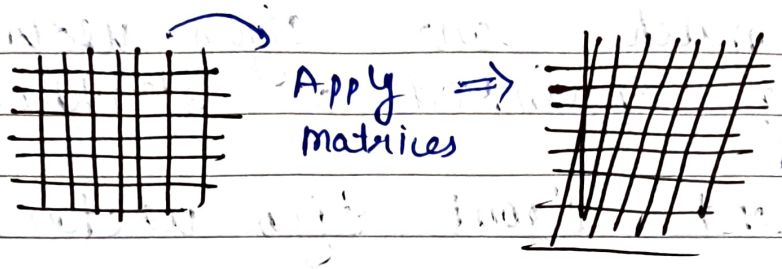
Eigen Decomposition of covariance matrix

- Calculating eigen values & vectors of covariance matrix.
- Eigen Vectors
- Eigen values
- Before this you must understand Matrices & linear transformations.

- A coordinate system is made of infinite pts. ie vectors.

- When you apply matrix on coordinate system, it transforms the coordinate system.

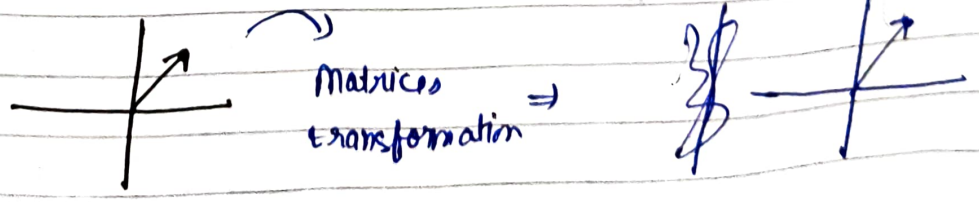
Ex 

The transformation may be squish, expand, rot or any other.

- Conclusion - Matrices are linear transformations when are applied on coordinate system, the vectors in system get transformed, it may be in terms of magnitude as well as direction.

- Eigen Vectors

special vectors, when applied transformation, their direction doesn't change.

Ex 

- Whenever you apply transformation you get ~~minimum~~ 2 Eigen vectors in 2 dimension

Eigen Values

- How much our eigen vectors is getting shrinked or stretched.

Statement about Eigen vectors

- $A\vec{V} = \lambda\vec{V}$

→ A is matrix
→ $\vec{V}$ is eigen vector
→ λ is eigen value

- This statement indicates when you multiply matrix with eigen vector, you will get the same vector only the magnitude may change.

- And how much the magnitude change after transformation is eigen value

Q How Eigen values & vectors are related to PCA?

Ans When Mathematicians solved the optimization function.

They realized, when you find the eigen vector of covariance matrix, the biggest eigen vector (whose eigen value is largest) is only the vector which is pointing to the direction of largest variance of data.

That's why we find eigen values and vectors.