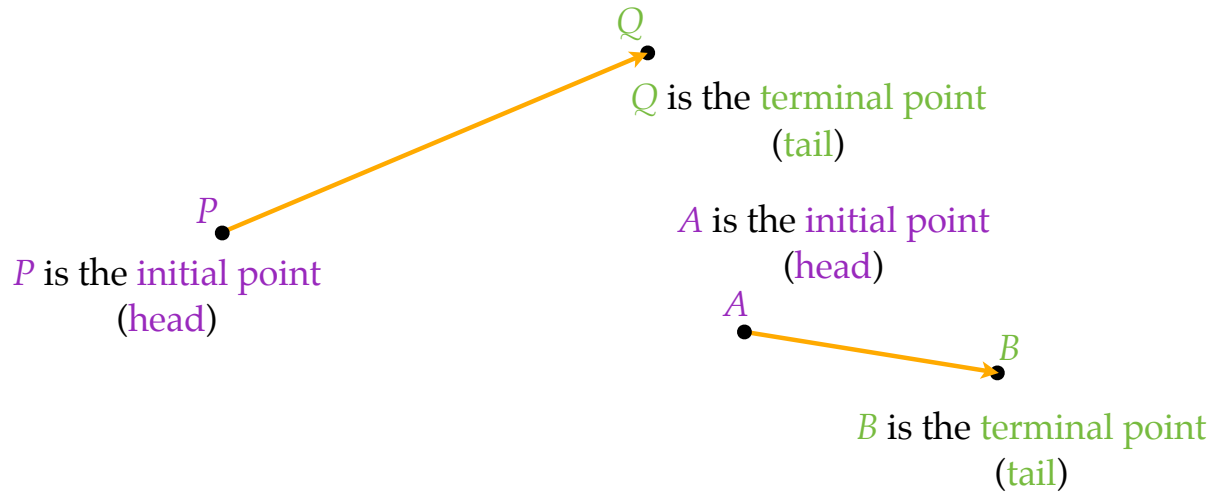
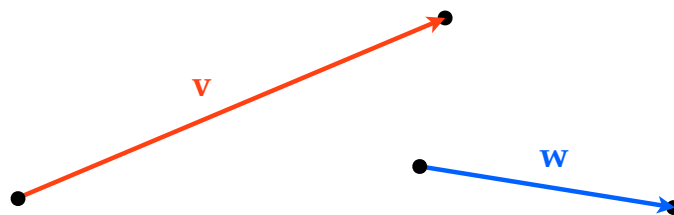


Vectors have a starting and ending point



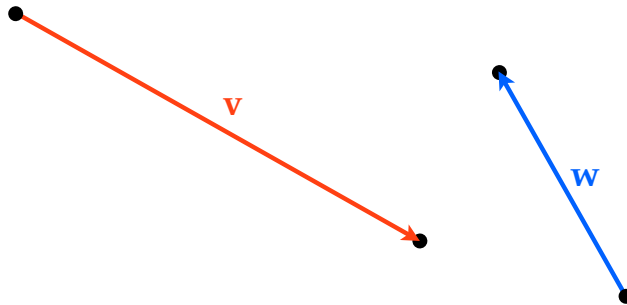
To add two vectors...

1. Align the terminal point (tail) of \mathbf{v} with initial point (head) of \mathbf{w} .
2. Draw vector from the initial point (head) of \mathbf{v} to the terminal point (tail) of \mathbf{w} .



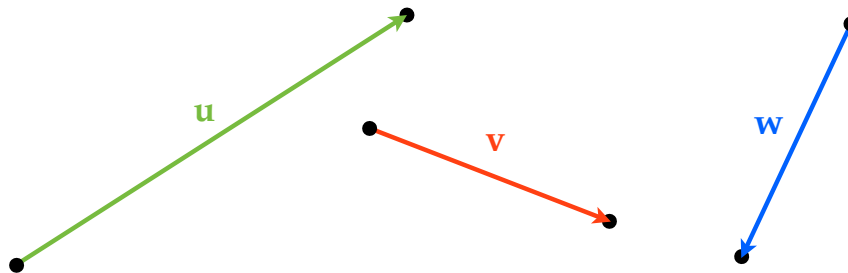
To add two vectors...

1. Align the terminal point (**tail**) of **v** with initial point (**head**) of **w**.
2. Draw **vector** from the initial point (**head**) of **v** to the terminal point (**tail**) of **w**.



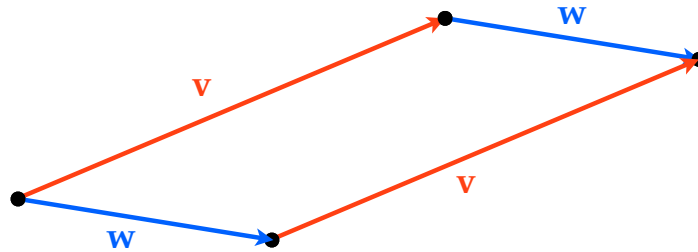
To add two vectors...

1. Align the terminal point (**tail**) of **v** with initial point (**head**) of **w**.
2. Draw **vector** from the initial point (**head**) of **v** to the terminal point (**tail**) of **w**.



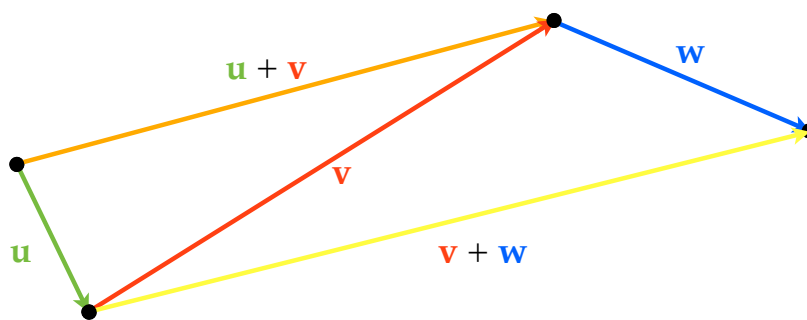
Vector addition is commutative

$$\mathbf{v} + \mathbf{w} = \mathbf{w} + \mathbf{v}$$



Vector addition is associative

$$(\mathbf{u} + \mathbf{v}) + \mathbf{w} = \mathbf{u} + (\mathbf{v} + \mathbf{w})$$



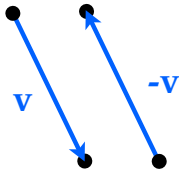
The Zero Vector, $\mathbf{0}$

The zero vector has a magnitude of 0 and no direction.

$$\mathbf{v} + \mathbf{0} = \mathbf{0} + \mathbf{v} = \mathbf{v}$$

The Opposite Vector, $-\mathbf{v}$

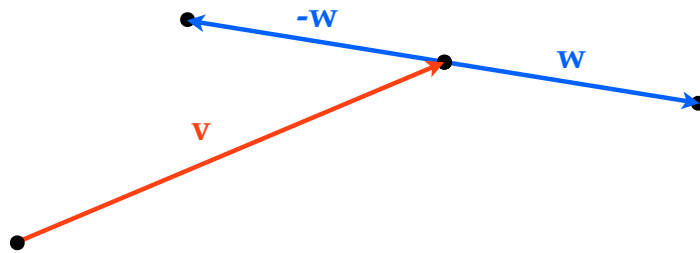
The opposite vector, $-\mathbf{v}$, has the same magnitude of \mathbf{v} but has an opposite direction of \mathbf{v} .



$$\mathbf{v} + (-\mathbf{v}) = \mathbf{0}$$

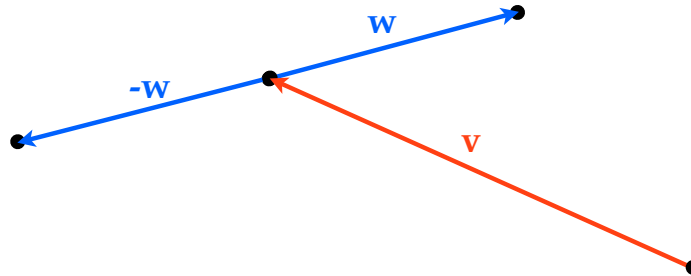
Subtracting Vectors

$$\mathbf{v} - \mathbf{w} = \mathbf{v} + (-\mathbf{w})$$



Subtracting Vectors

$$\mathbf{v} - \mathbf{w} = \mathbf{v} + (-\mathbf{w})$$



To add two vectors...

1. Align the terminal point (**tail**) of \mathbf{v} with initial point (**head**) of \mathbf{w} .
2. Draw **vector** from the initial point (**head**) of \mathbf{v} to the terminal point (**tail**) of \mathbf{w} .

Vector addition is commutative

$$\mathbf{v} + \mathbf{w} = \mathbf{w} + \mathbf{v}$$

Vector addition is associative

$$(\mathbf{u} + \mathbf{v}) + \mathbf{w} = \mathbf{u} + (\mathbf{v} + \mathbf{w})$$

The **Zero Vector**, $\mathbf{0}$

$$\mathbf{v} + \mathbf{0} = \mathbf{0} + \mathbf{v} = \mathbf{v}$$

The **Opposite Vector**, $-\mathbf{v}$

$$\mathbf{v} + (-\mathbf{v}) = \mathbf{0}$$

Subtracting Vectors

$$\mathbf{v} - \mathbf{w} = \mathbf{v} + (-\mathbf{w})$$