

## REAL INNER PRODUCT

# Why

We want to measure angles in space.<sup>1</sup>

### Definition

The real inner product (or dot product, scalar product) of two real vectors  $x, y \in \mathbb{R}^n$  is

$$x_1y_1 + x_2y_2 + \dots + x_ny_n$$

We denote the inner product of x and y by  $\langle x, y \rangle$ .

## **Properties**

The inner product has several important properties

- 1.  $\langle \alpha x, y \rangle = \alpha \langle x, y \rangle$
- 2.  $\langle x + y, z \rangle = \langle x, z \rangle + \langle y, z \rangle$
- 3.  $\langle x, y \rangle = \langle y, x \rangle$
- 4.  $\langle x, x \rangle \geq 0$
- 5.  $\langle x, x \rangle = 0 \longleftrightarrow x = 0$

#### Connection to norm

It is important to note that  $||x|| = \sqrt{\langle x, x \rangle}$ .

<sup>1</sup>Future editions will expand, and perhaps give the development for  $\mathbb{R}^2$  first. Future editions will include pictures.

