

Matrix Theory (EE5609) Assignment 4

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Abstract—This document solves an equation on matrix. Additionally it finds characteristic equation of a square matrix.

1 PROBLEM

If $\mathbf{A} = \begin{pmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{pmatrix}$, prove that $\mathbf{A}^3 - 6\mathbf{A}^2 + 7\mathbf{A} + 2\mathbf{I} = 0$

2 SOLUTION

The solution code for this problem can be found at: https://github.com/Arko98/EE5609/blob/master/Assignment_4/Codes/Solution.py

3 PROBLEM 2

Find the characteristic equation of the matrix \mathbf{A}

$$= \begin{pmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{pmatrix}$$

4 SOLUTION

For a general order k square matrix \mathbf{A} , the characteristic equation in variable λ is defined by

$$\det(\mathbf{A} - \lambda\mathbf{I}) = 0 \quad (4.0.1)$$

$$\implies \det \mathbf{A} - \lambda \det \mathbf{I} = 0 \quad (4.0.2)$$

$$\implies \begin{vmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{vmatrix} - \begin{vmatrix} \lambda & 0 & 0 \\ 0 & \lambda & 0 \\ 0 & 0 & \lambda \end{vmatrix} = 0 \quad (4.0.3)$$

$$\implies \begin{vmatrix} 1 - \lambda & 0 & 2 \\ 0 & 2 - \lambda & 1 \\ 2 & 0 & 3 - \lambda \end{vmatrix} = 0 \quad (4.0.4)$$

Hence, equation (4.0.4) is the required characteristic equation of matrix \mathbf{A} . Further expanding the determinant from the equation (4.0.4) we get the following polynomial equation of λ

$$(1 - \lambda)(2 - \lambda)(3 - \lambda) - 4(2 - \lambda) = 0 \quad (4.0.5)$$

$$\implies \lambda^3 - 6\lambda^2 + 7\lambda + 2 = 0 \quad (4.0.6)$$

Hence, equation (4.0.6) is the required characteristic equation of matrix \mathbf{A} for λ .