

Applied Engineering Problem Solving (CHEN.3170)

Homework Assignment #2a -- Fall 2017

Matrix and Linear Algebra Operations

Problem #1: Matrix Operations -- Hand and Matlab Computations

Given the following matrices

$$\mathbf{A} = \begin{bmatrix} 0 & 1 \\ 1 & -2 \end{bmatrix} \quad \mathbf{B} = \begin{bmatrix} 1 & 0 & 2 \\ -1 & 3 & 1 \end{bmatrix} \quad \mathbf{C} = \begin{bmatrix} 1 & 0 & 2 \\ 0 & -1 & 0 \\ -1 & 3 & 2 \end{bmatrix} \quad \mathbf{x} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

- Perform the indicated operations via hand calculations (show intermediate results, as appropriate):
 $\mathbf{B}^T\mathbf{B}$, \mathbf{ABC} , $\mathbf{x}^T\mathbf{Ax}$, \mathbf{xx}^T , and \mathbf{A}^2
- Now, define the above arrays in a short Matlab script file and perform the indicated operations in Matlab. Do your results from Part a agree with the Matlab results?
- What is the difference between $\mathbf{A}*\mathbf{A}$ and $\mathbf{A}.*\mathbf{A}$ in Matlab? Explain and show the results...

Problem #2: Linear Algebra Calculations -- Hand and Matlab Computations

Given the following data:

$$\mathbf{A} = \begin{bmatrix} 3 & 2 & -1 \\ 2 & -1 & -3 \\ -4 & 0 & 1 \end{bmatrix} \quad \mathbf{B} = \begin{bmatrix} 2 & 2 & -1 \\ 2 & 1 & 3 \\ 2 & 4 & -9 \end{bmatrix} \quad \mathbf{C} = \begin{bmatrix} -4 & 4 & 0 \\ 6 & -12 & 6 \\ 0 & 4 & -4 \end{bmatrix} \quad \mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \quad \mathbf{y} = \begin{bmatrix} 1 \\ -4 \\ -5 \end{bmatrix}$$

- Calculate $\det \mathbf{A}$
 - Using Laplace's Expansion
 - By performing row operations to obtain an upper triangular matrix
- Find the inverses of \mathbf{A} and \mathbf{B}
- Solve the following matrix equation for the solution vector \mathbf{x} : $\mathbf{Ax} = \mathbf{y}$
- Calculate the eigenvalues and eigenvectors of \mathbf{C}
- Parts a – d should be done via hand calculation. Now, for Part e, use Matlab to verify that you did these correctly, and address any differences that you get (note: just use Matlab's `det` command to do the Matlab implementation of Part a).

Note: Most of the exercises requested here in Probs. 1 & 2 were already demonstrated as part of Lab #2a -- the primary difference here is the use of different matrices. Thus, you should refer to your work from Lab#2a as a starting point for this HW.

Documentation

Documentation for this assignment should include your hand calculations for Problems #1 and #2, a listing of the Matlab script files that were generated, the resultant Matlab outputs, and a brief description of the data and results of your analyses for each problem. Note that, for this HW, there is not much to discuss other than a statement indicating if the hand and Matlab results agree or not -- however, every problem should have a brief description/discussion, even if it is somewhat trivial. Thus, always be sure to include the key results along with a brief discussion for every problem -- and **please keep each problem separate for ease of evaluation!** An overall professional job is expected here!!!

See HW#1 for a description of the expected format -- every HW in this course should follow these basic instructions...