Trig 8.4

Find the inner (dot) product of 2 vectors
Determine the cross product of 2 vectors
Determine whether 2 vectors are perpendicular

product X

perpendicular ⊥ meet @ 90° opp & recip. slope

dot product (inner product)

determinant
of a 2x2 matrix
of a 3x3 matrix

$$\begin{vmatrix} 2 & 5 & 3 \\ 1 & 4 & 7 \\ 3 & 8 & 8 \end{vmatrix}$$

☆ expansion by minors

Cross product (vector)

It's a slope thing...

$<a_1, a_2>$ $<b_1, b_2>$

$a_1b_1+a_2b_2=0$

perp.

Ex. <3,5> and <-5,3>

a_1 a_2 b_1 b_2

$3 \cdot -5$ $5 \cdot 3$

$-15 + 15 = 0$

$\vec{r} \cdot \vec{t}$

dot

Find each inner product and state whether the vectors are perpendicular. Write ***yes*** **or** ***no.***

4. $\langle 5, 2\rangle \cdot \langle -3, 7\rangle$

$-15 + 14$

not ⊥

5. $\langle -8, 2\rangle \cdot \langle 4.5, 18\rangle$

$-36 + 36$

0 ⊥

6. $\langle -4, 9, 8\rangle \cdot \langle 3, 2, -2\rangle$

$-12 + 18 - 16$

not ⊥

3x3 determinant
(lesson 2.5)
cofactor method...

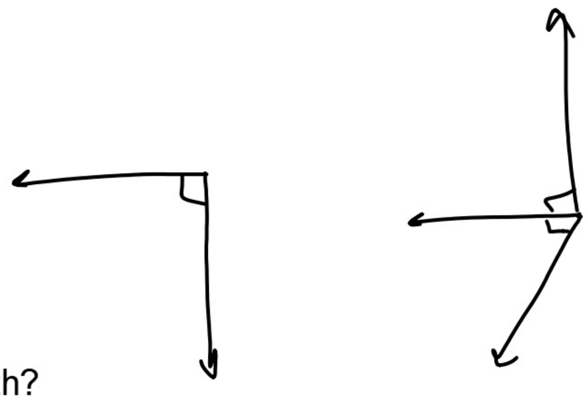
+	−	+
−	+	−
+	−	+

1	3	0
-1	2	4
6	0	5

Smaller det

~~Did we do this? (asking...)~~

What would it look like for 3 lines to all be perpendicular to each other?



demo spaghetti
perpendicular to both?

$\vec{a} \cdot \vec{b}$ are they ⊥

Cross Product of Vectors in Space

$\vec{a} \times \vec{b}$

If $\vec{a} = \langle a_1, a_2, a_3 \rangle$ and $\vec{b} = \langle b_1, b_2, b_3 \rangle$, then the cross product of $\vec{a}$ and $\vec{b}$ is defined as follows.

$$\vec{a} \times \vec{b} = \begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} \vec{i} - \begin{vmatrix} a_1 & a_3 \\ b_1 & b_3 \end{vmatrix} \vec{j} + \begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix} \vec{k}$$

$\vec{a} \times \vec{b}$

$\vec{a} = 2, 5, 3$

$\vec{b} = 1, 0, -1$

$+ - +$

$- + -$

$+ - +$

3x3 matrix...

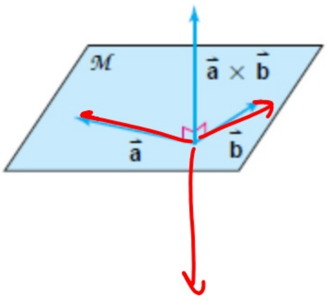
$\vec{i}$	$\vec{j}$	$\vec{k}$
2	5	3
1	0	-1

$$+\vec{i}\begin{vmatrix} 5 & 3 \\ 0 & -1 \end{vmatrix} - \vec{j}\begin{vmatrix} 2 & 3 \\ 1 & -1 \end{vmatrix} + \vec{k}\begin{vmatrix} 2 & 5 \\ 1 & 0 \end{vmatrix}$$

0, -5; 3, -2; 5, 0

$-5\vec{i} + 5\vec{j} - 5\vec{k}$ also + - + etc.

⊥ to both → $\langle -5, 5, -5 \rangle$



cross prod is vector perp to both
could be above the plane or below the plane

a) $\vec{V} \times \vec{W}$

3 Find the cross product of $\overline{\mathbf{v}}$ and $\overline{\mathbf{w}}$ if $\overline{\mathbf{v}} = \langle 0, 3, 1\rangle$ and $\overline{\mathbf{w}} = \langle 0, 1, 2\rangle$.
b) Verify that the resulting vector is perpendicular to $\overline{\mathbf{v}}$ and $\overline{\mathbf{w}}$.

$$\begin{matrix} \vec{i} & \vec{j} & \vec{k} \\ 0 & 3 & 1 \\ 0 & 1 & 2 \end{matrix} \quad +\vec{i}\begin{vmatrix} 3 & 1 \\ 1 & 2 \end{vmatrix} - \vec{j}\begin{vmatrix} 0 & 1 \\ 0 & 2 \end{vmatrix} + \vec{k}\begin{vmatrix} 0 & 3 \\ 0 & 1 \end{vmatrix}$$

1, 6; 0, 0; 0, 0

$\vec{c}$ * $5\vec{i} + 0\vec{j} + 0\vec{k} \leftrightarrow \langle 5, 0, 0\rangle$

$5\vec{i}$

Is $\bar{a} \times \bar{b} = \bar{b} \times \bar{a}$?

$\vec{V} \cdot \vec{c}$

$\langle 0\ 3\ 1\rangle \cdot \langle 5\ 0\ 0\rangle$

$0 + 0 + 0$

0

$\vec{w} \cdot \vec{c}$

$\langle 0, 1, 2\rangle \cdot \langle 5, 0, 0\rangle$

$0 + 0 + 0$

0

Find each cross product. Then verify that the resulting vector is perpendicular to the given vectors.

7. $\langle 1, -3, 2\rangle \times \langle -2, 1, -5\rangle$ **8.** $\langle 6, 2, 10\rangle \times \langle 4, 1, 9\rangle$

Are their dot products = 0?

sketch… hint: it is a plane

9. Find a vector perpendicular to the plane containing the points $(0, 1, 2)$, $(-2, 2, 4)$, and $(-1, -1, -1)$.