

## Section 1.2: cont'd

Friday, September 7, 2018 1:23 PM

dot product:

examples: calculate  $\vec{u} \cdot \vec{v}$  if  $\vec{u} = \begin{bmatrix} 1 \\ 5 \end{bmatrix}$ ,  $\vec{v} = \begin{bmatrix} -2 \\ 7 \end{bmatrix}$

$$\begin{aligned}\vec{u} \cdot \vec{v} &= (1)(-2) + (5)(7) \\ &= 33\end{aligned}$$

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example: consider the vectors  $\vec{u} = \begin{bmatrix} x \\ 0 \\ 1 \end{bmatrix}$  and  $\vec{v} = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}$

- Find the value of  $x$  if vectors  $\vec{u}$  and  $\vec{v}$  are perpendicular.
- Find all possible values of  $x$  if the angle between  $\vec{u}$  and  $\vec{v}$  is  $60^\circ$ .

a)  $\vec{u} \perp \vec{v}$  means  $\vec{u} \cdot \vec{v} = 0$  (why?  $\cos \theta = 0$ )

$$\begin{aligned}x + 2 &= 0 \\ x &= -2\end{aligned}$$

b)  $\vec{u} \cdot \vec{v} = \|\vec{u}\| \|\vec{v}\| \cos \theta$

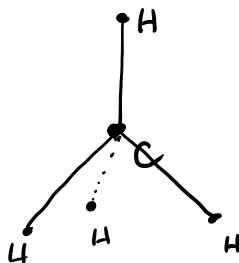
$$\vec{u} \cdot \vec{v} = x + 2$$

$$\|\vec{u}\| = \sqrt{x^2 + 1}$$

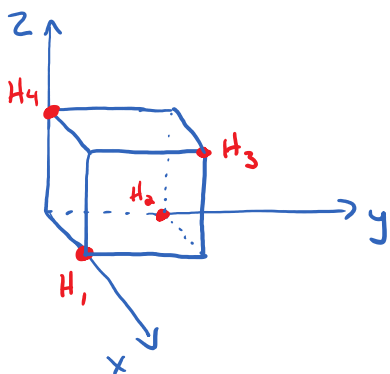
$$\|\vec{v}\| = \sqrt{9} = 3$$



- the Hs are evenly spaced around the C



What's the angle between the hydrogen bonds?



$$C = (1, 1, 1)$$

$$H_1 = (2, 0, 0)$$

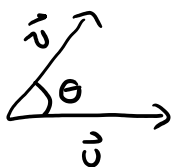
$$H_2 = (0, 2, 0)$$

$$\vec{CH}_1 = \begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix}, \quad \vec{CH}_2 = \begin{bmatrix} -1 \\ 1 \\ -1 \end{bmatrix}$$

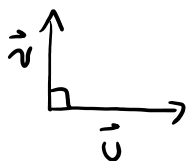
$$\begin{aligned} \cos \theta &= \frac{\vec{CH}_1 \cdot \vec{CH}_2}{\|\vec{CH}_1\| \|\vec{CH}_2\|} \\ &= \frac{-1}{\sqrt{3} \sqrt{3}} = -\frac{1}{3} \end{aligned}$$

$$\theta = 109.47^\circ$$

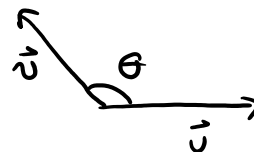
properties of the dot product:



$\theta$  is acute



$\theta$  is right



$\theta$  is obtuse

$\theta$  is acute

$$\vec{u} \cdot \vec{v} > 0$$

$\theta$  is right

$$\vec{u} \cdot \vec{v} = 0$$

$\theta$  is obtuse

$$\vec{u} \cdot \vec{v} < 0$$