Matgeo Presentation - Problem 12.381

ee25btech11056 - Suraj.N

October 2, 2025

Problem Statement

Consider the matrix

$$\mathbf{A} = \begin{pmatrix} 4 & 0 \\ 0 & 4 \end{pmatrix}$$

Which one of the following vectors is **NOT** a valid eigenvector of the above matrix?

$$\begin{pmatrix} 1 \\ 0 \end{pmatrix} \qquad\qquad \begin{pmatrix} -2 \\ 1 \end{pmatrix} \qquad\qquad \begin{pmatrix} 4 \\ -3 \end{pmatrix} \qquad\qquad \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

Data

Name	Value
A	$\begin{pmatrix} 4 & 0 \\ 0 & 4 \end{pmatrix}$

Table : Matrix

Solution

Since **A** is diagonal, its eigenvalues are the diagonal entries.

$$\lambda_1 = 4, \quad \lambda_2 = 4 \tag{0.1}$$

To find eigenvectors, we solve:

$$(\mathbf{A} - \lambda\mathbf{I})\mathbf{v} = \mathbf{0} \tag{0.2}$$

For $\lambda = 4$:

$$\mathbf{A} - 4\mathbf{I} = \begin{pmatrix} 4 & 0 \\ 0 & 4 \end{pmatrix} - \begin{pmatrix} 4 & 0 \\ 0 & 4 \end{pmatrix} \tag{0.3}$$

$$= \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} \tag{0.4}$$

Solution

So:

$$(\mathbf{A} - 4\mathbf{I})\mathbf{v} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} \mathbf{v} = \mathbf{0} \tag{0.5}$$

Thus, every $\mathbf{v} \in \mathbb{R}^2$ satisfies this equation. But an eigenvector must be nonzero.

Conclusion: Any nonzero vector is an eigenvector corresponding to $\lambda = 4$.

The zero vector $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ is **not** a valid eigenvector.
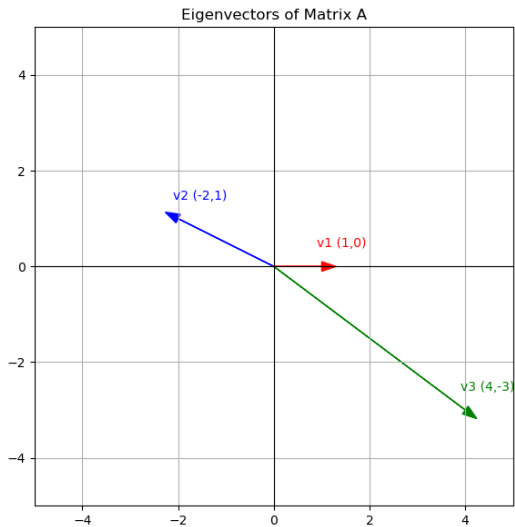
Plot

Fig : Eigen Vectors