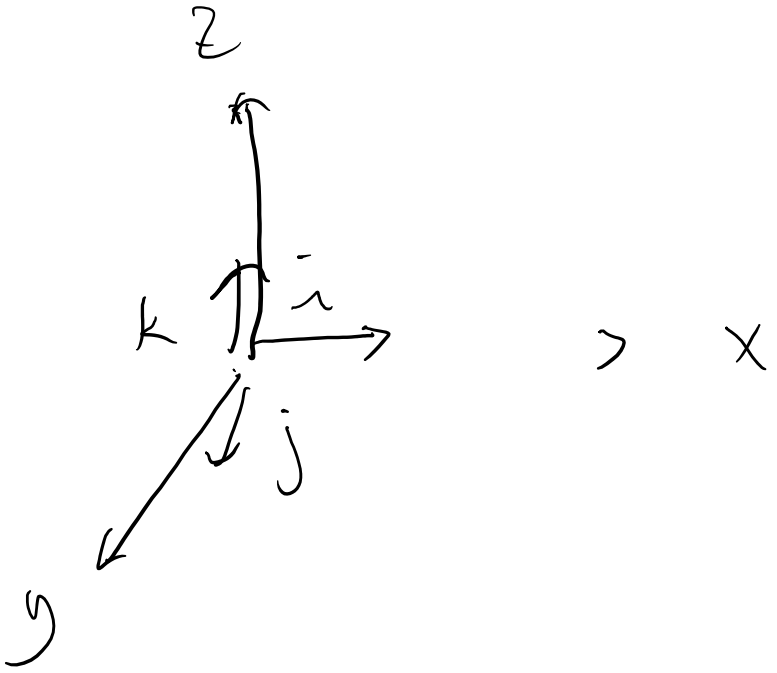
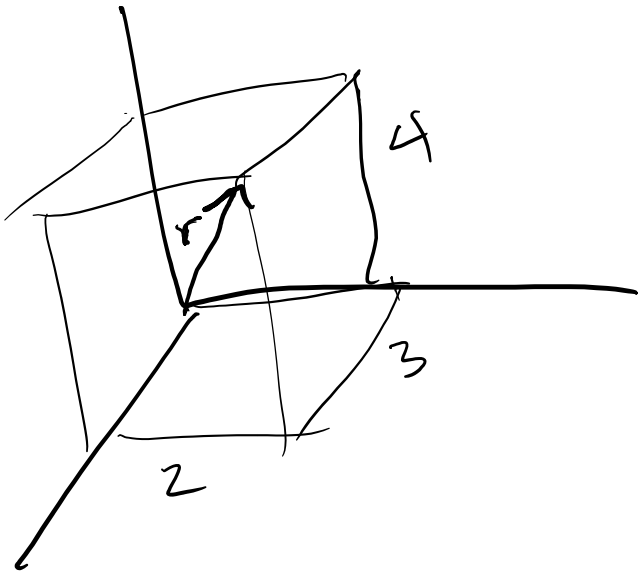


i, j, k are unit vectors.

$\hat{i} = \langle 1, 0, 0 \rangle$

$\hat{j} = \langle 0, 1, 0 \rangle$

$\hat{k} = \langle 0, 0, 1 \rangle$



$r = \langle 3, 2, 4 \rangle$

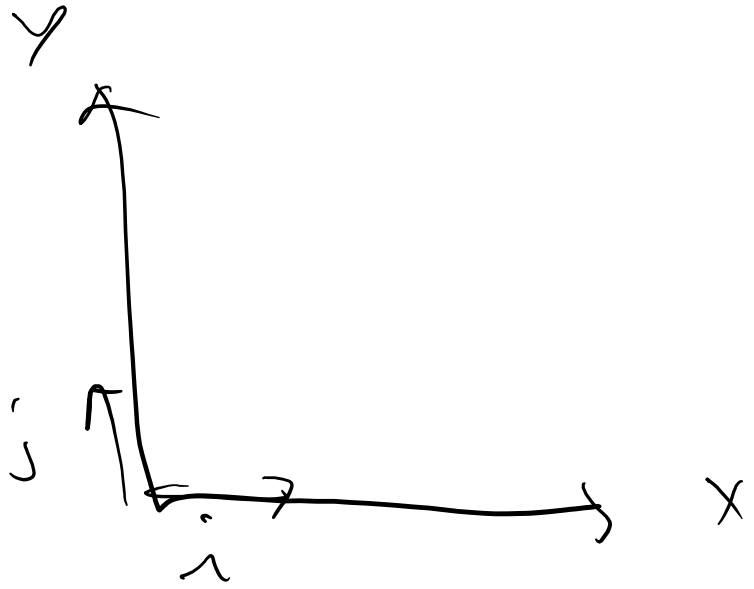
$r = 3i + 2j + 4k$

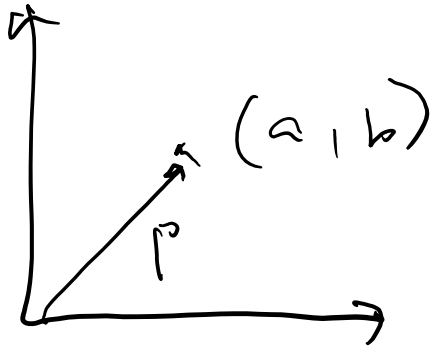
$= 3\langle 1, 0, 0 \rangle + 2\langle 0, 1, 0 \rangle + 4\langle 0, 0, 1 \rangle$

$= \langle 3, 0, 0 \rangle + \langle 0, 2, 0 \rangle + \langle 0, 0, 4 \rangle$

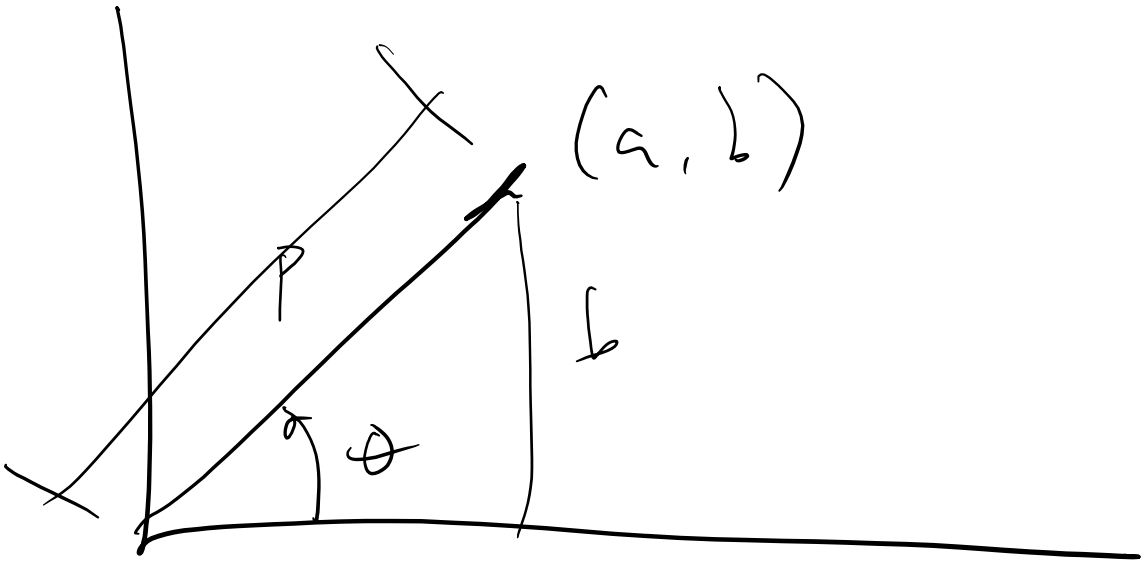
$r = \langle 3, 2, 4 \rangle$

$r = \langle 3, 2, 4 \rangle$





$p = \langle a, b \rangle = a\,i + b\,j$

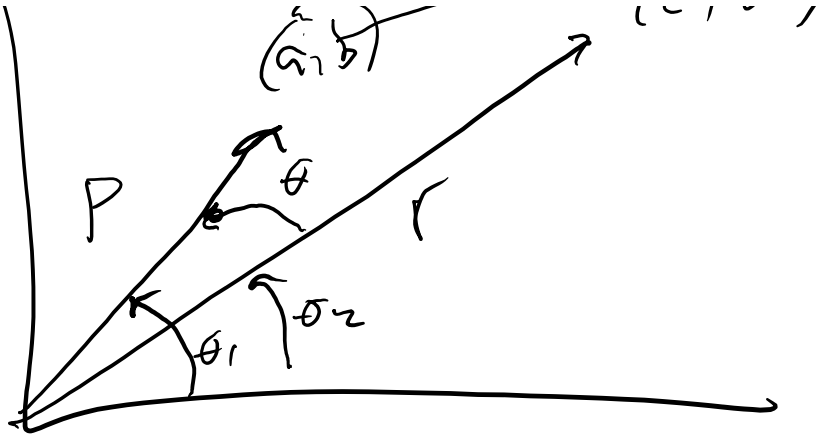


$$\tan\theta = \frac{b}{a}$$

$$|p| = \sqrt{a^2 + b^2}$$

$$\cos\theta = \frac{a}{|p|}$$

$$\sin\theta = \frac{b}{|p|}$$



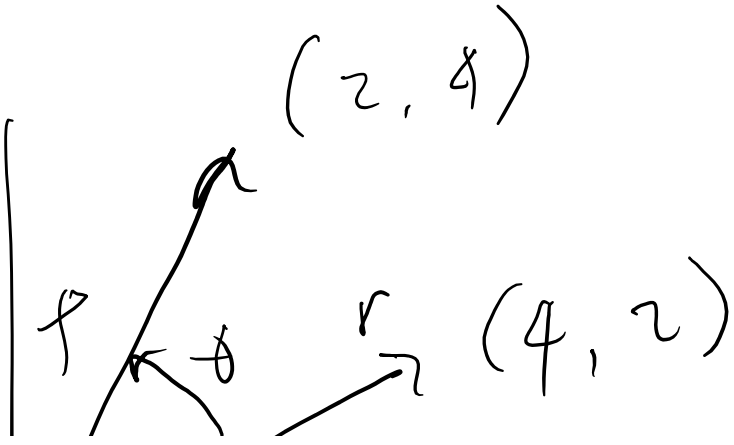
$\theta = \theta_1 - \theta_2$

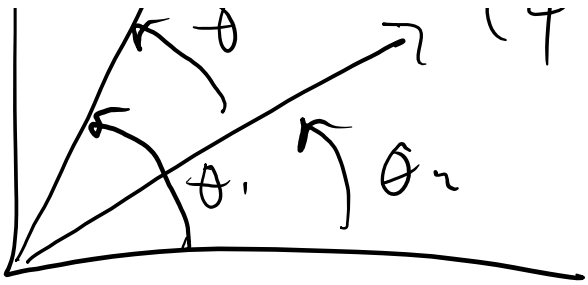
$$p \cdot r = |p| \, |r| \cos\theta$$

Given $p, r \rightarrow |p|, |r|$

$\rightarrow p \cdot r \rightarrow \theta = ?$

$p \cdot r = ac + bd$





$p \cdot r = 8 + 8 = 16$

$|p| = \sqrt{20} = |r|$

$p \cdot r = |p|\,|r| \cos\theta$

$16 = \sqrt{20}\sqrt{20}\cos\theta$

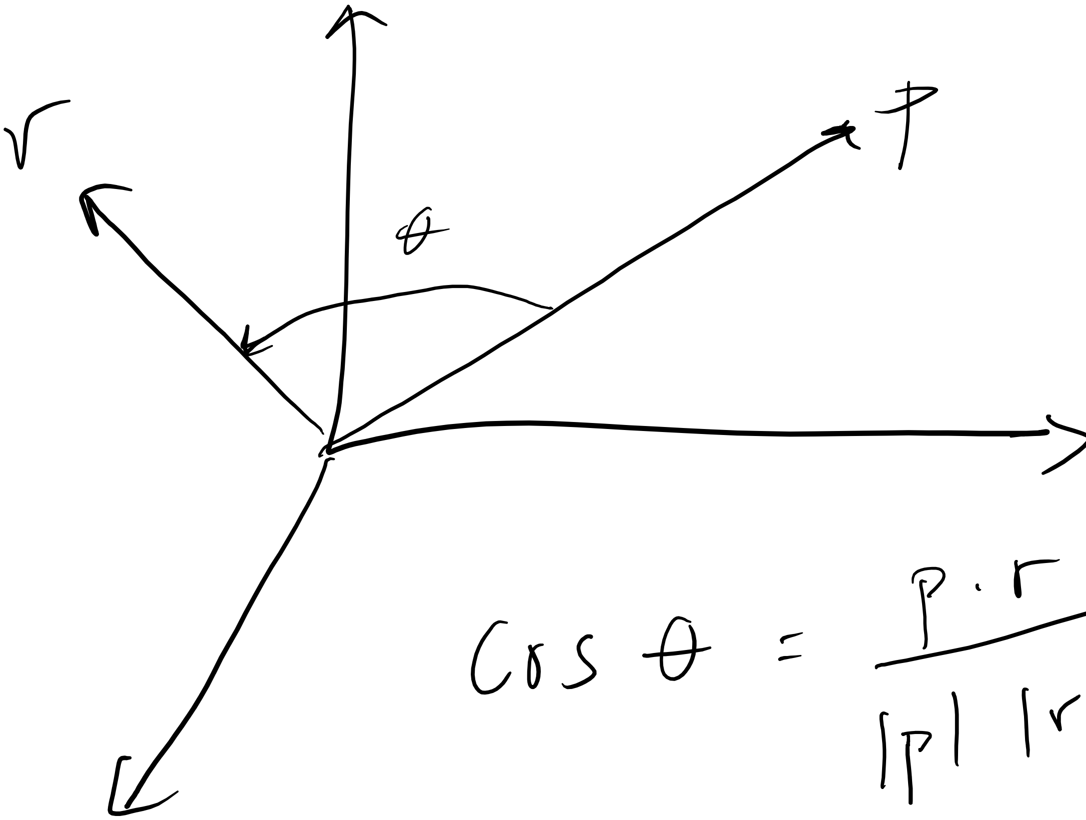
$\frac{16}{20} = \cos\theta$

$\theta = \cos^{-1}(4/5)$ ✓✓

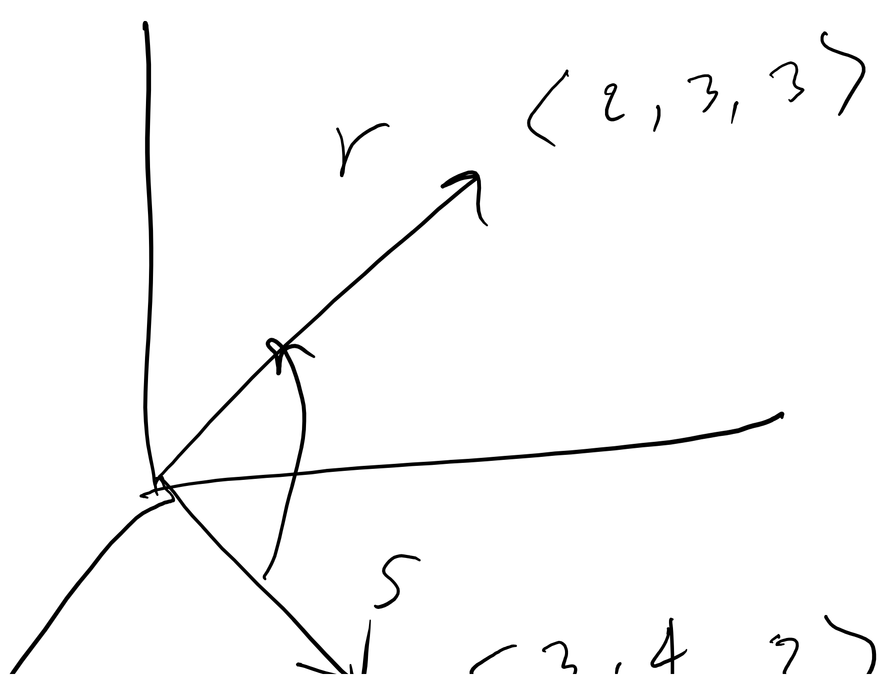
$\cos\theta_1 = \frac{2}{\sqrt{20}} \rightarrow \theta_1 = \cos^{-1}\left(\frac{2}{\sqrt{20}}\right)$

$\cos\theta_2 = \frac{4}{\sqrt{20}} \rightarrow \theta_2 = \cos^{-1}\left(\frac{4}{\sqrt{20}}\right)$

cos θ 2 $\sqrt{20}$



$$\cos\theta = \frac{p \cdot r}{|p|\,|r|}$$



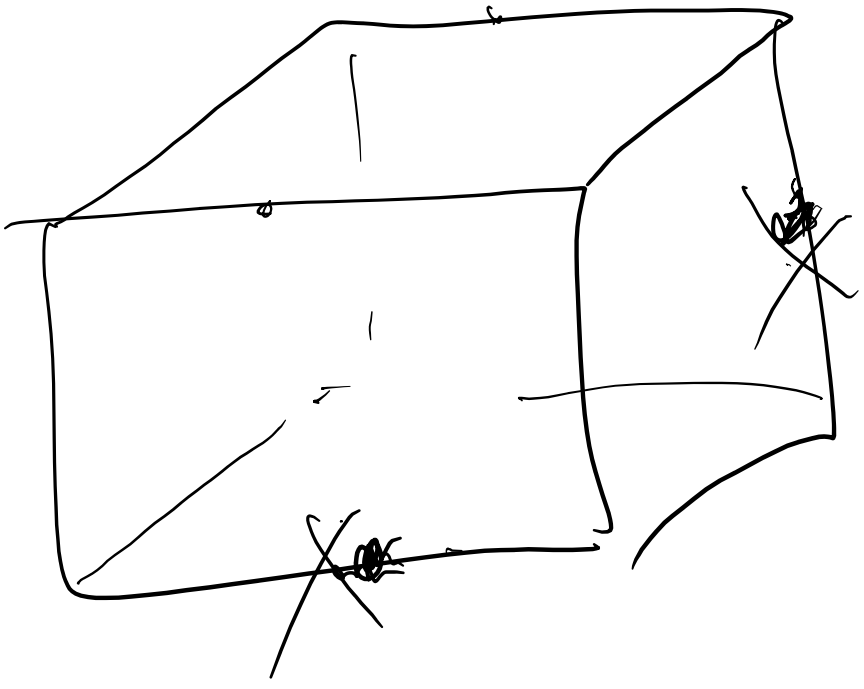
$\langle 3, 4, 2 \rangle$

$r \cdot s = 6 + 12 + 6 = 24$

$|r| = \sqrt{4+9+9} = \sqrt{22}$

$|s| = \sqrt{9+16+4} = \sqrt{29}$

$\cos\theta = \dfrac{24}{\sqrt{22 \cdot 29}}$ ✓



Angle Bw A of A & B

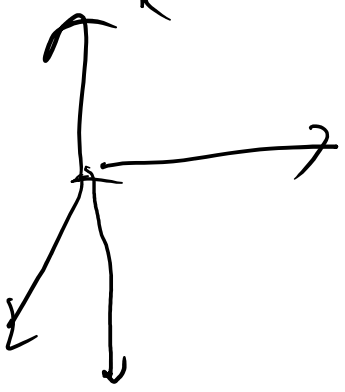
Cross Product of A & B

$A \times B$ = Vector ⊥ to both A & B.

$A = \langle a_1, a_2, a_3 \rangle$

$B = \langle b_1, b_2, b_3 \rangle$

$i \times j = k$



$j \times k = i$

$k \times i = j$

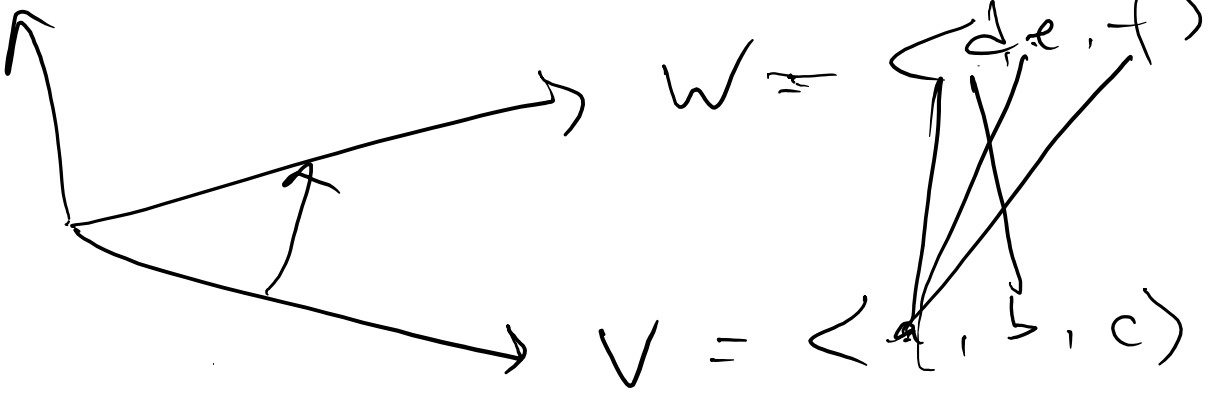
$i \cdot i = 1$

$\hat{i} \times \hat{j} = \hat{k}$

$\hat{k} \times \hat{j} = -\hat{i}$

$\hat{i} \times \hat{k} = -\hat{j}$

$V \times W$



$V \times W = ad(\hat{i} \times \hat{i}) + ae(\hat{i} \times \hat{j}) + af(\hat{i} \times \hat{k}) + bd(\hat{j} \times \hat{i}) + \dots$