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## 6. Unit vectors

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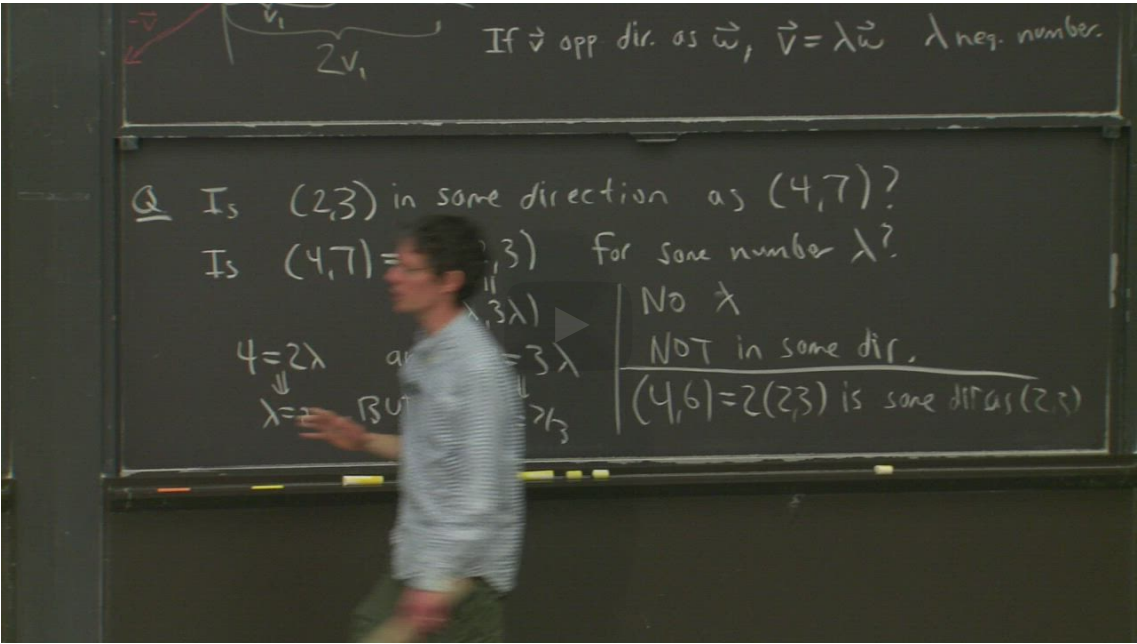
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Explore

Vectors with unit length

Start of transcript. Skip to the end.



PROFESSOR: Here's another very common example of a question about vectors in the same direction. It's the problem of finding a vector in a given direction with a given length. So-- suppose we have to find a vector-- find a unit vector-- I'll remind everybody what that is in a

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Definition 6.1

A vector  $\vec{v}$  is a **unit vector** if  $|\vec{v}| = 1$

**Note on notation:** If  $\vec{v}$  is any vector, then  $\hat{v}$  is a unit vector pointing in the same direction as  $\vec{v}$ .

**Example 6.2** Find a unit vector in the same direction as  $\langle 2, 1 \rangle$ .

**Solution:** We want to find

$$\hat{v} = \lambda \langle 2, 1 \rangle$$

where we choose  $\lambda$  so that  $|\hat{v}| = 1$ . So we want

$$1 = |\hat{v}| \tag{3.12}$$

$$= |\lambda \langle 2, 1 \rangle| \tag{3.13}$$

$$= \lambda |\langle 2, 1 \rangle|$$

$$= \lambda\sqrt{5} \implies \lambda = \frac{1}{\sqrt{5}}.$$

(3.15)

So

$$\hat{v} = \frac{1}{\sqrt{5}}\langle 2, 1 \rangle.$$

## A formula for unit vectors

1.0/1 point (graded)

Find a unit vector that points in the same direction as a nonzero vector  $\langle v_1, v_2 \rangle$ .

(Enter you answer as a vector with two components inside square brackets, e.g. `[a,b]` for  $\langle a, b \rangle$ , or as a scalar multiple times a vector, e.g. `2*[1,1]` . Type `v_1` for  $v_1$  and `v_2` for  $v_2$ .)

1/sqrt(v\_1^2+v\_2^2)\*[v\_1, v\_2]

✔ Answer: (1/sqrt(v\_1^2+v\_2^2))\*[v\_1,v\_2]

### Solution:

We want to find a vector

$$\hat{v} = \lambda \langle v_1, v_2 \rangle,$$

where we choose  $\lambda$  so that  $|\hat{v}| = 1$ .

Thus we want

$$1 = \lambda |\langle v_1, v_2 \rangle|$$

(3.16)

$$= \lambda \sqrt{v_1^2 + v_2^2} \implies \boxed{\lambda = \frac{1}{\sqrt{v_1^2 + v_2^2}}}$$

(3.17)

Therefore

$$\hat{v} = \frac{1}{\sqrt{v_1^2 + v_2^2}} \langle v_1, v_2 \rangle$$

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📘 Answers are displayed within the problem

## 6. Unit vectors

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? <u>Sign</u>	Can this formula for the unit vector be plus or minus?	3
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