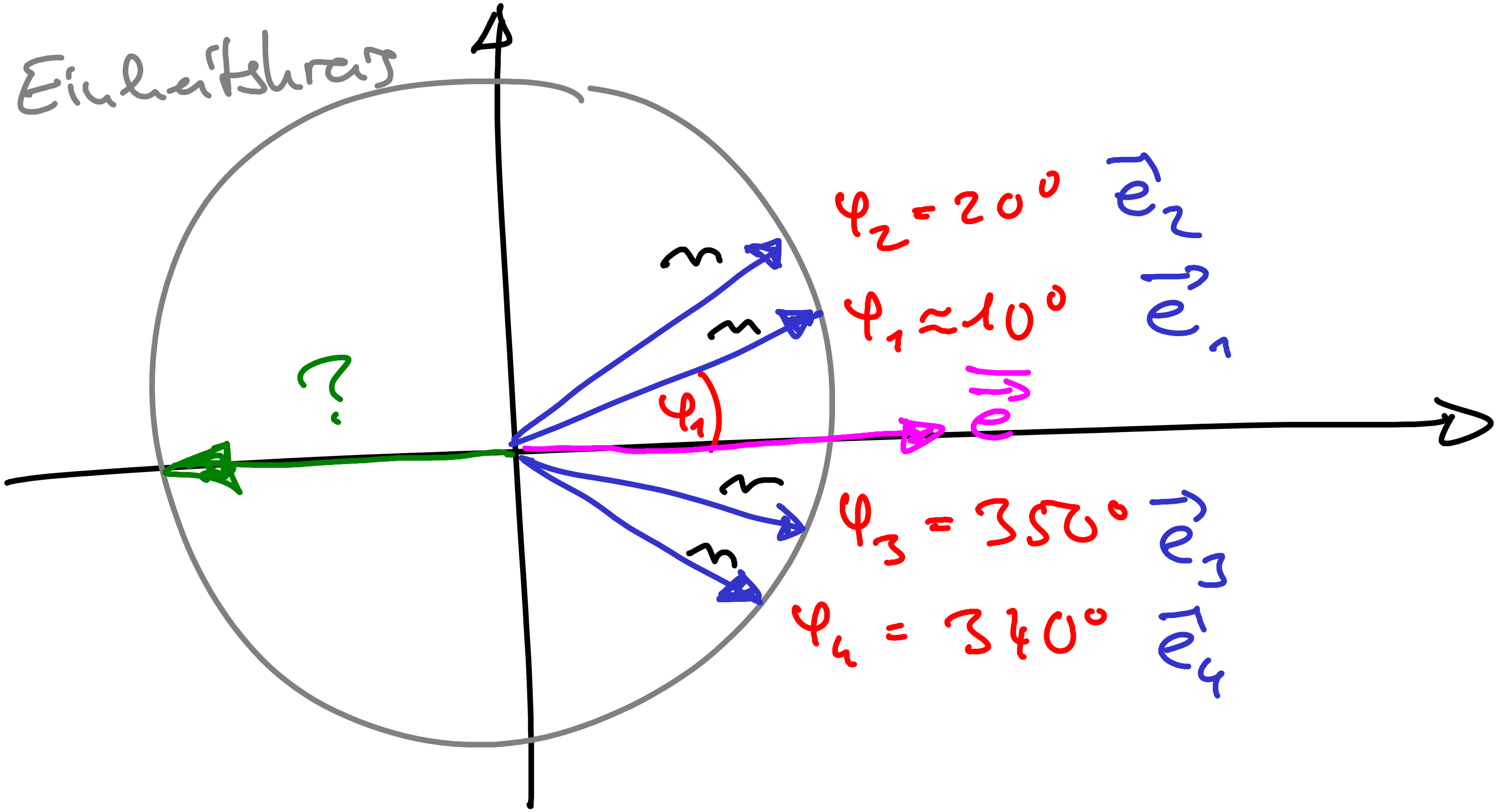
$\vec{u}+\vec{v}$: Geschw. Person (bzgl. Wasser)



$$\vec{u} = \begin{pmatrix} 0 \\ 50 \end{pmatrix} km \quad , \quad \vec{v} = \begin{pmatrix} 100\,km \\ 0 \end{pmatrix}$$

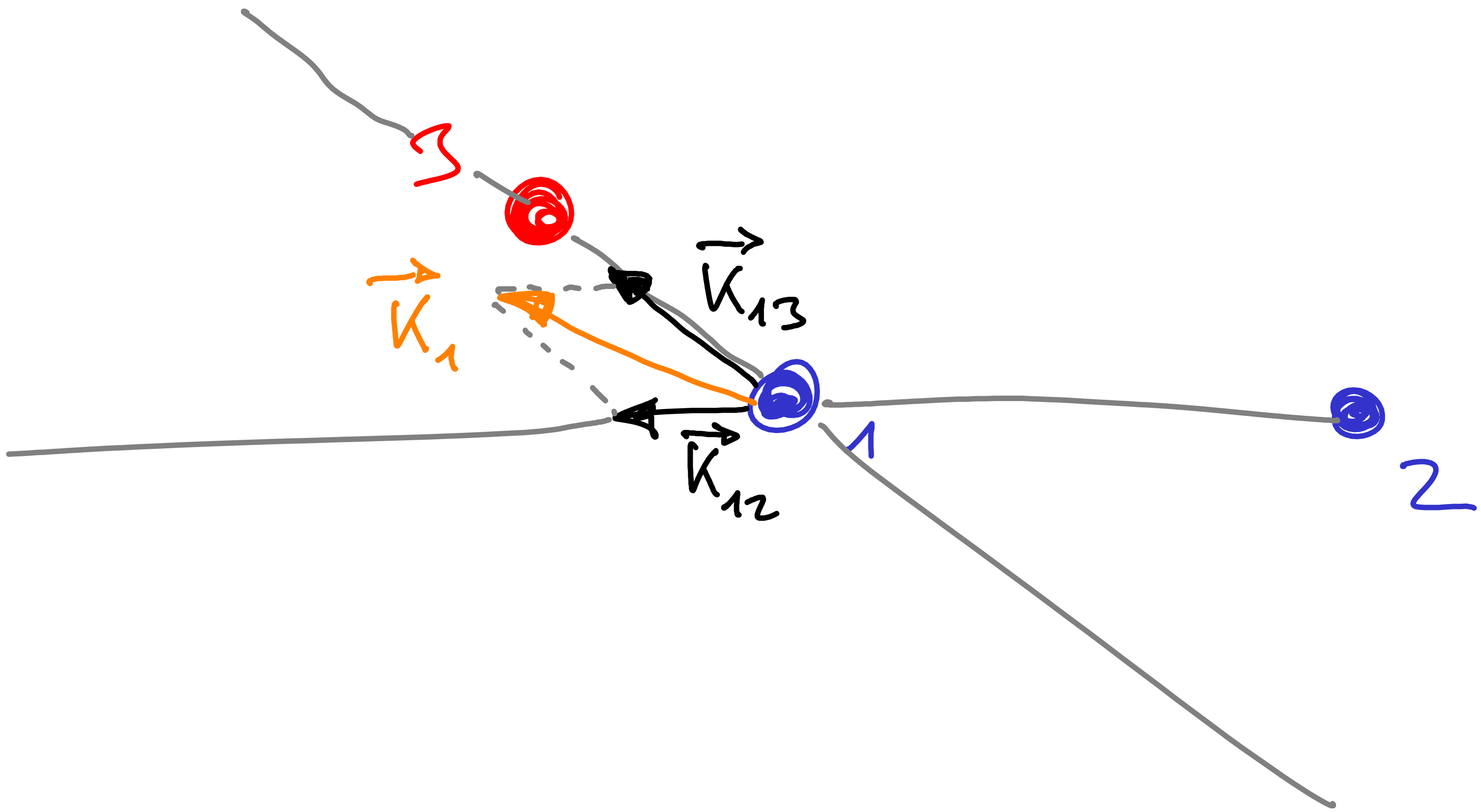
$$\vec{u} + \vec{v} = \begin{pmatrix} 100 \\ 50 \end{pmatrix} km$$

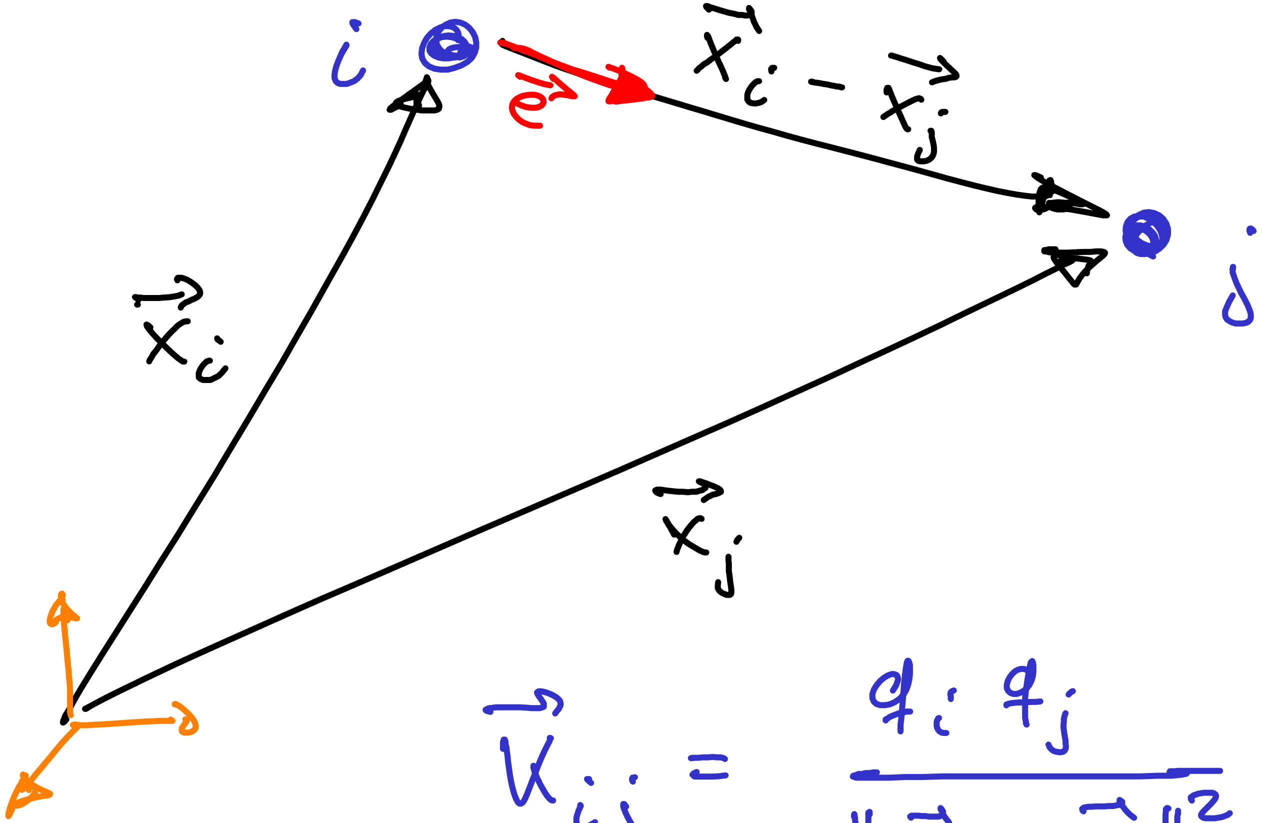
$$\| \vec{u} + \vec{v} \| = \sqrt{10\,000 + 2500} \approx 110\ km$$



$$\bar{\varphi} = \frac{\varphi_1 + \varphi_2 + \varphi_3 + \varphi_4}{4} = 180°$$?

$$\vec{\bar{e}} = \frac{\vec{e}_1 + \dots + \vec{e}_4}{4}$$ besser!


3
$\vec{K}_{13}$
$\vec{K}_1$
$\vec{K}_{12}$
1
2



$\|\vec{e}\| = 1$

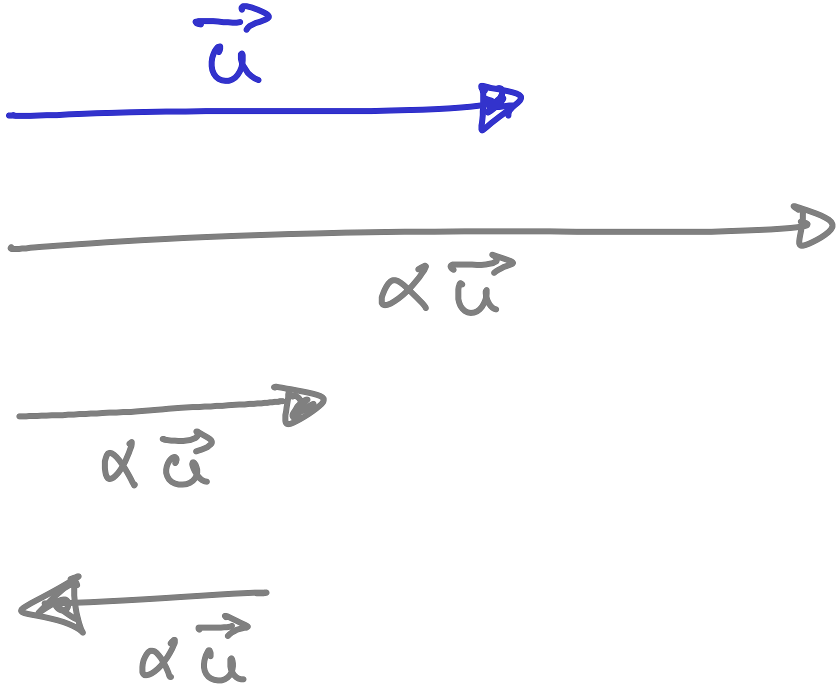
$$\vec{K}_{ij} = \frac{q_i q_j}{\|\vec{x}_i - \vec{x}_j\|^2} \vec{e}$$

$$\vec{e} = \frac{\vec{x}_i - \vec{x}_j}{\|\vec{x}_i - \vec{x}_j\|}$$

damit

$$\vec{K}_{ij} = q_i q_j \frac{\vec{x}_i - \vec{x}_j}{\|\vec{x}_i - \vec{x}_j\|^3}$$

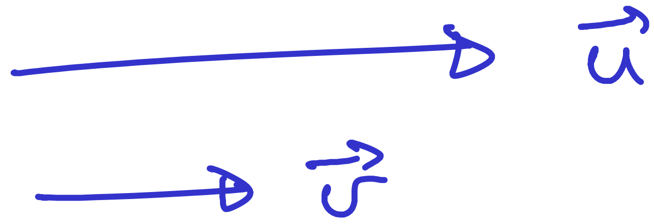
- $\alpha > 1$:
- $0 < \alpha < 1$:
- $\alpha < 0$:



parallel

bzw. (anti)parallel

$\vec{u} \parallel \vec{v}$



$\vec{v} = \alpha \cdot \vec{u}$, $\alpha = ?$

$$\vec{e} = \frac{\vec{u}}{\|\vec{u}\|} = \frac{\vec{v}}{\|\vec{v}\|} \Longrightarrow \vec{v} = \underbrace{\frac{\|\vec{v}\|}{\|\vec{u}\|}}_{=\alpha} \vec{u}$$

Matrizen

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & & & \vdots \\ \vdots & & & \vdots \\ a_{n1} & \cdots & \cdots & a_{nm} \end{pmatrix}$$

$n \times m$

\# Zeilen

\# Spalten

$n \neq m$: rechteckig

$$\underset{\text{Matrix}}{A} = \underset{\text{Matrixelement}}{(a_{ij})}, \quad \begin{array}{l} i = 1, \dots, n \\ j = 1, \dots, m \end{array}$$

$$\begin{pmatrix} 1 & 2 & 1 \\ 3 & 4 & 5 \end{pmatrix} + \begin{pmatrix} 0 & 8 & 1 \\ -1 & 3 & 2 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 10 & 2 \\ 2 & 7 & 7 \end{pmatrix}$$

alle 2×3

$$\cancel{\begin{pmatrix} 1 & 2 & 1 \\ 3 & 4 & 5 \end{pmatrix} + \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}}$$

geht nicht

$$\begin{pmatrix} 1 & 2 & 3 \\ -1 & 4 & 5 \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 1 & 5 \\ 0 & 2 & 2 & 0 \\ 0 & 4 & 3 & 0 \end{pmatrix}$$

$\underline{2} \times 3$ $\qquad$ $3 \times \underline{4}$

Ergebnis: 2×4

$$B = \begin{pmatrix} 1 & 0 & 1 & 5 \\ 0 & 2 & 2 & 0 \\ 0 & 4 & 3 & 0 \end{pmatrix}$$

$$A = \begin{pmatrix} 1 & 2 & 3 \\ -1 & 4 & 5 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 16 & 14 & 5 \\ -1 & 28 & 22 & -5 \end{pmatrix} = AB$$

$$1 \cdot 1 + 2 \cdot 2 + 3 \cdot 3 = 14$$

$$(-1) \cdot 0 + 4 \cdot 2 + 5 \cdot 4 = 28$$

$\cancel{BA}$ gilt hier nicht