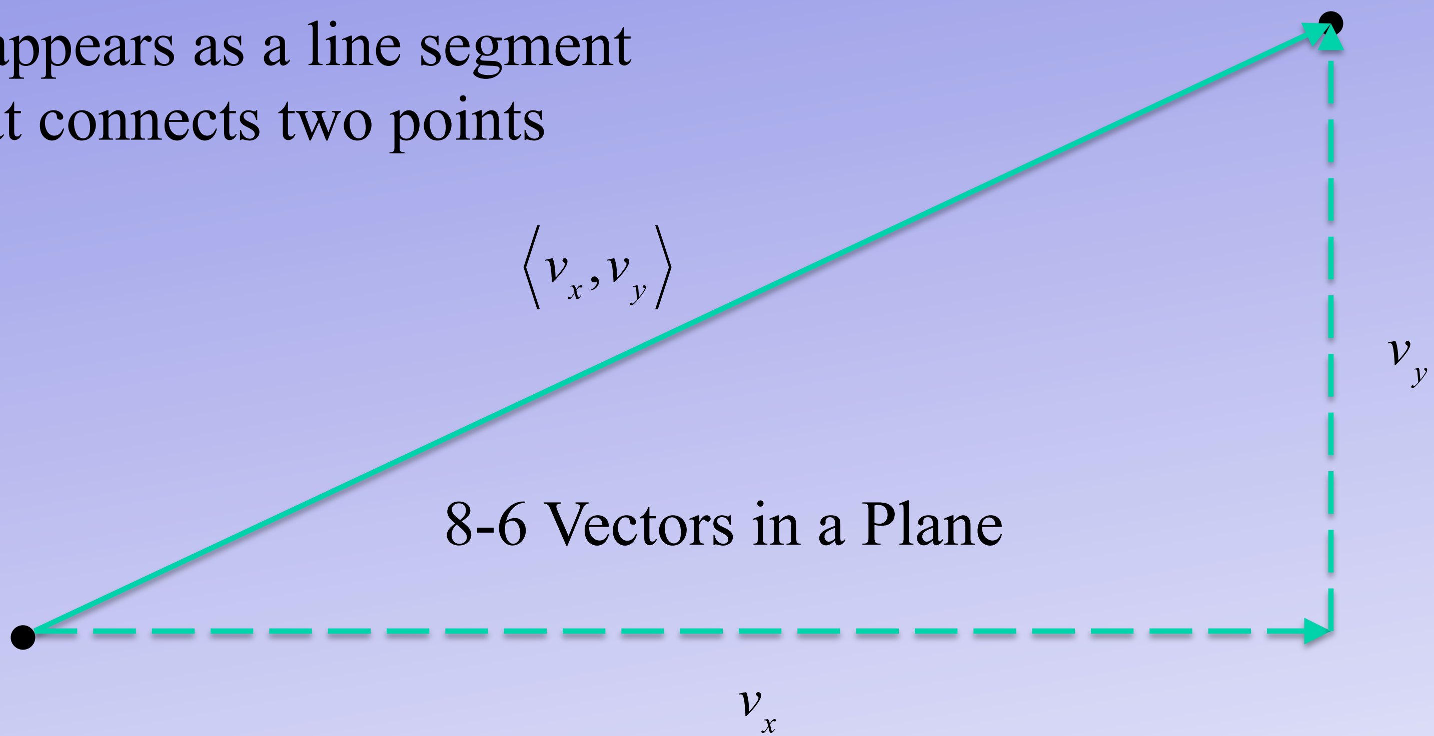
This is a Vector

It appears as a line segment
that connects two points

# 8-6 Vectors in a Plane




It also has something else:  Direction

But the best part is it’s really just the hypotenuse of a right triangle

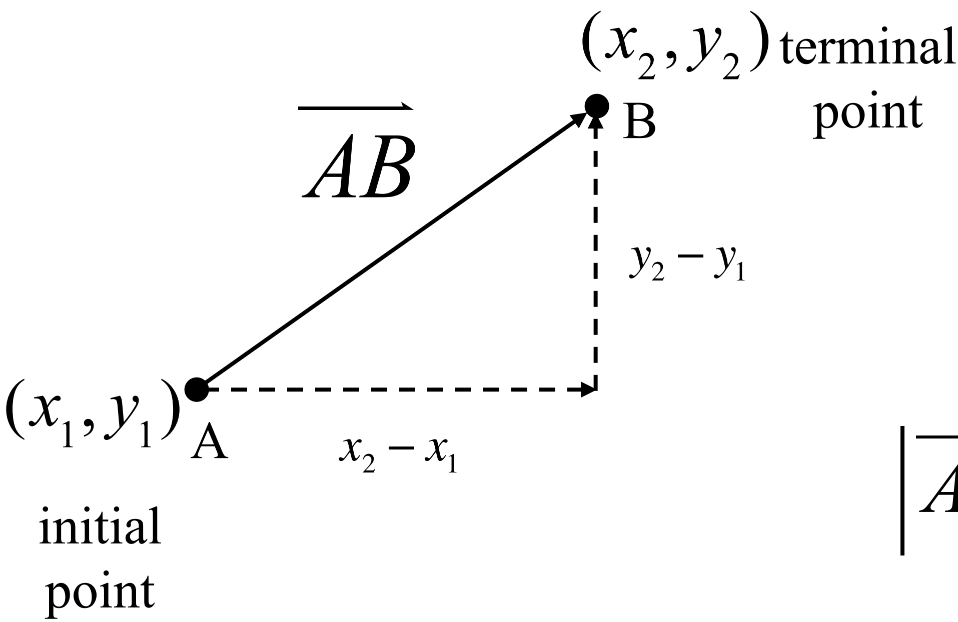
What are those symbols next to each line segment?

We shall soon see.

In the past we've only worked with lines that have slopes but not necessarily direction.

Quantities such as force, displacement or velocity that have direction as well as magnitude are represented by directed line segments.

There's a difference between going 50 mph north and 50 mph south




The length is of this vector is written as

$$\left|\overrightarrow{AB}\right|$$

It can be calculated like this:

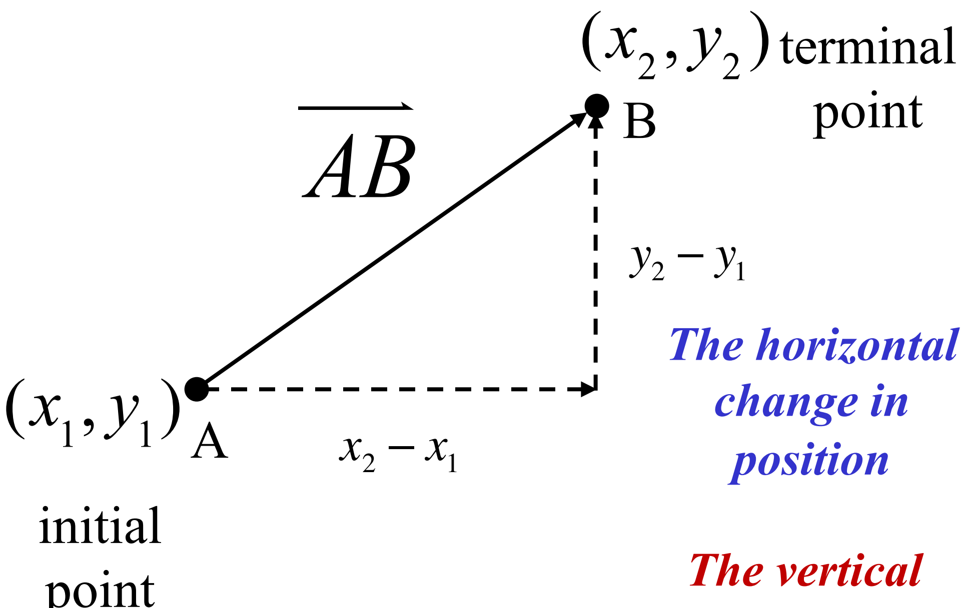
$$\left|\overrightarrow{AB}\right| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Look, it's just the distance formula

In the past we've only worked with lines that have slopes but not necessarily direction.

Quantities such as force, displacement or velocity that have direction as well as magnitude are represented by directed line segments.

There's a difference between going 50 mph north and 50 mph south




The component form of this vector is:

$$\overrightarrow{AB} = \langle x_2 - x_1, y_2 - y_1 \rangle$$

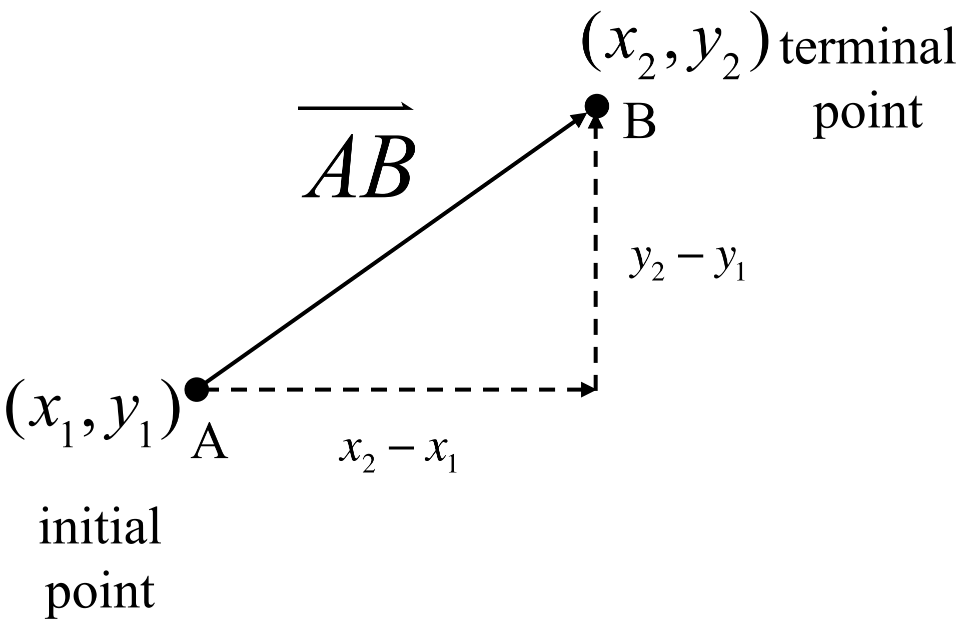
*The horizontal change in position*

*The vertical change in position*

In the past we've only worked with lines that have slopes but not necessarily direction.

Quantities such as force, displacement or velocity that have direction as well as magnitude are represented by directed line segments.

There's a difference between going 50 mph north and 50 mph south




The component form of this vector is:

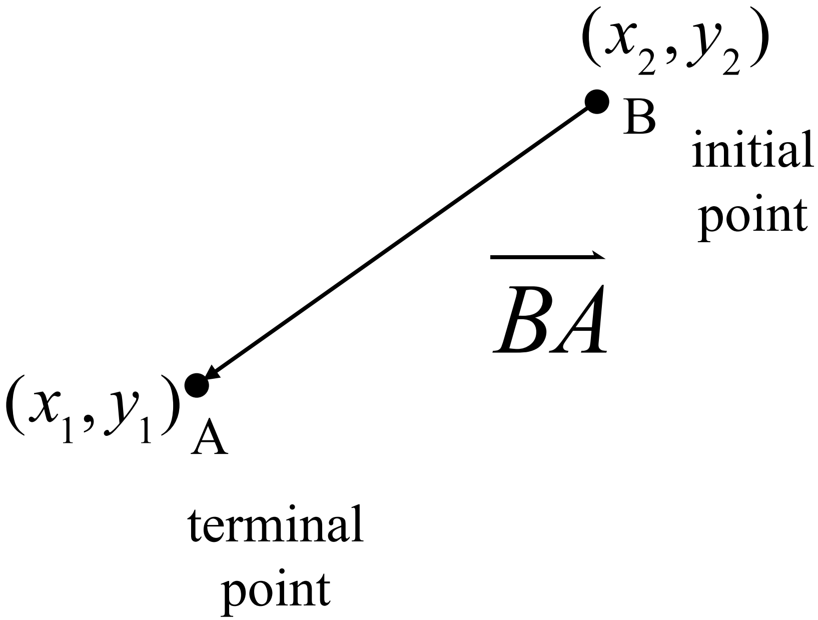
$$\overrightarrow{AB} = \left\langle x_2 - x_1, y_2 - y_1 \right\rangle$$

Notice here that we always subtract the initial point from the terminal point because we need to establish direction

In the past we've only worked with lines that have slopes but not necessarily direction.

Quantities such as force, displacement or velocity that have direction as well as magnitude are represented by <u>directed line segments</u>.

There's a difference between going 50 mph north and 50 mph south




The length is written as

$$\left|\overrightarrow{BA}\right|$$

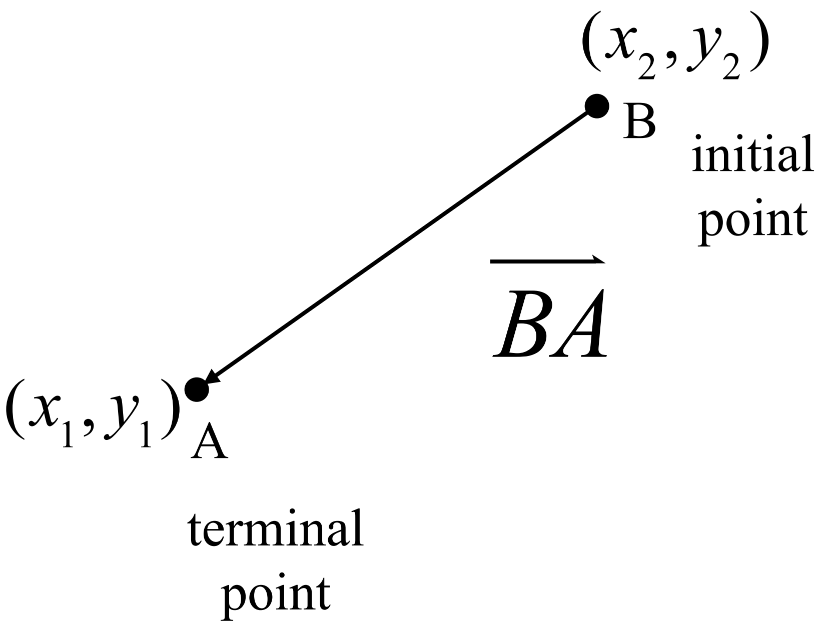
$$\left|\overrightarrow{BA}\right| = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Notice that the length will be the same

In the past we've only worked with lines that have slopes but not necessarily direction.

Quantities such as force, displacement or velocity that have direction as well as magnitude are represented by <u>directed line segments</u>.

There's a difference between going 50 mph north and 50 mph south

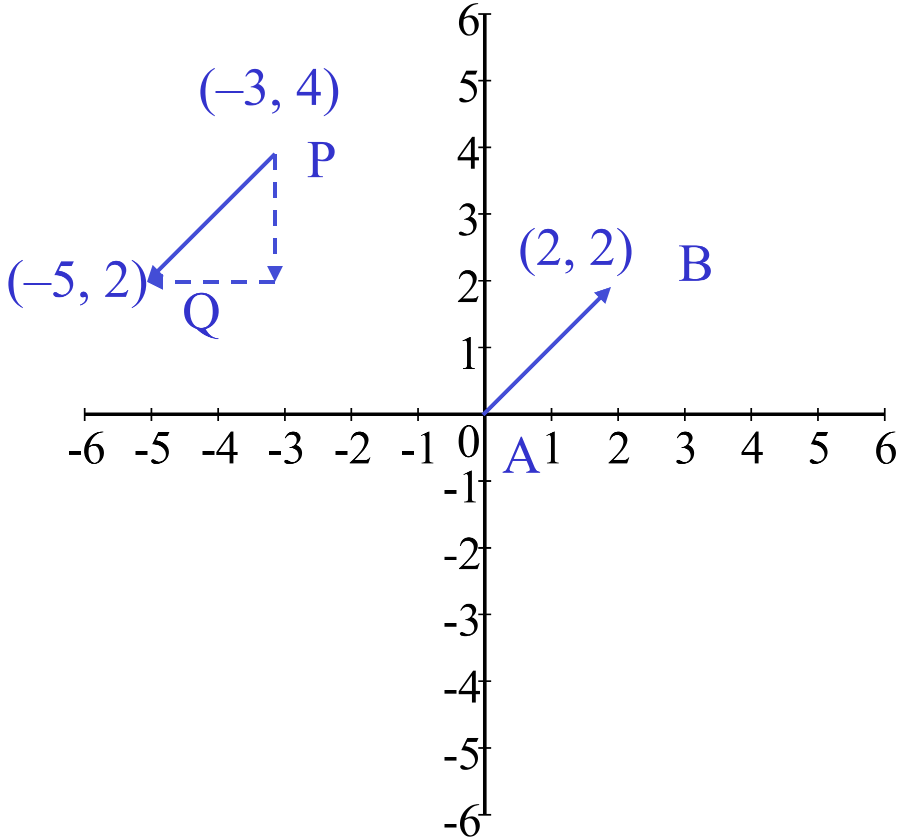



The <u>component form</u> of this vector is:

$$\overrightarrow{BA} = \langle x_1 - x_2, y_1 - y_2 \rangle$$

Same vector length (magnitude), same slope (line segment) but opposite vectors.

Find the component form of each vector




$$\overrightarrow{AB} = \langle 2-0, 2-0 \rangle$$

$$\overrightarrow{AB} = \langle 2, 2 \rangle$$

$$\overrightarrow{PQ} = \langle -5+3, 2-4 \rangle$$

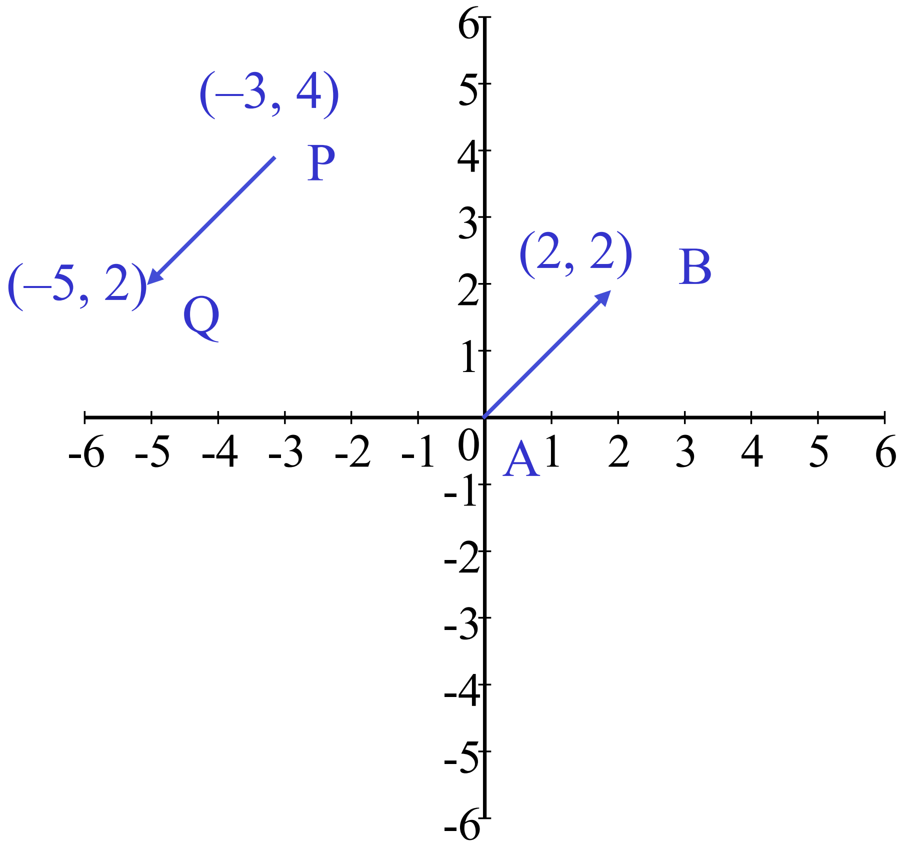
$$\overrightarrow{PQ} = \langle -2, -2 \rangle$$

$$\left|\overrightarrow{AB}\right| = \sqrt{(2)^2 + (2)^2}$$

$$\left|\overrightarrow{PQ}\right| = \sqrt{(-2)^2 + (-2)^2}$$

$$\left|\overrightarrow{AB}\right| = \left|\overrightarrow{PQ}\right| = \sqrt{8} = 2\sqrt{2}$$

Find the component form of each vector



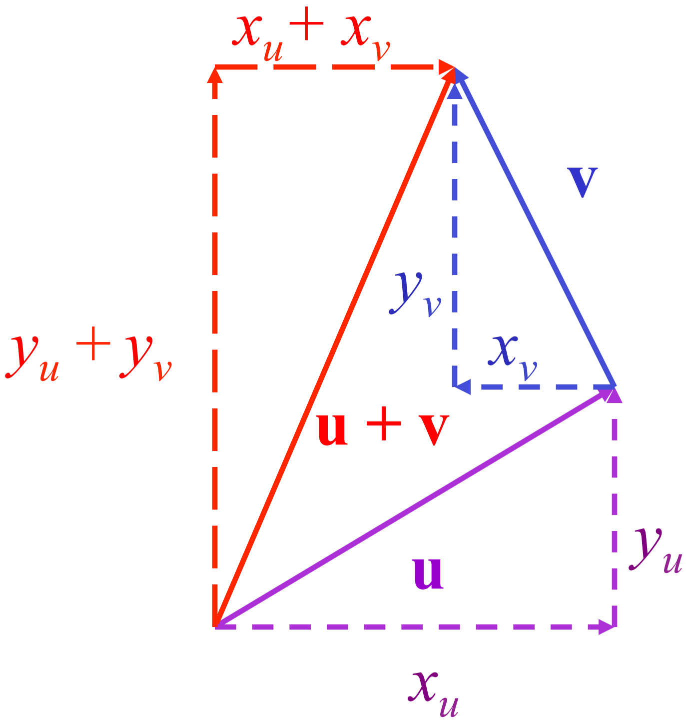

$$\overrightarrow{AB} = \langle 2,2 \rangle$$

$$\overrightarrow{PQ} = \langle -2,-2 \rangle$$

$$\left|\overrightarrow{AB}\right| = \left|\overrightarrow{PQ}\right| = \sqrt{8} = 2\sqrt{2}$$

Notice that the vectors are pointed in opposite directions

but have the same length.




# Vector Addition:

**u** + **v**

**u** + **v** is the resultant vector.

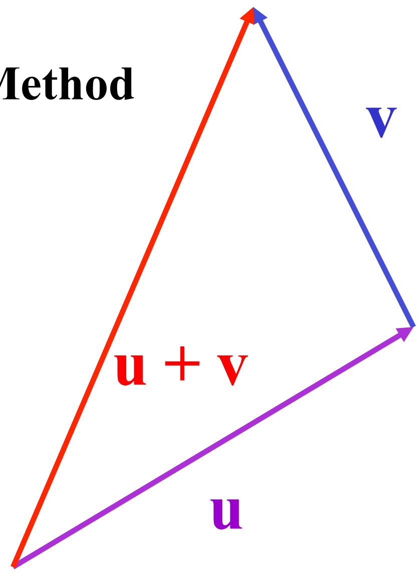
$$\mathbf{u} = \langle x_u, y_u \rangle$$

$$\mathbf{v} = \langle x_v, y_v \rangle$$

$$\mathbf{u} + \mathbf{v} = \langle x_u + x_v, y_u + y_v \rangle$$

(Add the components.)

One method of adding vectors is the **Head to Tail Method**




# Vector Addition:

**u** + **v**

**u** + **v** is the resultant vector.

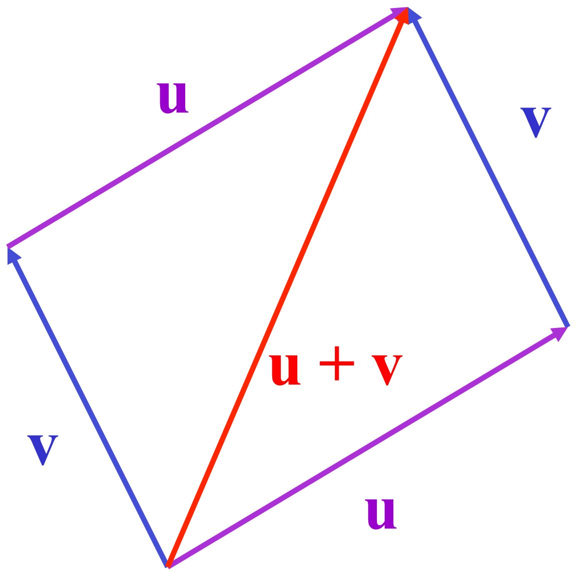
$$\mathbf{u} = \langle x_u, y_u \rangle$$

$$\mathbf{v} = \langle x_v, y_v \rangle$$

$$\mathbf{u} + \mathbf{v} = \langle x_u + x_v, y_u + y_v \rangle$$

(Add the components.)

# Vector Addition:




**u + v**

**u + v** is the resultant vector.

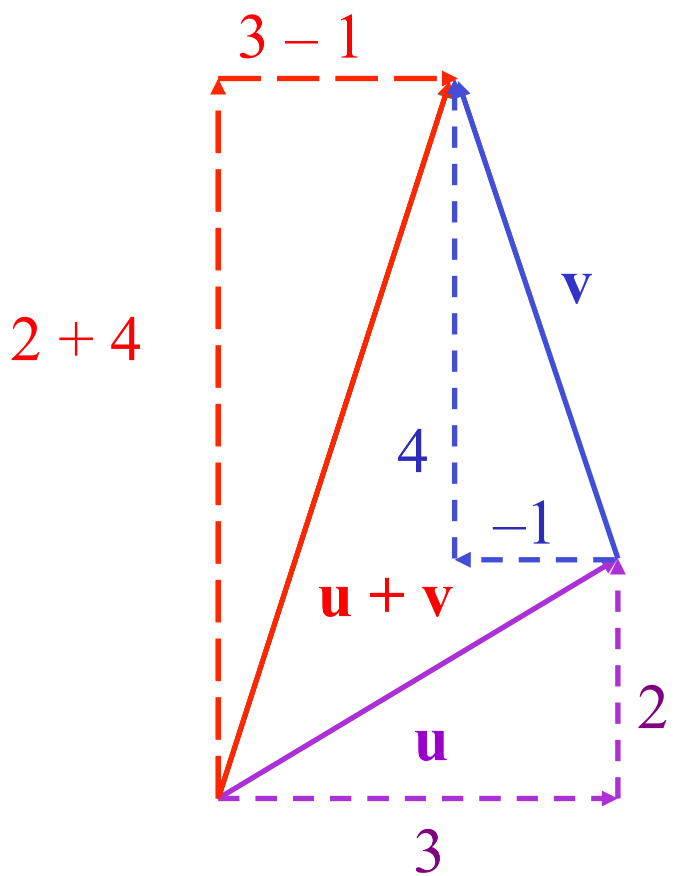
$$\mathbf{u} = \langle x_u, y_u \rangle$$

$$\mathbf{v} = \langle x_v, y_v \rangle$$

This one is called the
**Parallelogram Method**

$$\mathbf{u} + \mathbf{v} = \langle x_u + x_v, y_u + y_v \rangle$$

(Add the components.)




# Vector Addition:

**u** + **v**

**u** + **v** is the resultant vector.

$\mathbf{u} = \langle 3, 2 \rangle$

$\mathbf{v} = \langle -1, 4 \rangle$

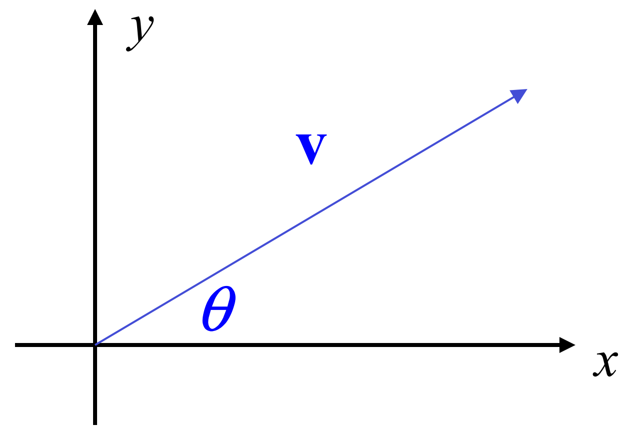
$\mathbf{u} + \mathbf{v} = \langle 2, 6 \rangle$

See?  Just add the components

By the way, what's the length of this new vector?

$$|\mathbf{u} + \mathbf{v}| = \sqrt{2^2 + 6^2} = \sqrt{4 + 36} = \sqrt{40} = \sqrt{4 \cdot 10} = 2\sqrt{10}$$

Now let's use trig ratios to break vectors into components.




What if we only knew the length of the vector and the angle?

$|\mathbf{v}|$ $\theta$

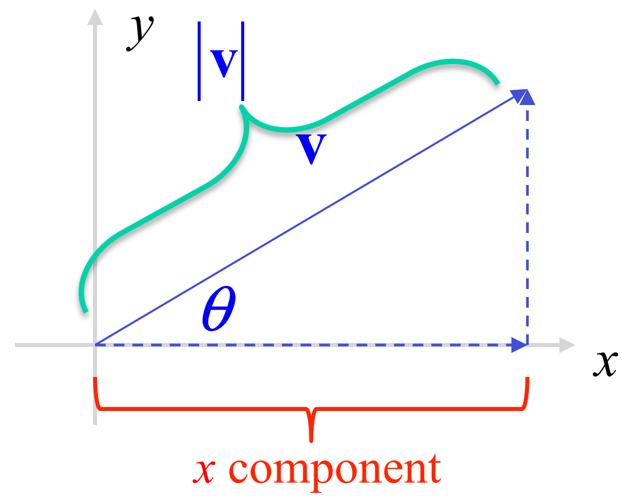
The <u>component form</u> of this vector is:

$$\mathbf{v} = \left\langle |\mathbf{v}|\cos\theta, |\mathbf{v}|\sin\theta \right\rangle$$

Before anyone panics, this is just SOHCAHTOA…

Just watch…

A vector is in standard position if the initial point is at the origin.



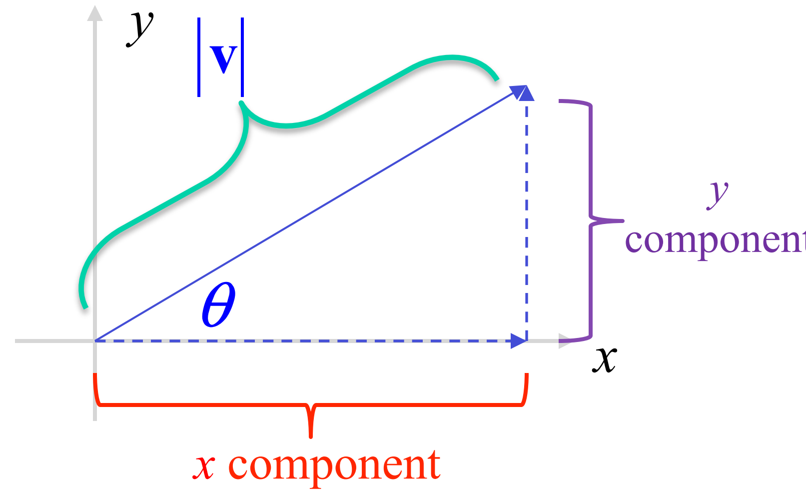

$$\frac{adj}{hyp} = \frac{x \text{ component}}{|\mathbf{v}|} = \cos\theta$$

$$x \text{ component} = |\mathbf{v}|\cos\theta$$

Remember what this really means: $|\mathbf{v}|$ ← Think of it as a hypotenuse of the right triangle above because it's the length of the vector

$$\mathbf{v} = \langle \underbrace{|\mathbf{v}|\cos\theta}_{x \text{ component}}, |\mathbf{v}|\sin\theta \rangle$$

A vector is in <u>standard position</u> if the initial point is at the origin.




$$\frac{opp}{hyp} = \frac{y\ \text{component}}{|\mathbf{v}|} = \sin\theta$$

$$y\ \text{component} = |\mathbf{v}|\cos\theta$$

See? Just SOHCAHTOA

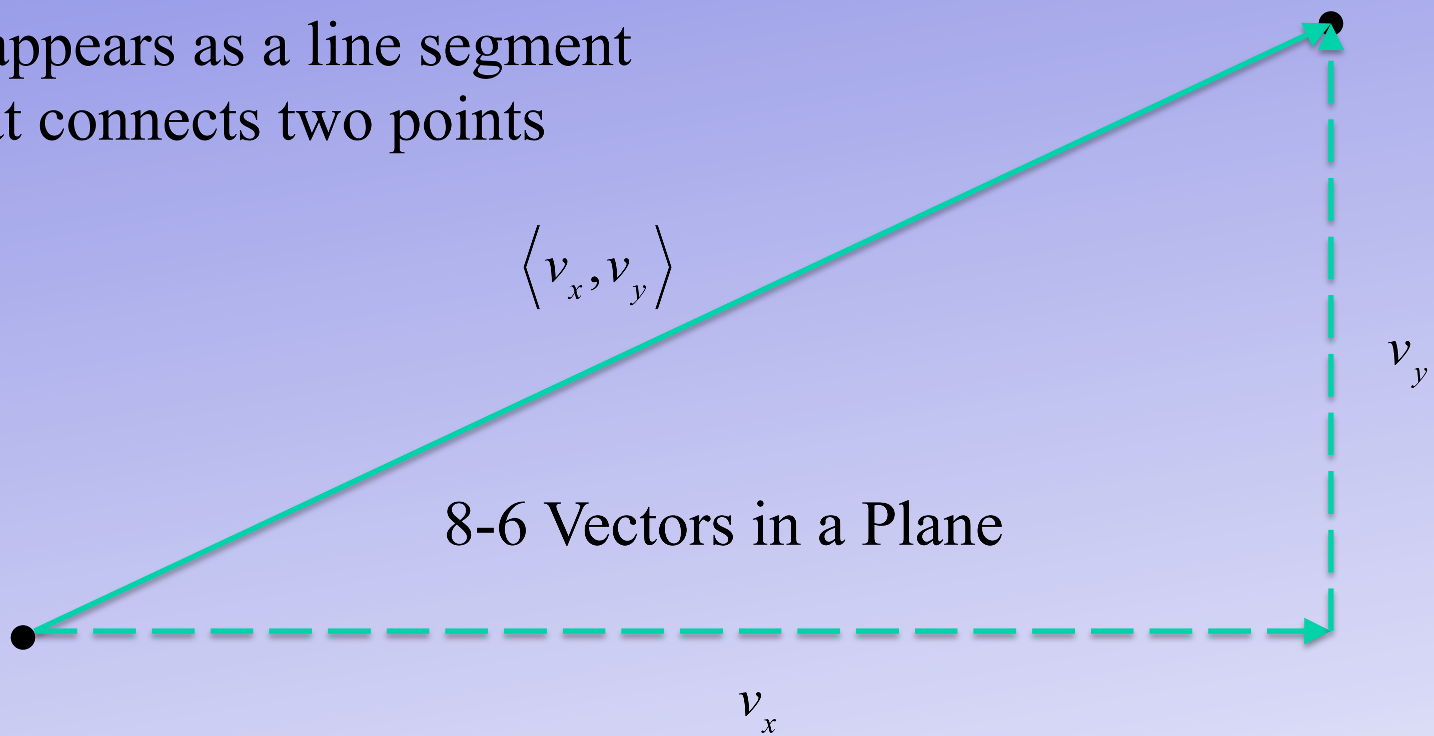
Remember what this really means: $|\mathbf{v}|$ ← Remember that the length of the vector is just the hypotenuse of the right triangle above.

$$\mathbf{v} = \langle \underbrace{|\mathbf{v}|\cos\theta}_{x\ \text{component}}, \underbrace{|\mathbf{v}|\sin\theta}_{y\ \text{component}} \rangle$$

This is a Vector

It appears as a line segment
that connects two points

# 8-6 Vectors in a Plane




It also has something else: Direction

But the best part is it's really just the hypotenuse of a right triangle