

ME760 Engineering Analysis I

Homework Set 3

due: Mon. Oct. 5, 2020

- Find the matrix \mathbf{A} for each of the indicated linear transformation $\mathbf{y} = \mathbf{A}\mathbf{x}$. Find its eigenvalues and eigenvectors.
 - Reflection about the x -axis in R^2 . Here $\mathbf{x} = [x \ y]$.
 - Orthogonal projection of R^3 onto the plane $x = y$. Here $\mathbf{x} = [x \ y \ z]$.
- Prove that trace of a square real or complex matrix \mathbf{A} equals the sum of its eigenvalues. This fact is often a useful check on the accuracy of eigenvalue calculations. Demonstrate with an example of your choosing.
- Prove that the eigenvectors of a real symmetric matrix corresponding to different eigenvalues are orthogonal.
- Do there exist real symmetric 3×3 matrices that are orthogonal (except for the unit matrix \mathbf{I})? If so, give an example.
- Prove that Hermitian, skew-Hermitian and unitary matrices are all normal matrices.
- Find the similarity transformation that diagonalizes the following matrix. Show details of your work.

$$\mathbf{A} = \begin{pmatrix} 16 & 0 & 0 \\ 48 & -8 & 0 \\ 84 & -24 & 4 \end{pmatrix}$$

- Use the power method to find the largest eigenvalue to 5 significant figures of the matrix

$$\mathbf{A} = \begin{pmatrix} 3 & 5 & 3 \\ 0 & 4 & 6 \\ 0 & 0 & 1 \end{pmatrix}$$