

# Vector fun

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## 1 Vector Basics

- a)  $\vec{b} = \begin{pmatrix} 7 \\ 8 \end{pmatrix}$   
b)  $\begin{pmatrix} 7 \\ 8 \end{pmatrix} - \begin{pmatrix} 4 \\ 3 \end{pmatrix} = \begin{pmatrix} 3 \\ 5 \end{pmatrix}$   
c)  $\sqrt{3^2 + 5^2} = \sqrt{34}$   
d)  $\begin{pmatrix} 2 \\ -2 \end{pmatrix} + \begin{pmatrix} 5 \\ 2 \end{pmatrix} = \begin{pmatrix} 7 \\ 0 \end{pmatrix}$   
e)

- 1.  $\begin{pmatrix} 3 \\ 2 \end{pmatrix} + \begin{pmatrix} 5 \\ 1 \end{pmatrix} = \begin{pmatrix} 7 \\ 3 \end{pmatrix}$
- 2.  $\begin{pmatrix} 5 \\ 1 \end{pmatrix} + \begin{pmatrix} -2 \\ 6 \end{pmatrix} = \begin{pmatrix} 3 \\ 7 \end{pmatrix}$
- 3.  $\left(\begin{pmatrix} 3 \\ 2 \end{pmatrix} + \begin{pmatrix} 5 \\ 1 \end{pmatrix}\right) + \begin{pmatrix} -2 \\ 6 \end{pmatrix} = \begin{pmatrix} 6 \\ 9 \end{pmatrix}$
- 4.  $\begin{pmatrix} 3 \\ 2 \end{pmatrix} + \left(\begin{pmatrix} 5 \\ 1 \end{pmatrix} + \begin{pmatrix} -2 \\ 6 \end{pmatrix}\right) = \begin{pmatrix} 6 \\ 9 \end{pmatrix}$
- 5.  $\begin{pmatrix} 5 \\ 1 \end{pmatrix} + \begin{pmatrix} 3 \\ 2 \end{pmatrix} = \begin{pmatrix} 7 \\ 3 \end{pmatrix}$

## 2 Vector Decomposition

- f)  $5 \cdot \cos\left(\frac{\pi}{5}\right)$   
g)  $\vec{F} = \begin{pmatrix} 5 \cdot \cos\left(\frac{\pi}{5}\right) \\ 5 \cdot \sin\left(\frac{\pi}{5}\right) \end{pmatrix}$   
h)  $\sqrt{5 \cdot \cos\left(\frac{\pi}{5}\right) + 5 \cdot \sin\left(\frac{\pi}{5}\right)} \approx 2.25$

## 3 Multiplication of a Vector with a Scalar

- i)  $\vec{b} = \begin{pmatrix} -4 \\ 5 \end{pmatrix} \cdot 5 = \begin{pmatrix} -4 \cdot 5 \\ 5 \cdot 5 \end{pmatrix} = \begin{pmatrix} -20 \\ 25 \end{pmatrix}$   
j)  $|\vec{a}| = \sqrt{(-4)^2 + 5^2} = \sqrt{41}$   
k)  $|\vec{b}| = \sqrt{(-20)^2 + 25^2} = 5 \cdot \sqrt{41}$

$$\begin{aligned} \text{l)} \quad & \begin{pmatrix} 1 \\ 0 \end{pmatrix} \cdot 4 = \begin{pmatrix} 4 \\ 0 \end{pmatrix} \\ \text{m)} \quad & \begin{pmatrix} 1 \\ 3 \end{pmatrix} \cdot \frac{1}{2} = \begin{pmatrix} \frac{1}{2} \\ \frac{3}{2} \end{pmatrix} \end{aligned}$$

## 4 Unit Vectors

$$\begin{aligned} \text{n)} \quad \hat{e} &= \begin{pmatrix} \cos(\arg(\hat{e})) \\ \sin(\arg(\hat{e})) \end{pmatrix} = \begin{pmatrix} \frac{x}{\sqrt{x^2+y^2}} \\ \frac{y}{\sqrt{x^2+y^2}} \end{pmatrix} \\ \text{o)} \quad & \begin{pmatrix} \frac{3}{\sqrt{3^2+2^2}} \\ \frac{2}{\sqrt{3^2+2^2}} \end{pmatrix} \approx \begin{pmatrix} 0.83 \\ 0.55 \end{pmatrix} \\ \text{p)} \quad & \begin{pmatrix} \frac{\sqrt{7^2+(-2)^2}}{\sqrt{7^2+(-2)^2}} \\ \frac{-2}{\sqrt{7^2+(-2)^2}} \end{pmatrix} \approx \begin{pmatrix} -0.27 \\ 0.96 \end{pmatrix} \end{aligned}$$

## 5 Dot Product / Scalar Product

$$\begin{aligned} \text{q)} \quad & \sqrt{2^2+3^2} \cdot \sqrt{4^2+6^2} \cdot \cos(0) = 26 \\ \text{r)} \quad & \sqrt{2^2+3^2} \cdot \sqrt{(-3)^2+2^2} \cdot \cos(90) = 13 \cdot 0 = 0 \end{aligned}$$

## 6 python

See file : vectorfun\_python.py