Matematika 3
Eigenvalues and Eigenvector

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1 Exercises

1. Find the eigenvalue of A or the value of λ

$$A = \begin{bmatrix} 4 & 0 & 1 \\ -2 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix}$$

Answer

$$\begin{aligned} Ax &= \lambda x \\ Ax &= \lambda I x \\ Ax - \lambda I x &= 0 \\ (A - \lambda I)x &= 0 \\ A - \lambda I &= \begin{bmatrix} 4 & 0 & 1 \\ -2 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \\ &= \begin{bmatrix} 4 & 0 & 1 \\ -2 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix} - \begin{bmatrix} \lambda & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \lambda \end{bmatrix} \\ &= \begin{bmatrix} (4-\lambda) & 0 & 1 \\ -2 & (1-\lambda) & 0 \\ -2 & 0 & (1-\lambda) \end{bmatrix} \end{aligned}$$

$$\begin{aligned} det(A - \lambda I) &= \left[\begin{array}{ccc|cc} (4-\lambda) & 0 & 1 & (4-\lambda) & 0 \\ -2 & (1-\lambda) & 0 & -2 & (1-\lambda) \\ -2 & 0 & (1-\lambda) & -2 & 0 \end{array}\right] \\ &= (4-\lambda)(1-\lambda)(1-\lambda) + (0)(0)(-2) + (1)(-2)(0) \\ &\quad - (1)(1-\lambda)(-2) - (4-\lambda)(0)(0) - (0)(-2)(1-\lambda) \\ &= (4-\lambda)(1-\lambda)^2 + 2(1-\lambda) \\ &= (4-\lambda)(1-2\lambda+\lambda^2) + 2(1-\lambda) \\ &= 6 - 11\lambda + 6\lambda^2 - \lambda^3 \\ &= -\lambda^3 + 6\lambda^2 - 11\lambda + 6 \\ &= -(\lambda-1)(\lambda-2)(\lambda-3) \\ \lambda &= 1 \\ \lambda &= 2 \\ \lambda &= 3 \end{aligned}$$

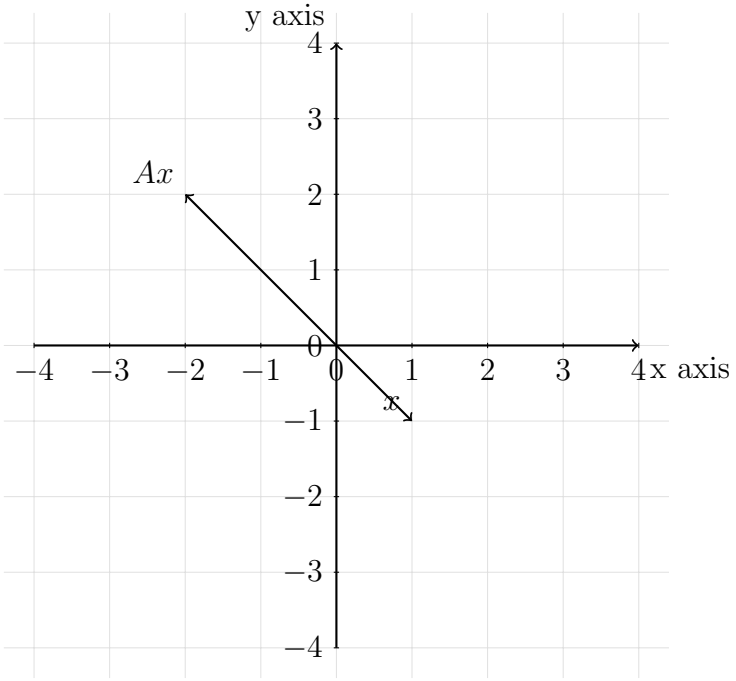
2. Determine the eigenvalue with

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

and draw it on a 2-dimensional

Answer

$$Ax = \lambda x$$
$$\begin{bmatrix} 1 & 3 \\ 3 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ -1 \end{bmatrix} = \lambda \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$
$$\begin{bmatrix} 1-3 \\ 3-1 \end{bmatrix} = \lambda \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$
$$\begin{bmatrix} -2 \\ 2 \end{bmatrix} = \lambda \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$
$$\lambda = -2$$



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