

# Eigenvalues and Eigenvectors

Eigenvalues and eigenvectors, in some sense, characterize a square matrix  $A$ . Therefore, we want to be able to compute them.

**Definition 0.1.** Let  $A$  be a square matrix. An *eigenvector* of  $A$  is

It turns out, it's easier to search for eigenvalues first and then find eigenvectors. So, how can we find them?

What does the equation  $\det(A - \lambda I) = 0$  look like in terms of  $\lambda$ ? Let's look at a  $2 \times 2$  matrix as an example.

**Example.** Set up the equation for  $\det(A - \lambda I) = 0$  for the matrix

$$A = \begin{bmatrix} 4 & 3 \\ -2 & -1 \end{bmatrix}$$

This gives us a straight-forward way to compute the eigenvalues of a matrix.

**Definition 0.2.** The *characteristic polynomial* of a matrix is