4.1 Vectors in the Plane

Review the basic terminology:

- vectors, scalars ($\rightarrow$ p. 170)
- rectangular (or Cartesian) coordinate system, projection, 2-space ($\rightarrow$ p. 171)
- tail (initial point) and head (terminal point) of a vector ($\rightarrow$ p. 172, 174)
- direction and magnitude ($\rightarrow$ p. 172)
- components of a vector ($\rightarrow$ p. 173, 174)
- directed line segment vs. vector ($\rightarrow$ p. 173)
- notation for vectors: $\overrightarrow{u} = \begin{pmatrix} x \\ y \end{pmatrix} = (x, y)$

  ($\rightarrow$ p. 174)
- length ($\rightarrow$ p. 175)

$$\left\| \overrightarrow{u} \right\| = \|(x, y)\| = \sqrt{x^2 + y^2}$$

- what does $\overrightarrow{u} = \overrightarrow{v}$ mean? ($\rightarrow$ p. 173, 174)
- parallel vectors ($\rightarrow$ p. 175)

- Sum (→ p. 177)

$$\overrightarrow{u} + \overrightarrow{v} = (x_1, y_1) + (x_2, y_2)$$
$$= (x_1 + x_2, y_1 + y_2)$$

- Scalar multiple (→ p. 178)

$$c\overrightarrow{u} = c(x_1, y_1) = (cx_1, cy_1)$$

- Dot product (→ p. 180)

$$\overrightarrow{u} \bullet \overrightarrow{v} = (x_1, y_1) \bullet (x_2, y_2)$$
$$= x_1x_2 + y_1y_2)$$

- Angle θ between $\overrightarrow{u}$ and $\overrightarrow{v}$ (→ p. 180)

$$\cos\theta = \frac{\overrightarrow{u} \bullet \overrightarrow{v}}{\left\|\overrightarrow{u}\right\| \left\|\overrightarrow{v}\right\|}$$

- $\overrightarrow{u}$ and $\overrightarrow{v}$ are orthogonal (→ p. 181) if and only if $\overrightarrow{u} \bullet \overrightarrow{v} = 0$.
- Unit vector in the direction of $\overrightarrow{u}$ (→ p. 182)

$$\frac{1}{\left\|\overrightarrow{u}\right\|}\overrightarrow{u}$$