3. Vector examples in 2 dimensions

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Vectors in 2D

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PROFESSOR: So we draw a vector as an arrow.

We'll say this is the vector v. And we can describe v

with numbers.

So this here is called v1.

And this here is called v2.

And then the vector v is going to be written [v1, v2].

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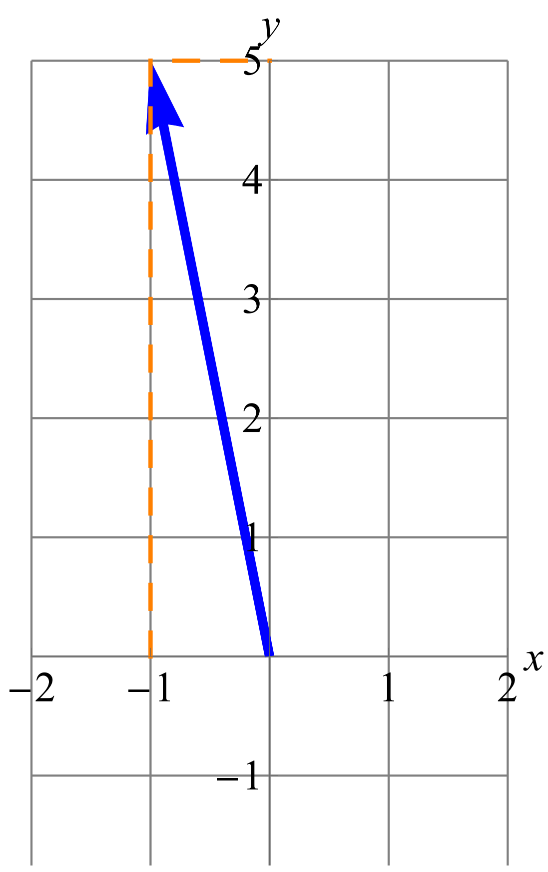
For now, we'll work with 2-dimensional vectors. Later in the course, we will discuss 3-dimensional and higher dimensional vectors. We will have some spoilers about these ideas in case you are interested now.

Example 3.1

The vector $\vec{v} = \langle -1, 5 \rangle$ is represented by an arrow starting at the origin and extending to the point in the coordinate plane given by $(x, y) = (-1, 5)$. The image below shows the vector in blue. The lengths of its components are indicated by the dashed orange lines.



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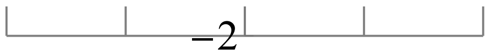
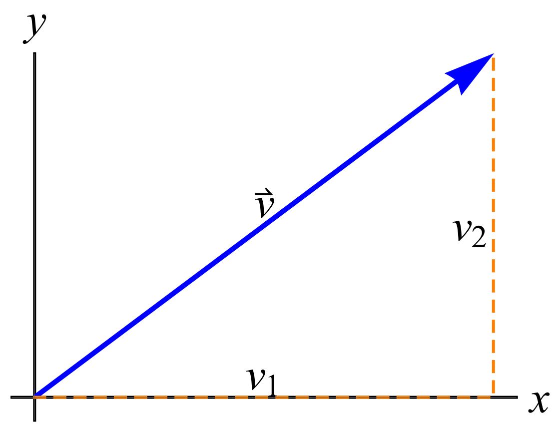


Example 3.2

Sometimes the components of a vector are described using variables or parameters. For example, a vector

$$\vec{v} = \langle v_1, v_2 \rangle$$

is shown below.



Spoiler: vectors in 3D

A vector in three dimensions has three components and can be written as

$$\vec{v} = \langle v_1, v_2, v_3 \rangle \quad (3.1)$$

or

$$\vec{v} = v_1 \hat{\imath} + v_2 \hat{\jmath} + v_3 \hat{k} \quad (3.2)$$

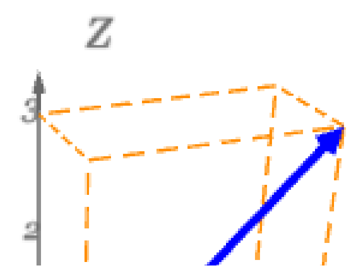
where $\hat{\imath}$, $\hat{\jmath}$, and $\hat{k}$ are the unit vectors in the x, y, and z directions, respectively. In other words,

$$\begin{aligned} \hat{\imath} &= \langle 1, 0, 0 \rangle \\ \hat{\jmath} &= \langle 0, 1, 0 \rangle \\ \hat{k} &= \langle 0, 0, 1 \rangle. \end{aligned}$$

Example 3.3

The vector $\vec{v} = \langle 1, 2, 3 \rangle$ is represented by an arrow starting at the origin and extending to the point in the coordinate system given by $(x, y, z) = (1, 2, 3)$. The image below shows the vector in blue. The lengths of its components are indicated by the dashed orange lines.

▶ VECTOR IN 3 DIMENSIONS



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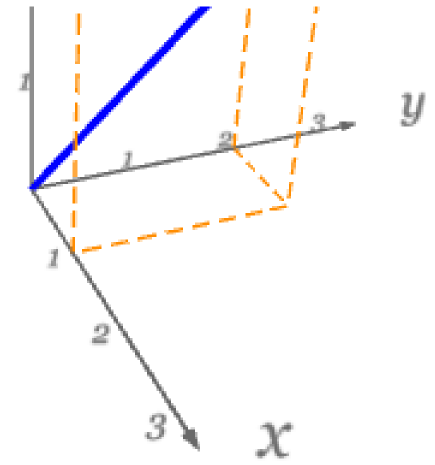

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A note about notation:

In this course, Professor Larry Guth uses the notation

$$\vec{v} = (v_1, v_2)\,.$$

In this text and in videos with Professor Denis Auroux, we use the notation

$$\vec{v} = \langle v_1, v_2 \rangle$$

to clarify any ambiguity between when we are talking about points or vectors.

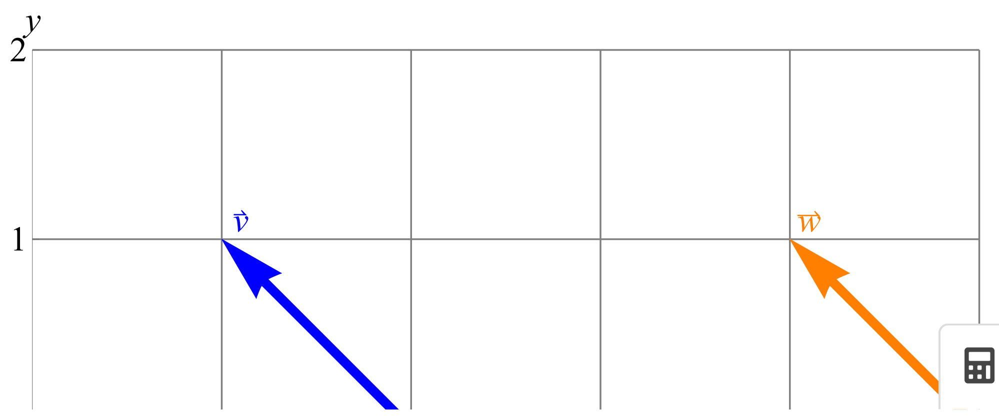
Other common notation:

$$\begin{aligned} \vec{v} &= \langle v_1, v_2 \rangle \\ \vec{v} &= [\, v_1, v_2 \,] \\ \vec{v} &= \begin{pmatrix} v_1 \\ v_2 \end{pmatrix} \\ \vec{v} &= v_1 \hat{i} + v_2 \hat{j}, \end{aligned}$$

where $\hat{\mathbf{i}}$ and $\hat{\mathbf{j}}$ are the unit vectors in the x and y directions, respectively. In other words,

$$\begin{aligned} \hat{i} &= \langle 1, 0 \rangle \\ \hat{j} &= \langle 0, 1 \rangle. \end{aligned}$$

The vector $\vec{v}$ in the above example was drawn starting at the origin. But vectors do not have to start at the origin.



In the above picture,

$$\vec{v} = \langle -1, 1 \rangle$$

where the -1 represents the change in the x coordinate and the 1 represents the change in the y coordinate. We also have

$$\vec{w} = \langle -1, 1 \rangle = \vec{v}.$$

Two vectors are equal if they have the same magnitude (or length) and point in the same direction.

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Voice almost inaudible...
In my laptop, in professor Guth videos, his voice is almos inaudible at top sound settings. This is not the case with other videos of th... 5

? [Staff] Small typo
In the text in "other common notation" section should be "in the x and y directions" instead of "in the xand y directions". Space need... 2

Subtitle Mistake
The subtitles say > What does it mean for two factors to be equal to each other? When it should say >What does it mean for two *ve... 2

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