UNIVERSITY OF CALIFORNIA
UC RIVERSIDE

CS133
Computational Geometry

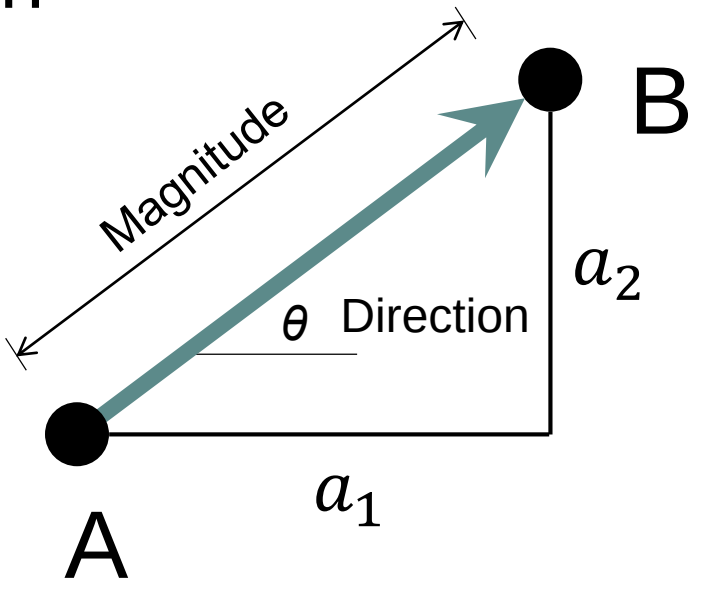
Review of Linear Algebra

In this class …

- Vectors
- Dot product
- Cross product
- Determinants

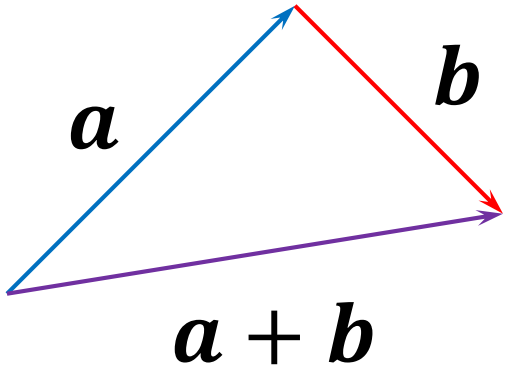
Vectors

- Euclidean vector or geometric vector
- A geometric object that has magnitude and direction
- Notation: $\boldsymbol{a} = \overrightarrow{AB}$
- Cartesian representation
  - $\boldsymbol{a} = (a_1, a_2)$
- Magnitude
  - $\|\boldsymbol{a}\| = \sqrt{a_1^2 + a_2^2}$
  - $\tan(\theta) = \frac{a_2}{a_1}$

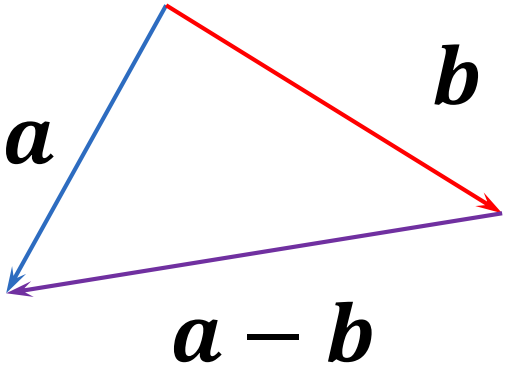


Addition/Subtraction

$$\boldsymbol{a} + \boldsymbol{b} = (a_1 + b_1, a_2 + b_2)$$

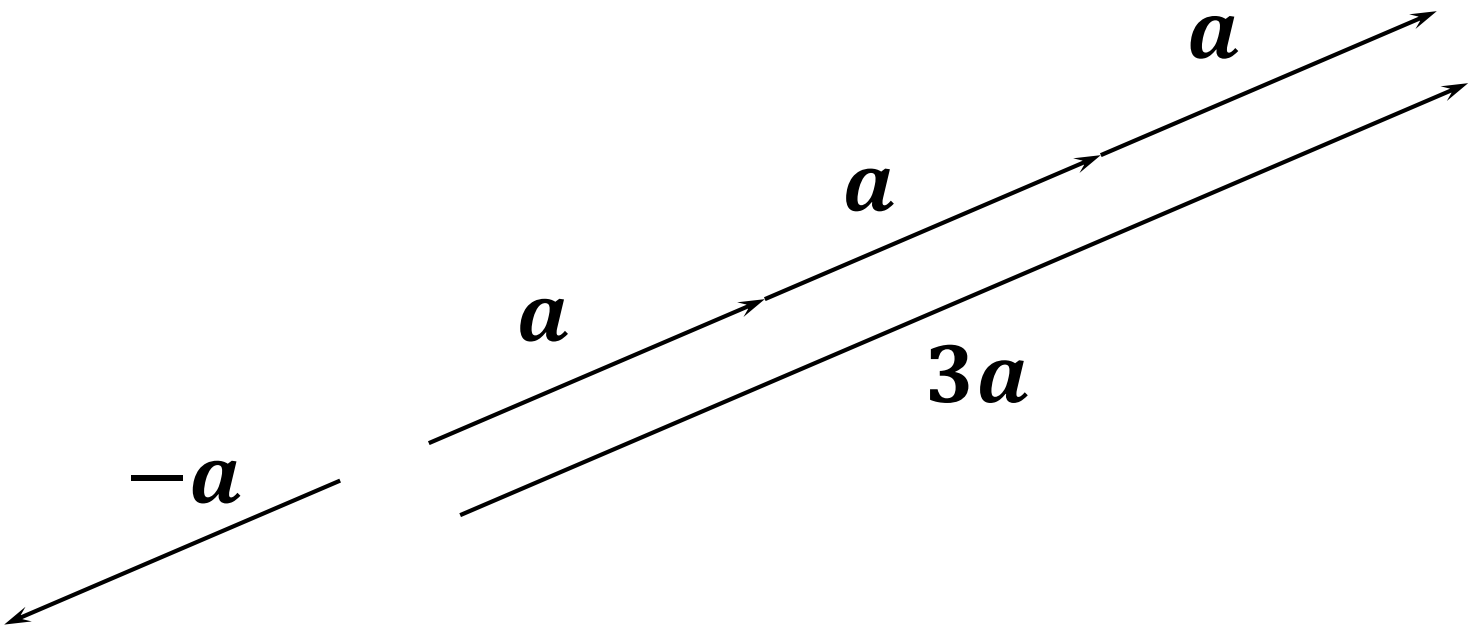


$$\boldsymbol{a} - \boldsymbol{b} = (a_1 - b_1, a_2 - b_2)$$



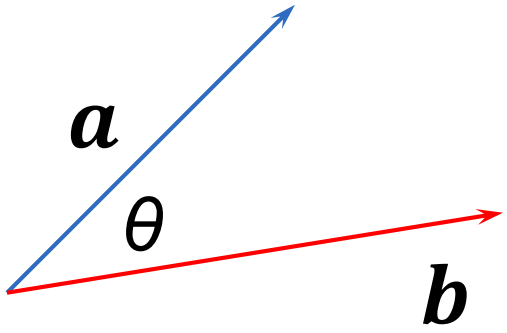
Scalar Multiplication

$$r\boldsymbol{a} = \boldsymbol{a} + \boldsymbol{a} + \cdots + \boldsymbol{a} = (ra_1, ra_2)$$



Dot Product

$$a \cdot b = \|a\|\|b\| \cos(\theta)$$

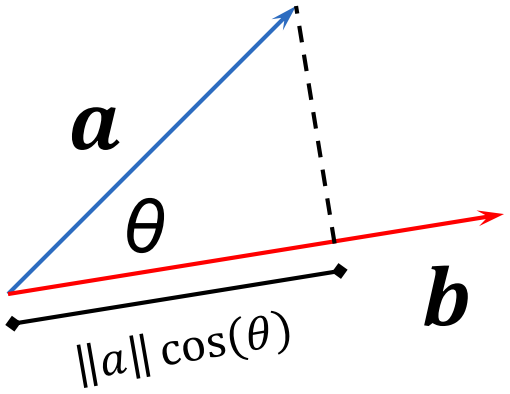


$$a \cdot b = a_1 b_1 + a_2 b_2$$

The result of a dot product is a scalar value

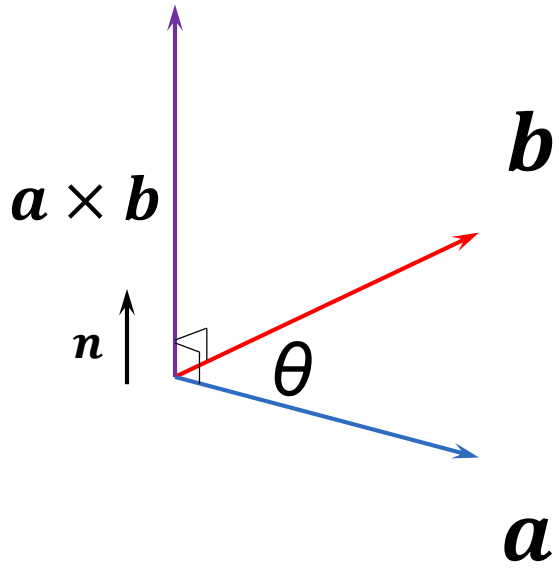
$$a \cdot b = b \cdot a$$

$$a \cdot a = \|a\|^2$$



Cross Product

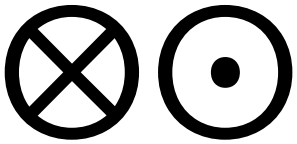
$$a \times b = \|a\|\|b\| \sin(\theta)\, \boldsymbol{n}$$



$$a \times b = a_1 b_2 - a_2 b_1$$

The result of a cross product is a vector

$$a \times b = -b \times a$$



Determinants

- $|D| = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = a \cdot d - b \cdot c$
- $|D| = \begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix} = a \begin{vmatrix} e & f \\ h & i \end{vmatrix} -$

$$b \begin{vmatrix} d & f \\ g & i \end{vmatrix} + c \begin{vmatrix} d & e \\ g & h \end{vmatrix}$$

$$= aei + bfg + cdh - ceg - bdi - afh$$