

## Adding and Subtracting Vectors



## Preliminaries and Objectives

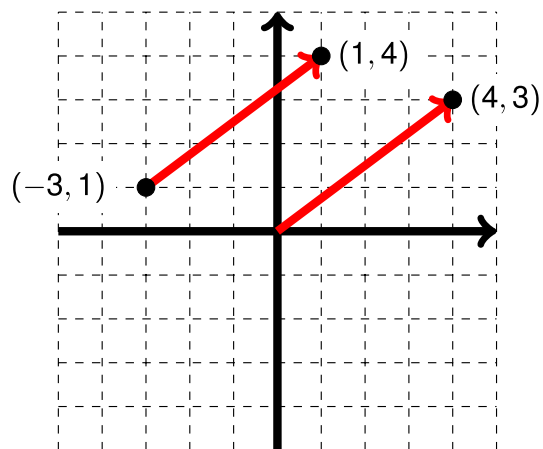
### Preliminaries

- Cartesian Coordinate System
- Vectors

### Objectives

- Add vectors
- Subtract vectors
- Scale vectors

## Location of Vectors



## Finding Vector Components

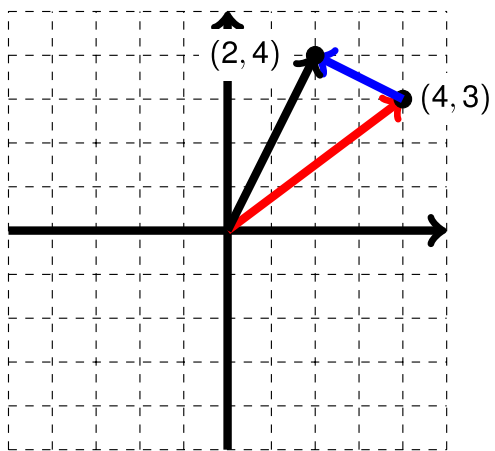
To find the vector  $\vec{v}$  that begins at  $(x_1, y_1)$  and ends at  $(x_2, y_2)$ , subtract the beginning coordinates from the ending coordinates.

$$\text{That is } \vec{v} = \langle x_2 - x_1, y_2 - y_1 \rangle$$

Example: If vector  $\vec{v}$  begins at  $(-3, 1)$  and ends at  $(1, 4)$ , then

$$\vec{v} = \langle 1 - (-3), 4 - 1 \rangle = \langle 4, 3 \rangle$$

## Adding Vectors



## Adding Vectors

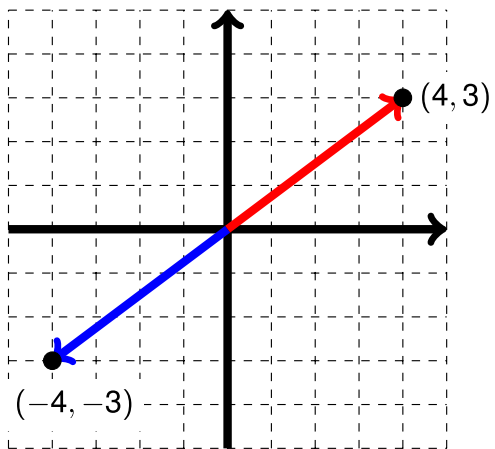
To add the vectors  $\vec{u} = \langle u_1, u_2 \rangle$  and  $\vec{v} = \langle v_1, v_2 \rangle$ , add the coordinates.

$$\text{That is } \vec{u} + \vec{v} = \langle u_1 + v_1, u_2 + v_2 \rangle$$

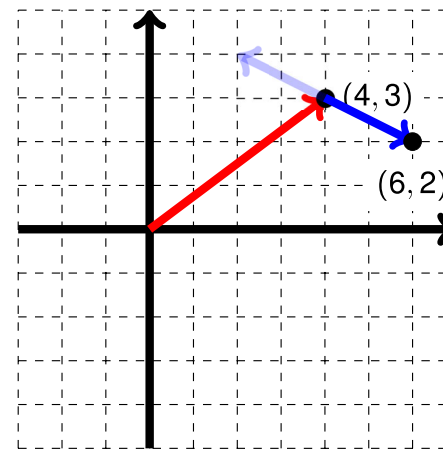
Example: If vector  $\vec{u} = \langle 4, 3 \rangle$  and  $\vec{v} = \langle -2, 1 \rangle$ , then

$$\vec{u} + \vec{v} = \langle 4 - 2, 3 + 1 \rangle = \langle 2, 4 \rangle$$

## The Opposite of a Vector



## Subtracting Vectors



## Subtracting Vectors

The opposite of  $\vec{u} = \langle u_1, u_2 \rangle$  is  $-\vec{u} = \langle -u_1, -u_2 \rangle$

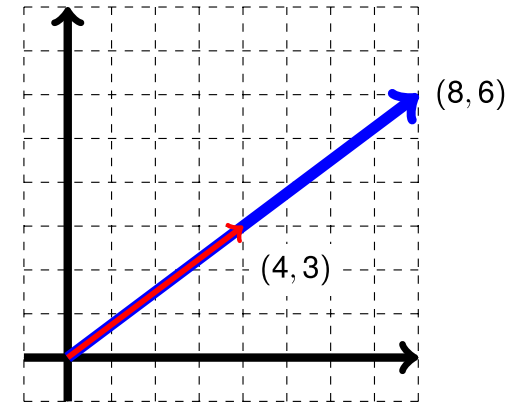
To subtract the vectors  $\vec{u} = \langle u_1, u_2 \rangle$  and  $\vec{v} = \langle v_1, v_2 \rangle$ , subtract the coordinates.

That is  $\vec{u} - \vec{v} = \langle u_1 - v_1, u_2 - v_2 \rangle$

Example: If vector  $\vec{u} = \langle 4, 3 \rangle$  and  $\vec{v} = \langle -2, 1 \rangle$ , then

$$\vec{u} - \vec{v} = \langle 4 - (-2), 3 - 1 \rangle = \langle 6, 2 \rangle$$

## Scaling Vectors



## Scaling Vectors

To find the vector that is  $k$  times as long as  $\vec{v} = \langle v_1, v_2 \rangle$ , multiply each coordinate of  $\vec{v}$  by  $k$

That is  $k\vec{v} = \langle kv_1, kv_2 \rangle$

Example: If vector  $\vec{v} = \langle 4, 3 \rangle$ , then

$$2\vec{v} = \langle 8, 6 \rangle$$

## Recap

Adding vectors:

$$\vec{u} + \vec{v} = \langle u_1 + v_1, u_2 + v_2 \rangle$$

Subtracting vectors:

$$\vec{u} - \vec{v} = \langle u_1 - v_1, u_2 - v_2 \rangle$$

Scaling vectors:

$$k\vec{v} = \langle kv_1, kv_2 \rangle$$