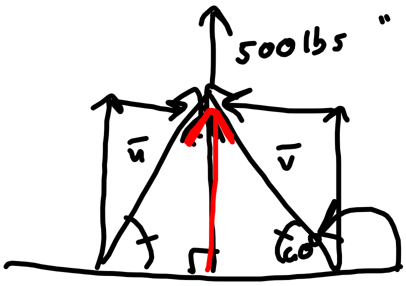


" = " $\langle 0, 500 \rangle$

$\bar{u} + \bar{v} = \langle 0, 500 \rangle$

$\bar{u} = \langle u_1, u_2 \rangle$

$u_2 = \|\bar{u}\| \sin 60^\circ = 250 \Longrightarrow \|\bar{u}\| = \frac{250 \cdot 2}{\sqrt{3}}$

$u_1 = \|\bar{u}\| \cos 60^\circ = ?$

$\|\bar{u}\| = \sqrt{u_1^2 + u_2^2}$

$\|\bar{u}\| = \|\bar{v}\|$

$\bar{u} + \bar{v} = \langle 0, 500 \rangle$

$\langle \|\bar{u}\| \cos 60^\circ, \|\bar{u}\| \sin 60^\circ \rangle + \langle \|\bar{v}\| \cos 120^\circ, \|\bar{v}\| \sin 120^\circ \rangle$

$= \|\bar{u}\| \left(\langle \frac{1}{2}, \frac{\sqrt{3}}{2} \rangle + \langle -\frac{1}{2}, \frac{\sqrt{3}}{2} \rangle \right)$

$= \|\bar{u}\| \langle 0, \sqrt{3} \rangle = \langle 0, 500 \rangle$

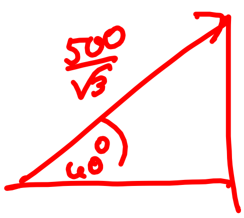
$\Longrightarrow \langle 0, \sqrt{3}\|\bar{u}\| \rangle = \langle 0, 500 \rangle$

$\Longrightarrow \|\bar{u}\| = \frac{500}{\sqrt{3}}$

$\bar{u} = \langle u_1, u_2 \rangle$

$\|\bar{u}\| = \sqrt{u_1^2 + u_2^2} = \frac{500}{\sqrt{3}}$

u_1 & u_2 from trig



Recall $\bar{a} = \langle a_1, a_2, a_3 \rangle$

$\bar{b} = \langle b_1, b_2, b_3 \rangle$

$$\Longrightarrow \bar{a} \cdot \bar{b} = a_1 b_1 + a_2 b_2 + a_3 b_3 = \sum_{k=1}^{3} a_k b_k$$

$$\bar{a} \cdot \bar{b} = \sum_{k=1}^{20} a_k b_k$$

$$a_{11} x_1 + a_{12} x_2 + a_{13} x_3 + \cdots + a_{1,10} x_{10} = 29$$

$$a_{21} x_1 + a_{22} x_2 + a_{23} x_3 + \cdots + a_{2,10} x_{10} = 50$$

$$\bar{x} = \langle x_1, x_2, x_3, \ldots, x_{10} \rangle$$

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1,10} \\ a_{21} & a_{22} & \cdots & a_{2,10} \\ \vdots & & & \\ a_{10,1} & a_{10,2} & \cdots & a_{10,10} \end{bmatrix}$$

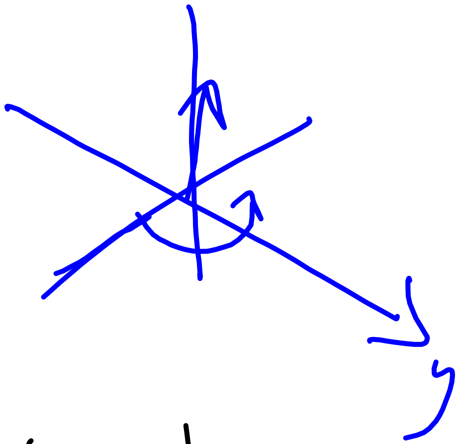
$\bar{b} = \langle 29, 50, \ldots, 71 \rangle$

$\boxed{\bar{x} \cdot \bar{b} =}$ Never comes up.

$x_1 \cdot 29 + x_2 \cdot 50 + \cdots + x_{10} \cdot 71$

$\bar{a} \perp \bar{b}$ iff $\bar{a} \cdot \bar{b} = 0$
$\Longleftrightarrow$

$$\cos\theta = \frac{\bar{a} \cdot \bar{b}}{\|\bar{a}\| \, \|\bar{b}\|}$$



New! Cross Product

Right-hand rule

$\bar{u} \times \bar{v}$ is orthogonal to $\bar{u}$ & $\bar{v}$

determined by right-hand rule.
curl fingers from $\bar{u}$ to $\bar{v}$ & thumb points to $\bar{u} \times \bar{v}$

Determinants

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

$$|A| = ad - bc$$

$$A = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} \quad \begin{bmatrix} + & - & + \\ - & + & - \\ + & - & + \end{bmatrix}$$

$$a(ei - fh) - b(di - fg) + c(dh - eg)$$

$\bar{u} = \langle u_1, u_2, u_3 \rangle$, $\bar{v} = \langle v_1, v_2, v_3 \rangle$

Then $\bar{u} \times \bar{v} = \begin{vmatrix} i & j & k \\ u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \end{vmatrix}$

$$= (u_2 v_3 - u_3 v_2)\bar{i} - (u_1 v_3 - u_3 v_1)\bar{j} + (u_1 v_2 - u_2 v_1)\bar{k}$$

$$= \langle u_2 v_3 - u_3 v_2, -(u_1 v_3 - u_3 v_1), (u_1 v_2 - u_2 v_1) \rangle$$

$$\begin{array}{ccccc} u_1, & u_2, & u_3, & u_1, & u_2 \\ v_1, & v_2, & v_3, & v_1, & v_2 \end{array}$$

$$\langle u_2 v_3 - u_3 v_2, -(u_3 v_1 - u_1 v_3), u_1 v_2 - u_2 v_1 \rangle$$

12.4 #s 1-4, 9, 10, 13-19, 25, 27, 29, 33, 35, 37, 39

#15 is a trick