Department of Engineering Technology
Washkewicz College of Engineering
Cleveland State University

GET 315 Advanced Programming Methods
Spring 2020
Computer Project 9

Introduction:

The subject of matrix algebra was discussed in class and more information was presented in another document. We also wrote C code that implement many different matrix operations. This project assignment explores the functions in the MATLAB® libraries that solve the same type of problems.

Assignment:

Use the 'Command Window' to perform the following operations:

1. Define the independent variable as a vector, then calculate the value of the function as element-by-element operation (use the operators .*, ./, & .^ when writing the expression for the function) for each value of the independent variable
   a) $y=\left(x+x\sqrt{x+3}\right)\left(1+2x^2\right)-x^3$ for x values of -2, -1.5, -1, -0.5, 0, 0.5, 1, 1.5, 2
   b) $y=\dfrac{4\sin(w)+6}{\left(\cos^2(w)\sin(w)\right)^2}$ for w values of 15°, 25°, 35°, 40°, 55°, 60°
2. Define the vector ($\mathbf{v} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$) in each part then calculate the required value as indicated using element-by-element operations
   a) The length of a vector is given by $|\boldsymbol{v}|=\sqrt{x^2+y^2+z^2}$. For the vector $\mathbf{v} = -5.6\mathbf{i} + 11\mathbf{j} - 14\mathbf{k}$, write a single command that calculates the length of the vector by multiplying it by itself and using the MATLAB 'sum' & 'sqrt' functions
   b) The angle between two vectors is determined by $\theta=\cos^{-1}\left(\dfrac{x_1x_2+y_1y_2+z_1z_2}{|\boldsymbol{v_1}||\boldsymbol{v_2}|}\right)$. Given the vectors $\mathbf{v}_1 = 3.2\mathbf{i} - 6.8\mathbf{j} + 9\mathbf{k}$ & $\mathbf{v}_2 = -4\mathbf{i} + 2\mathbf{j} + 7\mathbf{k}$, write a single MATLAB command that determines the angle θ (in degrees) between the two vectors using only the 'sum', 'sqrt', & 'acosd' functions
3. Given the vector x = [1 3 5 7], generate the following vectors using only element-by-element operations
   a) [3 9 15 21]
   b) [1 9 25 49]
   c) [1 1 1 1]
   d) [6 6 6 6]
4. The angle between two vectors, $\mathbf{v}_1$ & $\mathbf{v}_2$, can be determined by the formula $\theta=\sin^{-1}\left(\dfrac{|\boldsymbol{v_1}\times\boldsymbol{v_2}|}{|\boldsymbol{v_1}||\boldsymbol{v_2}|}\right)$ where $|\boldsymbol{v}|=\sqrt{\boldsymbol{v}\cdot\boldsymbol{v}}$ (Note that x & • are the cross & dot products of two vectors, respectively). Given the vectors $\mathbf{v}_1 = 2.5\mathbf{i} + 8\mathbf{j} - 5\mathbf{k}$ & $\mathbf{v}_2 = -\mathbf{i} + 6\mathbf{j} + 3\mathbf{k}$, use the MATLAB functions 'asind', 'cross', 'dot', & 'sqrt' to determine θ in degrees

5. Using the following matrices $A=\begin{bmatrix} 5 & -3 & 7 \\ 1 & 0 & -6 \\ -4 & 8 & 9 \end{bmatrix}$, $B=\begin{bmatrix} 3 & 2 & -1 \\ 6 & 8 & -7 \\ 4 & 4 & 0 \end{bmatrix}$, & $C=\begin{bmatrix} -9 & 8 & 3 \\ 1 & 7 & -5 \\ 3 & 3 & 6 \end{bmatrix}$
   a) Find $5(B + C)$ & $5B + 5C$ and compare the results
   b) Does $(B * C)^{-1} = B^{-1} * C^{-1}$
   c) Does $(A + B)^{T} = A^{T} + B^{T}$
6. Find the solution of the following systems of equations

$$\begin{gathered} 2u-4v+5w-3.5x\,1.8y+4z=52.52 \\ -1.5u+3v+4w-x-2y+5z=-21.1 \\ 5u+v-6w+3x-2y+2z=-27.6 \\ 1.2u-2v+3w+4x-y+4z=9.16 \\ 4u+v-2w-3x-4y+1.5z=-17.9 \\ 2u+v-w+4x-2y-4z=-16.2 \end{gathered}$$

Write up Requirements:

Your report must include at minimum the following -

- A single document with a title page that includes the following information

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CSU-ID: <your csu-id>

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Due Date: <date>

- For each question include a comment line (%) before each group of commands that identify the question number and any other relevant information
- A screen capture or a printout of MATLAB session showing the entered commands and responses for each question