University Physics 1A

Alvin Lin

August 31st, 2017

Vectors

$$\text{average speed} = \frac{\text{how far}}{\text{how long it takes}}$$

$$\text{average velocity} = \frac{\vec{pos_{final}} - \vec{pos_{initial}}}{\text{how long it takes}}$$

It is important to note that velocity takes the initial and final position. One can travel some distance, but if the initial and final position remain the same, the average velocity remains zero. This is only the vector quantity and the displacement and speed scalars remain the same.

Adding vectors in $\mathbb{R}^2$

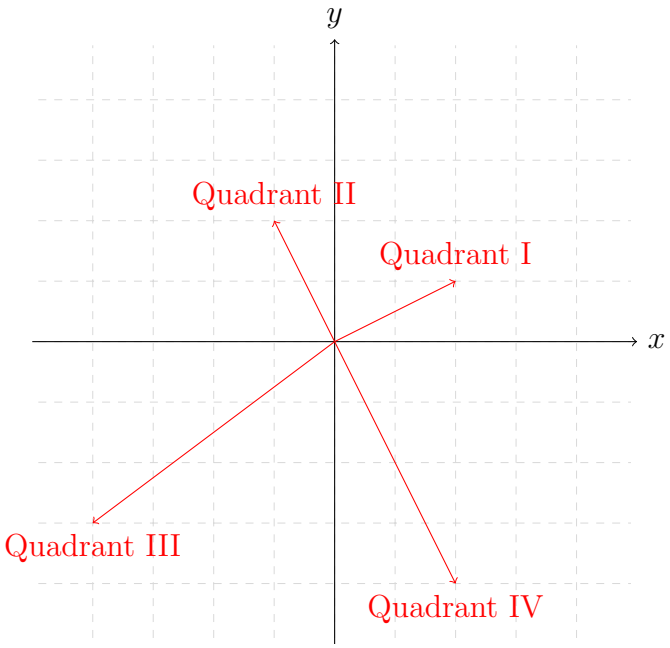
Take the following:

$$\begin{aligned}\vec{v} &= \langle v_1, v_2 \rangle \\ \vec{w} &= \langle w_1, w_2 \rangle \\ \vec{v} + \vec{w} &= \langle v_1 + w_1, v_2 + w_2 \rangle\end{aligned}$$

Geometrically, this is represented as putting the tail of $\vec{v}$ on the head of $\vec{w}$ and taking the vector from the tail of $\vec{w}$ to the head of $\vec{v}$. Subtraction is an analogous operation:

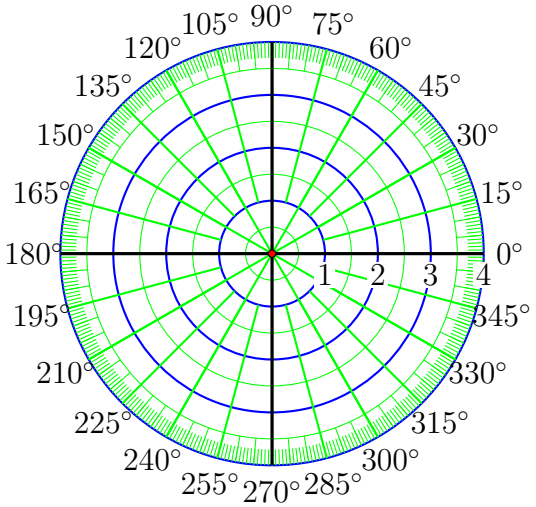
$$\begin{aligned}\vec{v} &= \langle v_1, v_2 \rangle \\ \vec{w} &= \langle w_1, w_2 \rangle \\ \vec{v} - \vec{w} &= \vec{v} + (-\vec{w}) \\ &= \langle v_1 + (-w_1), v_2 + (-w_2) \rangle \\ &= \langle v_1 - w_1, v_2 - w_2 \rangle\end{aligned}$$

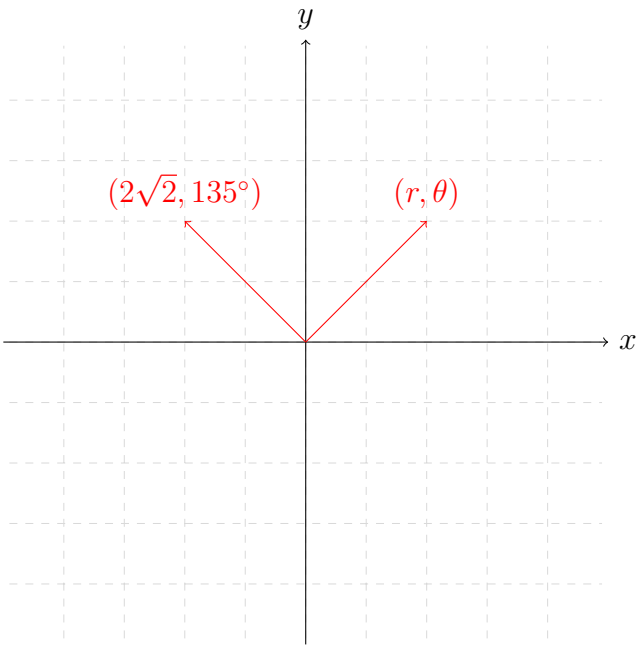
Vector Quadrants



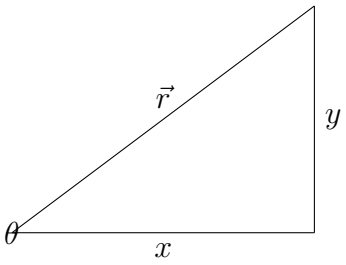
Polar Coordinates

Coordinates can be represented as an angle and direction.





Converting between polar and Cartesian coordinates



$$x = r\cos(\theta)$$
$$y = r\sin(\theta)$$
$$r^2 = x^2 + y^2$$
$$\theta = \tan^{-1}(\frac{y}{x})$$

Given the unit vectors $\vec{i}$ and $\vec{j}$, $\vec{r}$ can also be represented as:

$$\vec{r} = x\vec{i} + y\vec{j}$$

You can find all my notes at `http://omgimanerd.tech/notes`. If you have any questions, comments, or concerns, please contact me at alvin@omgimanerd.tech