Adding and Subtracting Vectors
Preliminaries and Objectives

Preliminaries
- Cartesian Coordinate System
- Vectors

Objectives
- Add vectors
- Subtract vectors
- Scale vectors
Location of Vectors

University of Minnesota

Adding and Subtracting Vectors
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.

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 $(4, 3)$ and $(2, 4)$ results in the vector $(6, 7)$. The diagram illustrates the addition of these vectors graphically.
To add the vectors $\vec{u} = \langle u_1, u_2 \rangle$ and $\vec{v} = \langle v_1, v_2 \rangle$, add 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

$$\vec{u} + \vec{v} = \langle 4 - 2, 3 + 1 \rangle = \langle 2, 4 \rangle$$
The Opposite of a Vector

Adding and Subtracting Vectors
Subtracting Vectors

\[(4, 3) \- (6, 2)\]
The opposite of $\overrightarrow{u} = \langle u_1, u_2 \rangle$ is $-\overrightarrow{u} = \langle -u_1, -u_2 \rangle$.

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

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

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

$\overrightarrow{u} - \overrightarrow{v} = \langle 4 - (-2), 3 - 1 \rangle = \langle 6, 2 \rangle$.
Scaling Vectors

Adding and Subtracting 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:
\[ \overrightarrow{u} + \overrightarrow{v} = \langle u_1 + v_1, u_2 + v_2 \rangle \]

Subtracting vectors:
\[ \overrightarrow{u} - \overrightarrow{v} = \langle u_1 - v_1, u_2 - v_2 \rangle \]

Scaling vectors:
\[ k \overrightarrow{v} = \langle kv_1, kv_2 \rangle \]