14. Perpendicular vectors

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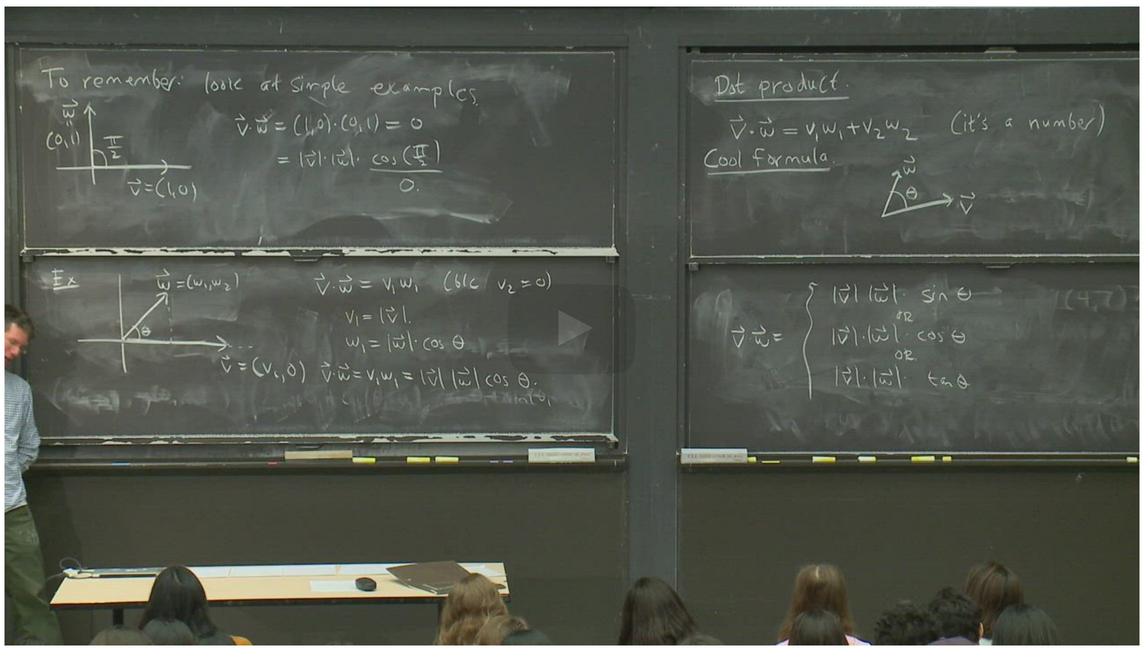
Lecture due Aug 18, 2021 20:30 IST Completed

Synthesize

Perpendicular vectors



0:00 / 0:00 2.0x

Start of transcript. Skip to the end.

PROFESSOR: We'll talk a bunch, well,

over the course over many days about why

this is useful and important.

One comment is that if we know v and w

and we'd like to find the angle between them,

this is a good way to do it because it's easy to find--

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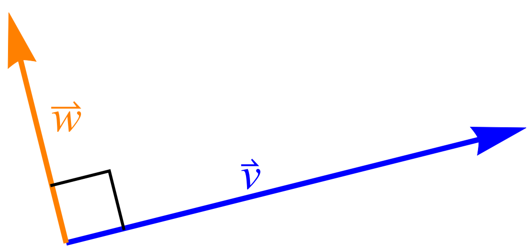
If we have two perpendicular vectors, then the angle between them is $\theta = \dfrac{\pi}{2}$ and so we get

$$\vec{v} \cdot \vec{w} = |\vec{v}||\vec{w}| \cos(\pi/2) = 0.$$



Similarly, if the dot product is zero, the angle between two vectors must be $\pm\pi/2$. This gives us a definition of what it means for two vectors to be perpendicular.

Theorem A vector $\vec{v}$ is **perpendicular** to a vector $\vec{w}$ if and only if $\vec{v} \cdot \vec{w} = 0$.

Example 14.2 Let $\vec{v} = \langle 1, 0 \rangle$ and $\vec{w} = \langle 0, 5 \rangle$. Then

$$\vec{v} \cdot \vec{w} = \langle 1, 0 \rangle \cdot \langle 0, 5 \rangle = (1)(0) + (0)(5) = 0. \quad (3.49)$$

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Dot product concept check

1/1 point (graded)

Let $\vec{v} = \langle 2, 1 \rangle$ and $\vec{w} = \langle -1, 1 \rangle$. True or False: The vectors $\vec{v}$ and $\vec{w}$ are perpendicular.

- True
- False ✔

Solution:

We have

$$\vec{v} \cdot \vec{w} = \langle 2, 1 \rangle \cdot \langle -1, 1 \rangle = (2)(-1) + (1)(1) = -2 + 1 = -1 \neq 0. \quad (3.50)$$

Since $\vec{v} \cdot \vec{w} \neq 0$, we can conclude that the two vectors are not perpendicular.

Submit You have used 1 of 1 attempt

Answers are displayed within the problem

Find a perpendicular vector

1.0/1 point (graded)

Find a vector $\vec{v}$ perpendicular to $\langle 2, 3 \rangle$.

(Enter vector as a pair of values between square brackets: e.g. type **[a,b]** for $\langle a, b \rangle$.)

[-3,2] ✔ **Answer:** [-3,2]

Solution:

$$0 = \vec{v} \cdot (2, 3) = 2v_1 + 3v_2.$$

Therefore if say $v_2 = 2$, then $v_1 = -3$. Note there are infinitely many solutions, but all solutions point in the same direction as the vector $\langle -3, 2 \rangle$.

Submit You have used 1 of 10 attempts

Answers are displayed within the problem

14. Perpendicular vectors

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? Perpendicular vectors finding issue 4
Is there a more systematic way to solve for perpendicular method except hit and trial?

Calculator Hide Notes

[staff] typo in equation 3.50 3

? Solution to Find a perpendicular vector 4
The solution mentions that all solutions point in the same direction as the vector ... Obviously, vectors pointing in the opposite directi...

? Zero vector 6
Is the zero vector perpendicular to any other vector, including itself?

? 14. Perpendicular vectors 3
So is it a definition or a theorem? *"This gives us a definition of what it means for two vectors to be perpendicular."*

[STAFF] error in solution for Dot Product Concept Check 2
Staff, could you please correct the final sentence of the worked solution for "Dot Product Concept Check"? It makes the wrong concl...

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