Module 5 - Eigen problems.

- we will draw on all of the ideas of the previous 4 modules.
- then applying this new information to re-create Google Pagerank
  i.e. taking internet search results and ordering them by relevance.

What are Eigenvalues and Eigenvectors -

Eigen ⇒ German ⇒ Characteristic

∴ Eigen problem ⇒ finding the characteristic properties of something.

But Characteristic of what?

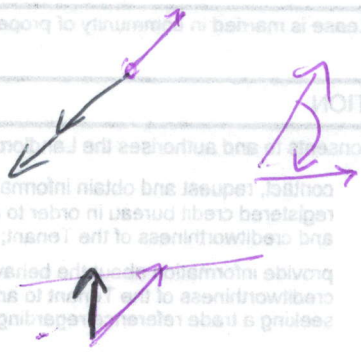
We'll explain the Eigenness through geometric interpretation

∴ we'll look at geometry / images, then to get tangled up by math / calculation

Idea here: as soon as you know how to sketch "problem" the rest is just algebra.

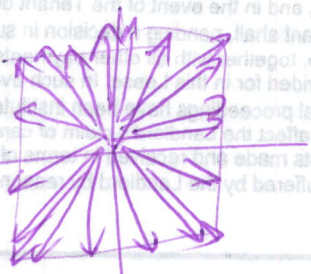
So we have learned that concept of linear algebra transformations can be expressed through matrices operators which can include:

- Scaling
- rotation
- Shears.



When applying these transformations, we determine what they may do to a SPECIFIC vector.

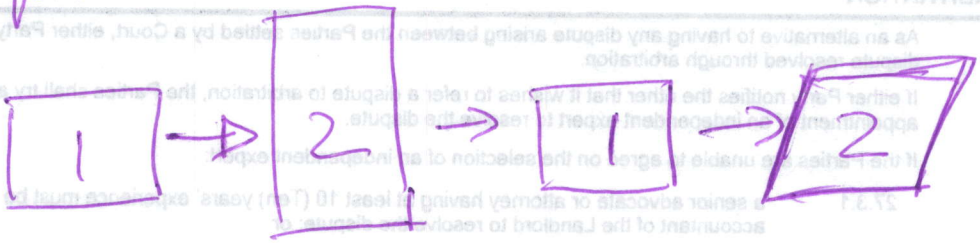
, But also how it may look like when it's applied to EVERY vector.



and this can be easily visualized by drawing a square - and see how your shape is distorted, when applying the transformation.

Eg applying a scaling of 2 in vertical direction

∴ square will become rectangle



and the applying a horizontal shear

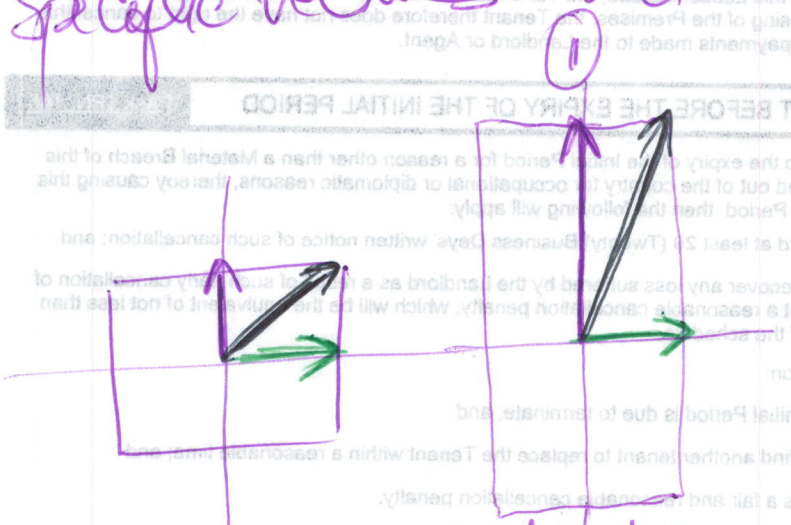
Here's key concept:

* we using the square to help us visualize what is happening to MANY vectors

But notice that same vectors end applying on the same line that they started on.

Where others do not.

To highlight this, we going to draw 3 (III) specific vectors onto our initial square



Lets consider our vertical scaling again and think what will happen to the 3 vectors.

(1) Horizontal green vector is unchanged
⇒ pointing same direction
⇒ and having the same length.

(2) Vertical purple vector:
⇒ points in same direction
⇒ But length has doubled

(3) Diagonal Brown vector
⇒ angle (between x-axis) increased
⇒ Length also increased

∴ Besides the horizontal and vertical vectors, any other vectors direction will change by the vertical scaling

∴ Horizontal & Vertical vectors are special, i.e characteristics of the particular transform.

and they are referred to as EIGEN VECTORS

⇒ And since the horizontals vector length was unchanged, it has a corresponding eigenvalue of 1

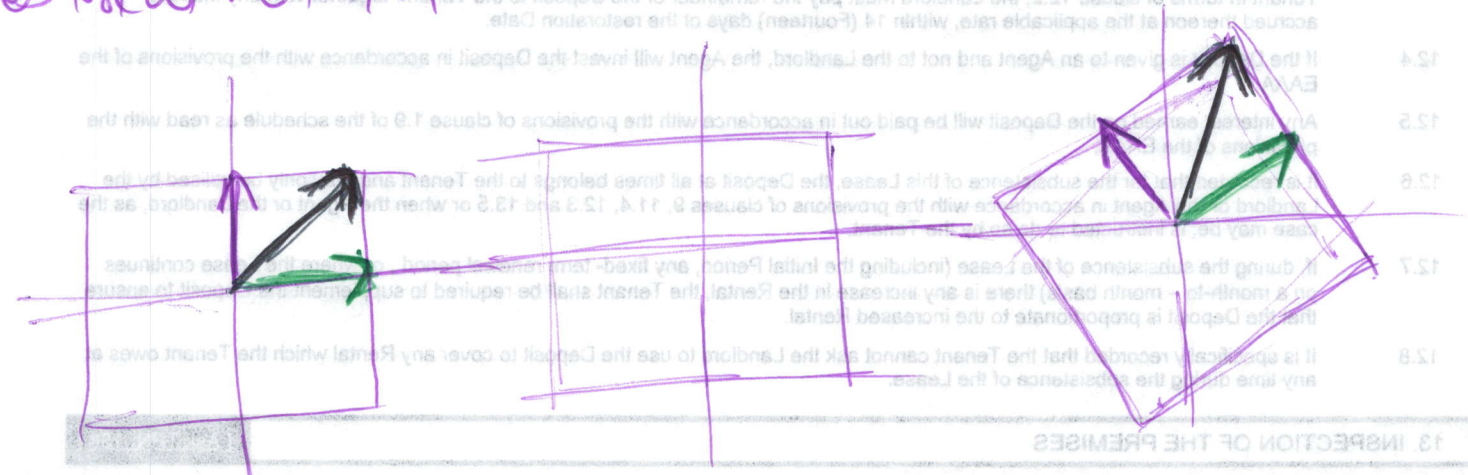
Vertical vector length doubled in length and thus has eigenvalue of 2

From a Conceptual perspective, that's it, for 2D Eigen Problems.

i.e we take transforms, and we look for vectors

all the other vectors are shifted.

Let's look at rotation:



- Here there are NO Eigenvectors, as all vectors have been rotated; off their original span.

With 3D ~~space~~ more space, the concept is the same

→ next we'll look at special case

→ and what we observe in mathematical terms