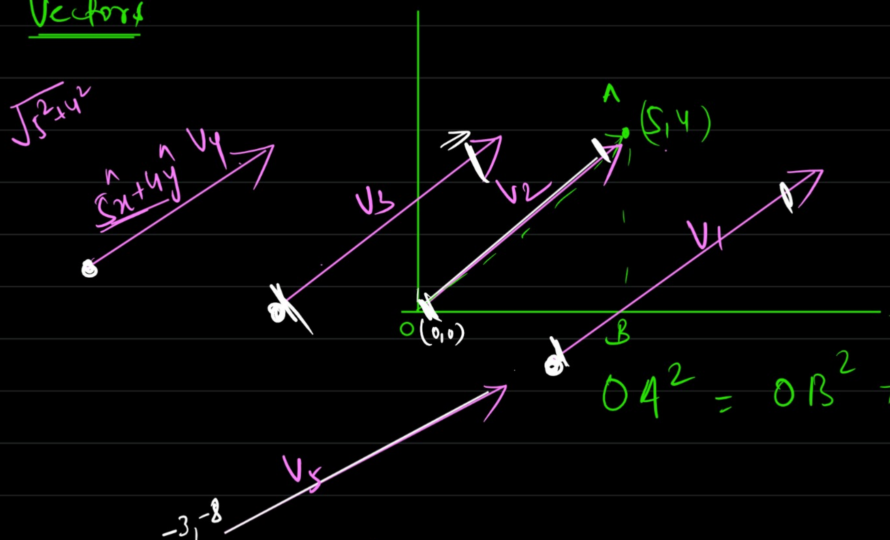
Vectors

$W^T x + b = 0$



$5\hat{x} + 4\hat{y}$

$\Downarrow$

$\begin{bmatrix} 5 \\ 4 \end{bmatrix} \rightarrow 5\hat{x}+4\hat{y}$

$OA^2 = OB^2 + AB^2$

* There can be multiple vectors in the space of same magnitude & direction; the origin is different.

Operations on Vectors

(addn)

$\mathbb{R}^2 \rightarrow$ 2d space.

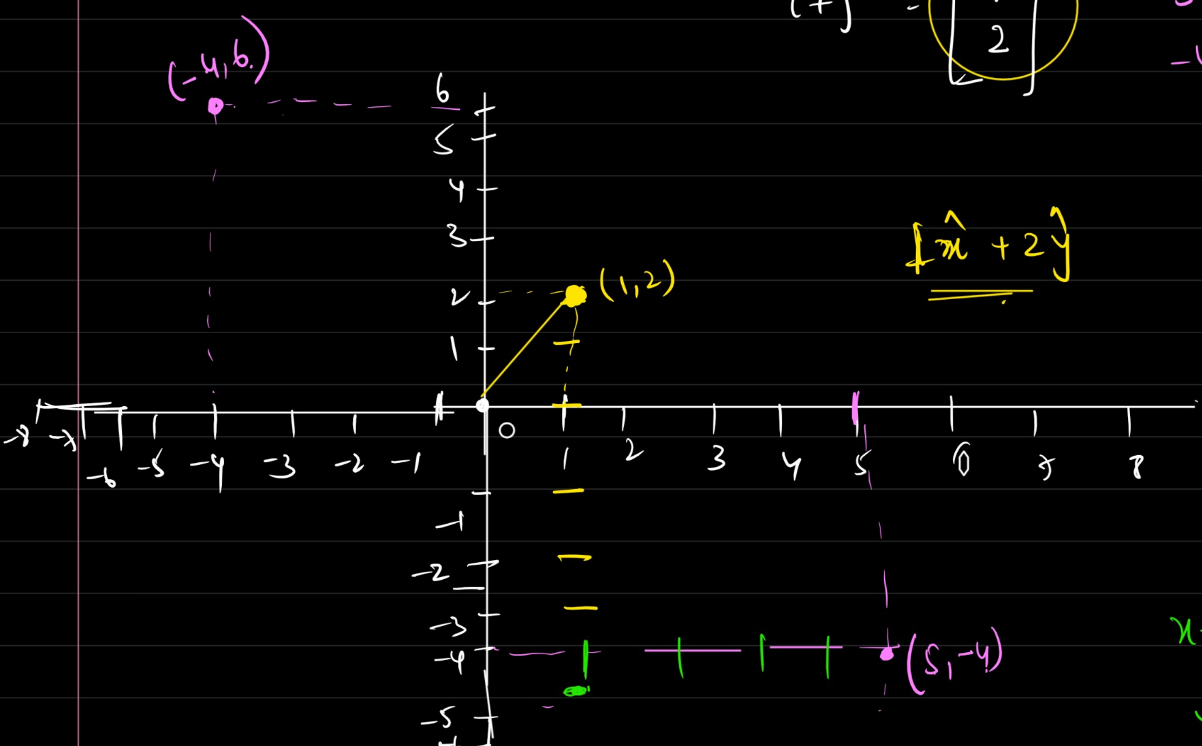
$i, j \in \mathbb{R}^2$

$\vec{i} = \begin{bmatrix} 5 \\ -4 \end{bmatrix}, \quad \vec{j} = \begin{bmatrix} -4 \\ 6 \end{bmatrix}$

$\vec{i} + \vec{j} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$

$5 + (-4) \Rightarrow 1$

$-4 + (6) \quad 2$

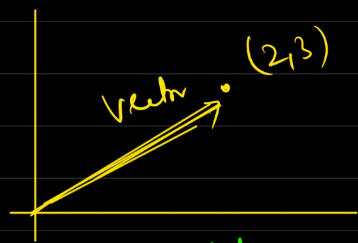


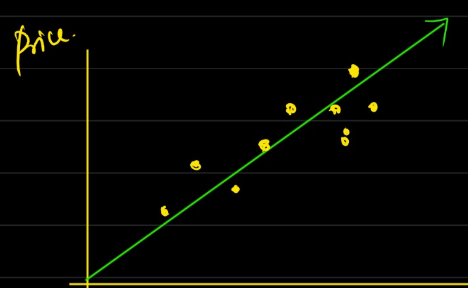
$1\hat{x} + 2\hat{y}$

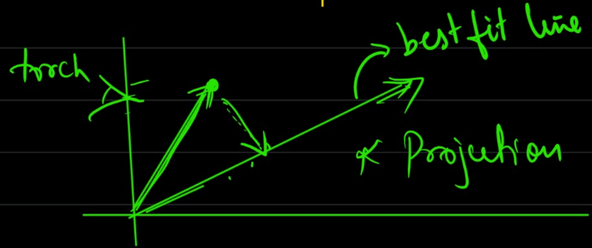
x-direction $5 + (-4)$

y-dir $-4 \rightarrow 6$ on top

Projection (Shadow)







* Projection of a dp will be smaller than best fit line but in same direction"

No of rooms

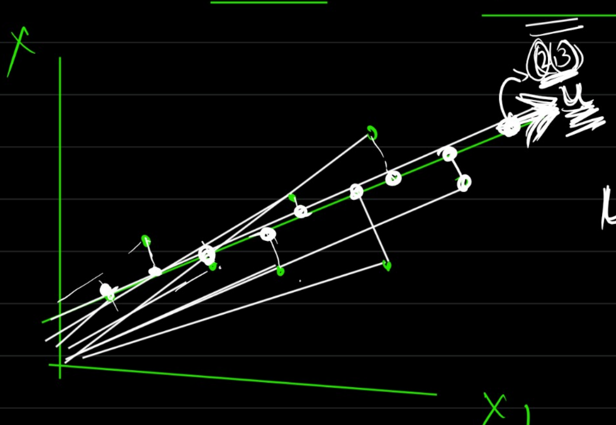
Why?

8 dps. → 16 coordinates

X_2 | X_2

2 colums — 16 coordinates

10 millions
100 colum



$u = \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$ & 8 magnitude

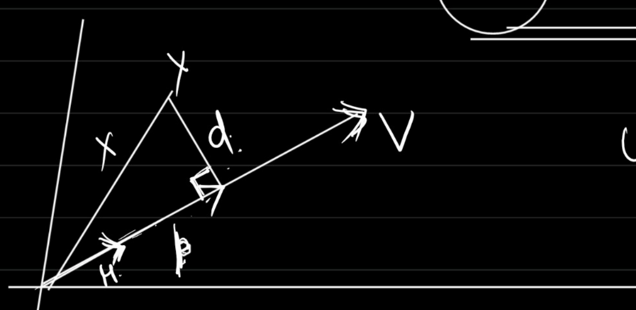
$k_1, k_2 \, --- \, k_8$.

$8 + 2 \Rightarrow 10$ coordin

10 Vs 16 corrds

$u = \dfrac{V}{\|V\|}$

↑
Unit vector



$u = \dfrac{V}{\|V\|}$ ↳ magnitude of V

$X = p + q$

$d = X - p$

$p = kU$

$d = X - kU$

then dot product will be 0

$a \cdot b = ab\cos\theta$

$= \cos 90 = 0$

$$= 0$$

$$p \cdot d = 0$$

$$= ku \times (x - ku) = 0$$

$$= kxu - k^2 u \cdot u = 0$$

$$k(xu - ku \cdot u) = 0 \qquad k = 0$$

$$xu - ku \cdot u = 0 \qquad \left(\text{magnitude of } u = 1 \quad u \cdot u = 1\right)$$

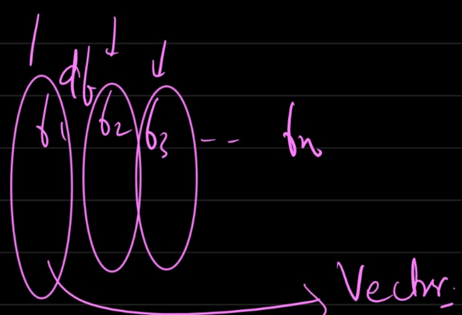
$$k = xu$$

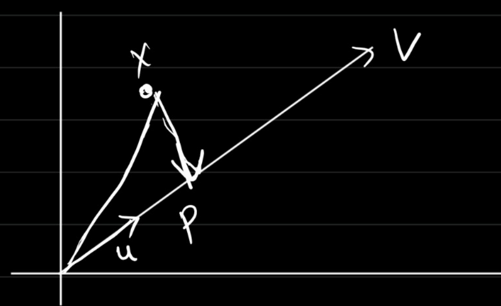
$$p = ku$$

$$p = (x \cdot u) \cdot u$$

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

$$p = \frac{x \cdot v \cdot u}{\|v\|}$$





* linear Algebra

$$\left.\begin{aligned} 3x + 2y &= 8 \\ 5x + 4y &= 18 \end{aligned}\right\}$$

$$\Downarrow$$

$$\begin{pmatrix} 3 & 2 \\ 5 & 4 \end{pmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 8 \\ 18 \end{bmatrix}$$

matrix addition

$$\begin{bmatrix} 2 & 2 \\ 4 & 1 \end{bmatrix} + \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \Rightarrow$$

matrix multiplication

$A = 3 \times 4$

$B = 4 \times 3$

$m \times n \quad n \times p$

A @ B

np.dot()

$$\begin{bmatrix} 2 & 2 \\ 4 & 1 \end{bmatrix} \times \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} = \begin{bmatrix} 2\times2+2\times1 & 2\times3+2\times4 \\ 4\times2+1\times1 & 4\times3+1\times4 \end{bmatrix}$$

$$\begin{bmatrix} 6 & 14 \\ 9 & 16 \end{bmatrix}$$

Transpose

$$A = \begin{bmatrix} 2 & 2 \\ 4 & 1 \end{bmatrix}$$

$$A^T = \begin{bmatrix} 2 & 4 \\ 2 & 1 \end{bmatrix}$$

* Determinant of a Matrix

det(A)

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

$$\text{Det}(A) = a * \begin{vmatrix} e & f \\ h & i \end{vmatrix} - b \begin{vmatrix} d & f \\ g & i \end{vmatrix} + c \begin{vmatrix} d & e \\ g & h \end{vmatrix}$$

$$= aei + bfg + cdh - afh - bdi - cef$$

$a \times (ei - fh) \Rightarrow aei - afh$

$- b \begin{vmatrix} d & f \\ g & i \end{vmatrix}$

$-b(di - fg)$

$\Rightarrow -bdi + bfg$

* Inverse matrix

np.inv

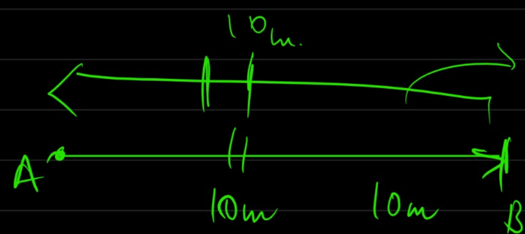
$2 \longrightarrow \frac{1}{2}$

$3 - \frac{1}{3}$

$\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix} = \frac{1}{\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}}$

Inverse of matrix

$A \cdot A^{-1} = 0$



work done is 0

for 2x2 (sq matrix — 2x2, 3x3, 4x4)

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

$\text{Inv}(A) = A^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ Adjoint A

for order 3x3

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

$\text{inv}(A) = \frac{1}{\det A} \left| \begin{vmatrix} e & f \\ h & i \end{vmatrix} \quad \begin{vmatrix} d & f \\ g & i \end{vmatrix} \quad \begin{vmatrix} d & e \\ g & h \end{vmatrix} \right|$

$$\left| \begin{vmatrix} b & c \\ h & i \end{vmatrix} \quad \begin{vmatrix} a & c \\ g & i \end{vmatrix} \quad \begin{vmatrix} a & b \\ g & h \end{vmatrix} \right|$$

$$\begin{vmatrix} b & c \\ e & f \end{vmatrix} \quad \begin{vmatrix} a & c \\ d & f \end{vmatrix} \quad \begin{vmatrix} a & b \\ d & e \end{vmatrix}$$

g $\quad A = \begin{bmatrix} 4 & 7 \\ 2 & 6 \end{bmatrix} \Rightarrow A^{-1} = \dfrac{1}{4\times 6 - 7\times 2}\begin{bmatrix} 6 & -7 \\ -2 & 4 \end{bmatrix}$

$$= \frac{1}{10}\begin{bmatrix} 6 & -7 \\ -2 & 4 \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} 0.6 & -0.7 \\ -0.2 & 0.4 \end{bmatrix}$$

$A \cdot A^{-1} = I \longrightarrow$ order matters.

$$\begin{bmatrix} 4 & 7 \\ 2 & 6 \end{bmatrix} \cdot \begin{bmatrix} 0.6 & -0.7 \\ -0.2 & 0.4 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Vectors $\longrightarrow$ **Matrix**

$V_1 = 3x + 4y \Rightarrow [3 \quad 4]$

$V_2 = x + 3y \Rightarrow [1 \quad 3]$

Zscore $\rightarrow$ Standardisation

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} \begin{bmatrix} S_x & 0 \\ 0 & S_y \end{bmatrix}$$

Rotation

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

* Vector — matrix

$$2x + y - z = 2$$
$$x + 3y + 2z = 1$$
$$x + y + z = 2$$

$$\rightarrow \begin{bmatrix} 2 & 1 & -1 & 2 \\ 1 & 3 & 2 & 1 \\ 1 & 1 & 1 & 2 \end{bmatrix}$$

→ Row echleon method or Column echleon method

→ inverse method

$$\begin{bmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & 1 \end{bmatrix}$$

$x = 2$
$y = -1$
$z = 1$