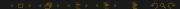
# Math 2130 Linear Algebra Week 2 Lengths and angles

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2025 September 3



# Today's topics

- Lengths
- 2 Angles

#### Vectors

- We may think of a vector in  $\mathbb{R}^n$  as consisting of a magnitude (or length) and a direction.
- Linear equations may represent lines, planes, or their higher-dimensional analogues.

### Length

■ The *length* of a vector  $(v_1, v_2, \ldots, v_n) \in \mathbb{R}^n$  is

$$|v| = \sqrt{v_1^2 + \dots + v_n^2}.$$

#### Length

Find the length of the vector (1, 2, 3, 4) in  $\mathbb{R}^4$ .

■ The dot product of  $u=(u_1,u_2,\ldots,u_n)\in\mathbb{R}^n$  and  $v=(v_1,v_2,\ldots,v_n)\in\mathbb{R}^n$  is

$$u \cdot v = u_1 v_1 + \dots + u_n v_n.$$

■ We have that  $u \cdot v = |u| |v| \cos(\theta)$  where  $\theta$  is the angle between u and v.

Find the angle between the vectors (0,1,2) and (1,-1,4) in  $\mathbb{R}^3$ .

■ The dot product of  $u = (u_1, u_2, ..., u_n) \in \mathbb{R}^n$  and  $v = (v_1, v_2, ..., v_n) \in \mathbb{R}^n$  is

$$u \cdot v = u_1 v_1 + \dots + u_n v_n.$$

- We have that  $u \cdot v = |u| |v| \cos(\theta)$  where  $\theta$  is the angle between u and v.
- When  $u \cdot v = 0$  (i.e. when the angle between u and v is  $\frac{\pi}{2}$ ), we say that u and v are orthogonal.

For which values of k are (-4,2,k) and (k,2,k) orthogonal?