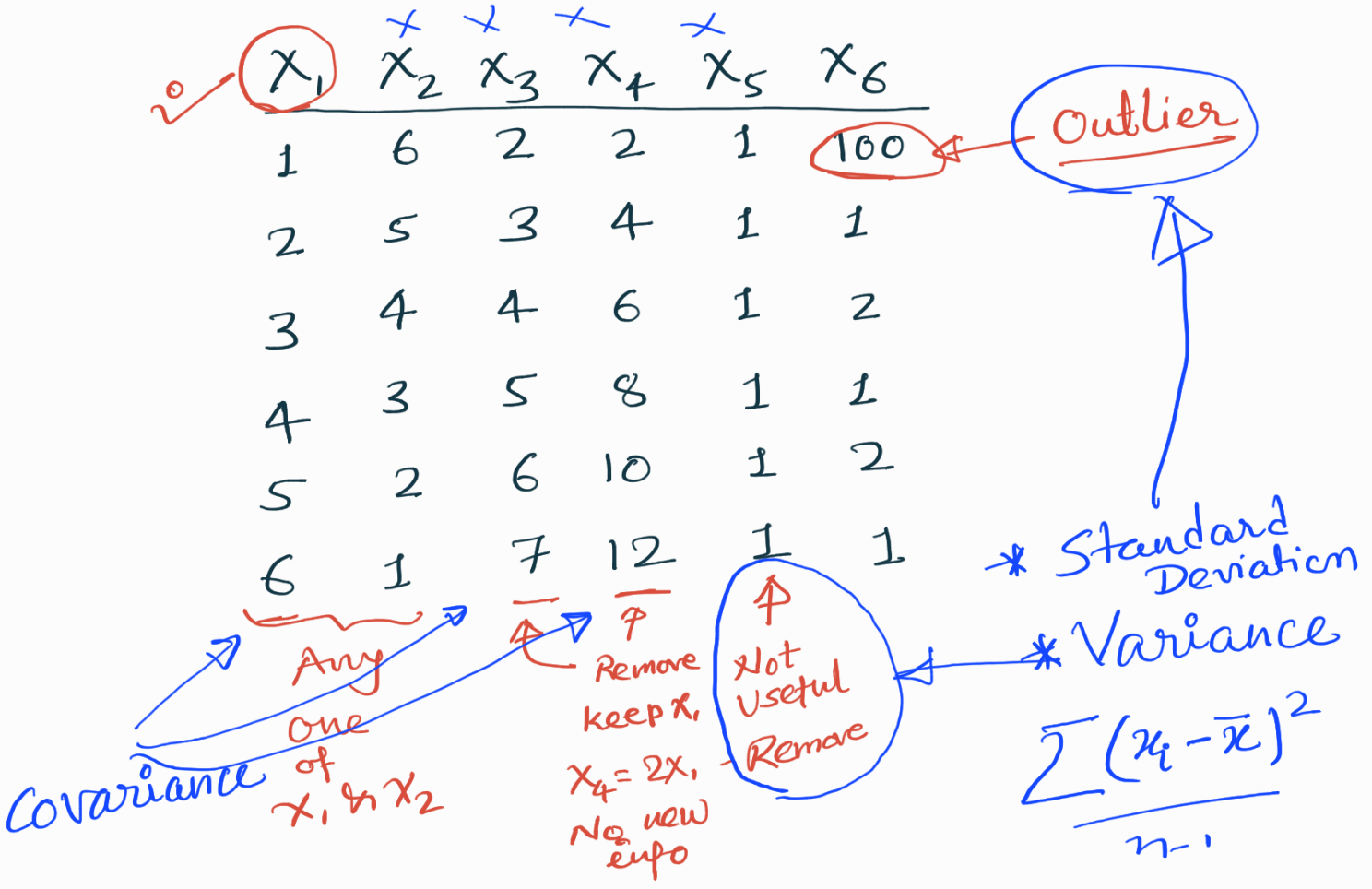


$$\frac{\sum (x_i - \bar{x}_i)(x_j - \bar{x}_j)}{}$$

$$\sum_{i=1}^{n} (X_{1i} - \bar{X}_1)(X_{2i} - \bar{X}_2)$$

Variance, Standard Deviation, Co-variance (1)

Vectors & Matrices

"If vectors are super heros, Matrix is Thanos"

← In some random Marvel

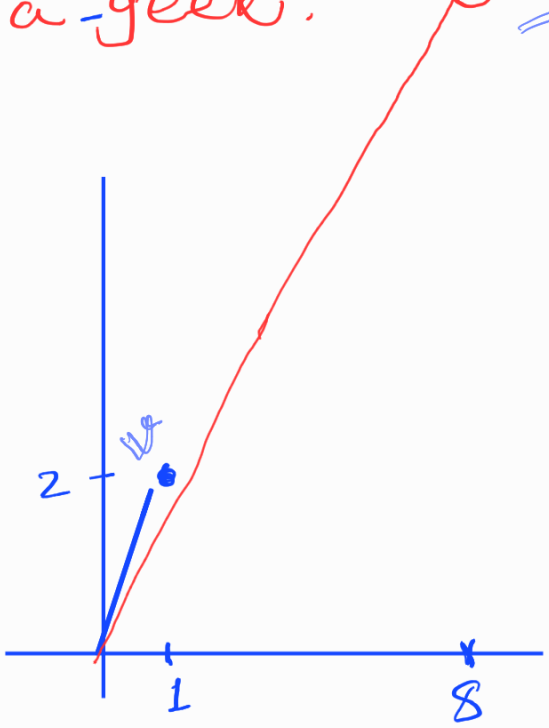
world of a geek.

$$V = [1, 2]$$

$$A = \begin{bmatrix} 2 & 3 \\ 3 & 4 \end{bmatrix}$$

$$A \times V =$$

$$\begin{bmatrix} 2 & 3 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 8 \\ 11 \end{bmatrix}$$



" There is always a vector who will not be affected by the matrix"

" For every Thanos there is an Iron man"

" Eigen Vector "

$$A \cdot v = \lambda \cdot v$$

scalar / Eigen value

matrix

vector / Eigen vector

$$A = \begin{bmatrix} -6 & 3 \\ 4 & 5 \end{bmatrix}$$

$$A \cdot v - \lambda \cdot v = 0$$

$$(A - \lambda I) \cdot v = 0$$

$$A - \lambda I = 0$$

$$\begin{bmatrix} -6 & 3 \\ 4 & 5 \end{bmatrix} - \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} = 0$$

$$\begin{bmatrix} -6-\lambda & 3 \\ 4 & 5-\lambda \end{bmatrix} = 0$$

$$(-6-\lambda)(5-\lambda) - 12 = 0$$

$$\lambda^2 + \lambda - 42 = 0$$

$$\boxed{\lambda_1 = -7, \quad \lambda_2 = 6}$$

$$A \cdot v = \lambda_1 \cdot v$$

$$\begin{bmatrix} -6 & 3 \\ 4 & 5 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = -7 \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$$

$$-6v_1 + 3v_2 = -7v_1$$

$$4v_1 + 5v_2 = -7v_2$$

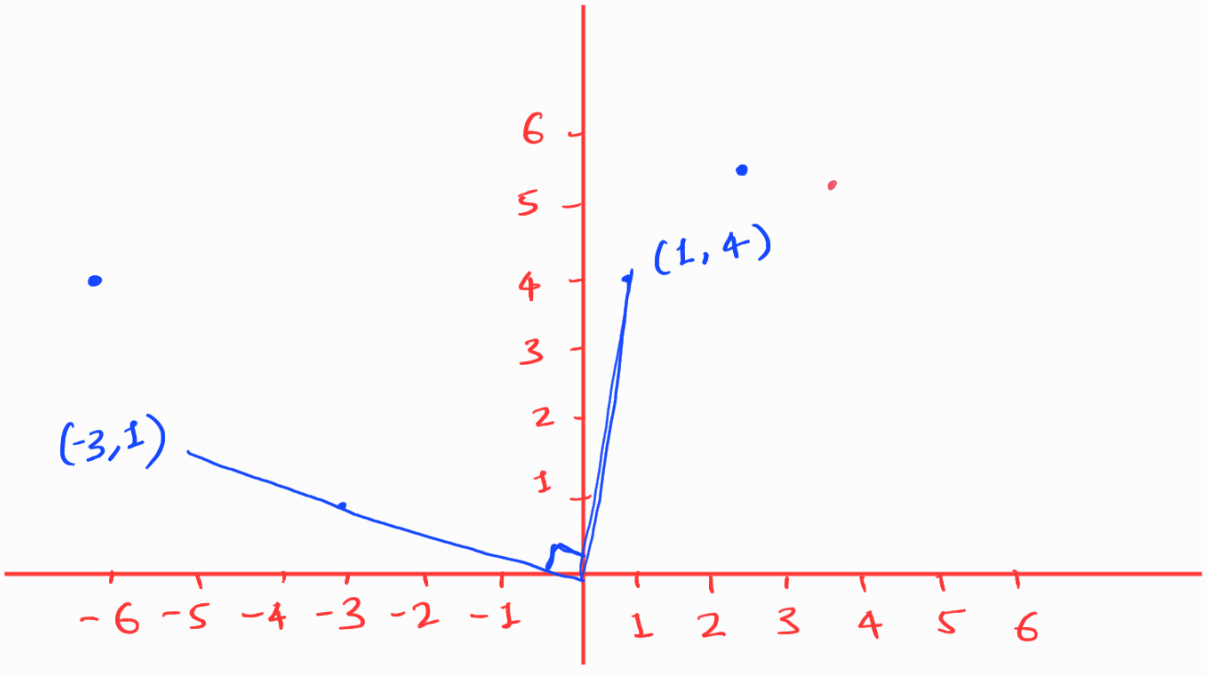
$$\boxed{v_1 = -3v_2}$$

$$v_1 = \begin{bmatrix} -3 \\ 1 \end{bmatrix}, \quad \lambda_1 = -7$$

$$v_2 = \begin{bmatrix} 1 \\ 4 \end{bmatrix}, \quad \lambda_2 = 6$$

$$A \times V = \begin{bmatrix} -6 & 3 \\ 4 & 5 \end{bmatrix} \begin{bmatrix} 1 \\ 4 \end{bmatrix}$$

$$= \begin{bmatrix} 6 \\ 24 \end{bmatrix} = 6 \begin{bmatrix} 1 \\ 4 \end{bmatrix}$$



① Eigen Vectors can serve as axis to study datapoints

② Along Eigen Vectors data points are not distorted

③ Eigen Vectors point to the direction along which the variance is maximum.

Covariance + Eigen Vector

↳ Principal Component Analysis (PCA)