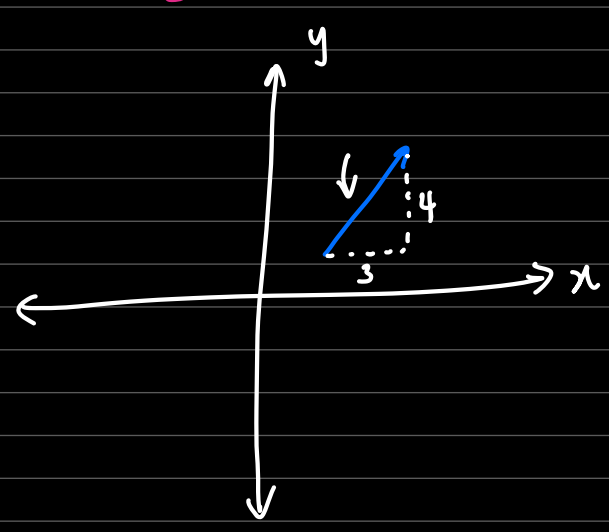
STARTING AT

3:03 PM (eastern)

Vectors



$$\begin{bmatrix} 3 \\ 4 \end{bmatrix}$$

$$\sqrt{3^2 + 4^2}$$

$$\begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$$

for Quantum: $|\uparrow\rangle$ $|\downarrow\rangle$

$$\begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

Vector Spaces

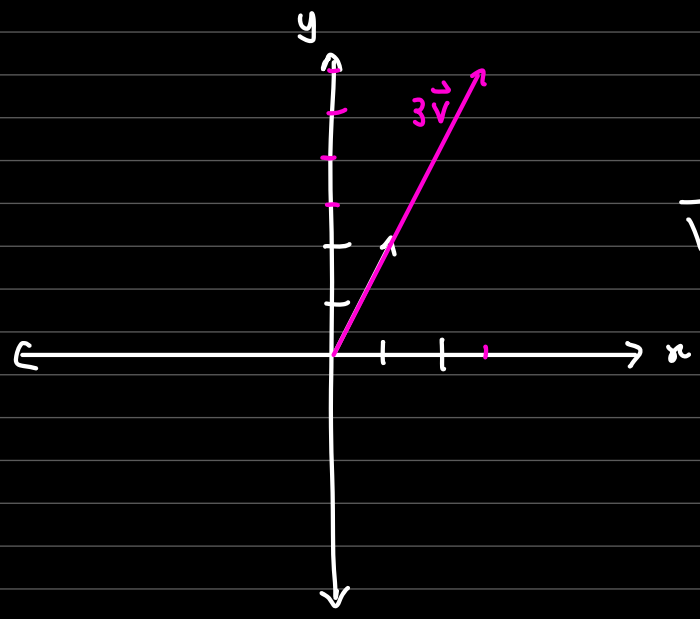
Every vector space has :

* zero vector $\quad \vec{0} \cdot \vec{v} = 0$
* identity vector $\quad I \cdot \vec{v} = \vec{v}$

Every vector space must define :

* vector addition : $\quad \begin{bmatrix} a \\ b \end{bmatrix} + \begin{bmatrix} c \\ d \end{bmatrix} = \begin{bmatrix} a+c \\ b+d \end{bmatrix}$

* Scalar multiplication: $\alpha \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} \alpha a \\ \alpha b \end{bmatrix}$



$\vec{v} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$ $\quad 3\vec{v} = 3\begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 3 \\ 6 \end{bmatrix}$

Linear Combinations:

$a_1 \vec{v} + a_2 \vec{u}$

$\vec{v} = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$ $\quad \vec{u} = \begin{bmatrix} 1 \\ 8 \end{bmatrix}$

linear combination:

$$2\vec{v} + 3\vec{u} = 2\begin{bmatrix} 3 \\ 1 \end{bmatrix} + 3\begin{bmatrix} 1 \\ 8 \end{bmatrix} = \begin{bmatrix} 9 \\ 26 \end{bmatrix}$$

Multiplying Vectors

* inner product ('dot product')
* cross product
* tensor product

Inner Product: $\begin{bmatrix} a \\ b \end{bmatrix} \cdot \begin{bmatrix} c \\ d \end{bmatrix} = \underbrace{a \cdot c + b \cdot d}_{\text{scalar.}}$

(dot → scalar)