* Vectors
* Matrix

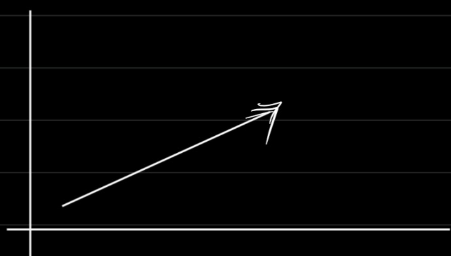
* Eigen value and Eigen Vector

— Useful PCA

↓

dimensionality reducing technique.

* Eigen vectors do not change direction if some transformation is applied to them.



* for any square matrix A, if there is a matrix V Such that if I multiply matrix V with a scalar λ

3x3
4x4
5x5

and $\boxed{AV = \lambda V}$ holds true. then λ is Eigen Value and V Eigen Vector.

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

$$AV = \lambda V$$

$$\begin{bmatrix} 3 & 6 \\ 5 & 4 \end{bmatrix} \cdot V = \lambda V$$

$AV = \lambda V$

$AV - \lambda V = 0$

$V(A - \lambda) = 0$

$\lambda \cdot I$

$$\begin{matrix} 3 & 6 \\ 5 & 4 \end{matrix} - \lambda \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$V(A - \lambda I) = 0$$

$A - \lambda$ as

$A - \lambda \cdot I$ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$$V\left(\begin{bmatrix} 3 & 6 \\ 5 & 4 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\right) = 0$$

1-0

$$\Rightarrow V\left(\begin{bmatrix}3&6\\5&4\end{bmatrix} - \begin{bmatrix}\lambda&0\\0&\lambda\end{bmatrix}\right)=0$$

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

$$V\left((3-\lambda)(4-\lambda)-30\right)=0$$

$$V\left(3(4-\lambda)-\lambda(4-\lambda)-30\right)=0$$

$$V\left(12-3\lambda-4\lambda+\lambda^2-30\right)=0$$

$V=0$

$12-3\lambda-4\lambda+\lambda^2-30=0$

$\lambda^2-7\lambda-18=0$

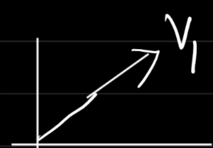
$\Rightarrow \lambda = 9, -2$

↳ Eigen Value.

$\lambda_1 = 9$ v_1

$\lambda_2 = -2$, v_2

$\lambda_1 = 9$



$$\begin{bmatrix}Cov(a,a) & Cov(a,b)\\ Cov(b,a) & Cov(b,b)\end{bmatrix}$$

$$\Downarrow$$

$\lambda_1 v_1 \to PC_1$ $\quad$ $\lambda_2 v_2 \to PC_2$

$\lambda_1 = 9$, $\lambda_2 = -2$

$$|9x_1 - 2x_2|$$

f_1	f_2
2	3
3	4
1	2
3	5

$$PC_1 = \lambda_1 f_1 + \lambda_2 f_2$$