# MAT 281E  Fall 2015-2016   HOMEWORK 1

Show how MATLAB is used to perform the following operations and determine the result. Use appropriate MATLAB expressions <u>as much as possible</u>! Brute force approaches will lose you points.

Submit a copy of the screen capture for each problem.

Submit the screen captures by October 9th, 2015 16:00 to the mailbox in the administrative office of the Computer and Informatics Faculty. Submissions that are submitted after October 9th, 2015 16:00, but before October 13th, 2015 16:00 will be graded over 50%. Submissions turned in later than October 13th, 2015 16:00 will not be graded.

1. Perform $\underline{\underline{A}} * \underline{\underline{B}}^T$ where $\underline{\underline{A}} = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 4 & 5 & 1 \\ 3 & 4 & 5 & 1 & 2 \end{bmatrix}$ $\underline{\underline{B}} = \begin{bmatrix} 3 & 4 & 5 & 1 & 2 \\ 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 4 & 5 & 1 \end{bmatrix}$

2. Let $\underline{\underline{A}} = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 5 \\ 3 & 4 & 5 & 1 \\ 1 & 2 & 3 & 4 \end{bmatrix}$

   a. Write down an expression to compute the sum of the diagonal entries of any 4x4 matrix. Then apply it to the above matrix to determine its trace.

   b. Compute the sum of elements of the second row by using as concise an expression as possible. (What is "?" in A(?)  ?)

   c. Compute the sum of elements of the third column by using as concise an expression as possible. (What is "?" in A(?)  ?)

   d. Concatenate the matrices in problem 1 to get $\underline{\underline{C}} = \lfloor \underline{\underline{A}} \vdots \underline{\underline{B}} \rfloor$ by using an expression.

3. Concatenate two 4x4 identity matrices and two 4x4 all zeroes matrices to get a 8x8 identity matrix. Conversely, start with an 8x8 identity matrix and partition it into two 4x4 identity matrices and two 4x4 all zeroes matrices.

4. Determine the inverse of the matrix $\underline{A} = \begin{bmatrix} 4 & -81 & 21 & -7 & 23 \\ 0 & -21 & 13 & 10 & -1 \\ 34 & 16 & -10 & 32 & 20 \\ 10 & 14 & 0 & -25 & 18 \\ 8 & -7 & 15 & 11 & 4 \end{bmatrix}$

5. Determine the $l_2$ norm $\|\vec{v}\|_2$ where $\vec{v} = \begin{bmatrix} 41 \\ -20 \\ 714 \\ 110 \end{bmatrix}$

6. Determine the determinant of the product in problem 1 in two different ways. (Second way makes use of the property discussed in class).
7. Solve the following system of linear equations using LU decomposition.

$$4x_1 + 3x_2 - 21x_3 + x_5 = 4$$
$$-x_2 - 2x_4 + 5x_5 = 1$$
$$11x_1 + 10x_2 + x_3 + 4x_4 - x_5 = -1$$
$$2x_1 + 5x_2 + 8x_3 + -3x_4 + 2x_5 = 10$$
$$x_1 - 7x_3 + 2x_4 + 9x_5 = 8$$

   Specifically determine the upper triangular matrix $\underline{\underline{U}}$ of the decomposition of the augmented matrix as $\underline{\underline{\tilde{A}}} = \underline{\underline{L}}\,\underline{\underline{U}}$ where $\underline{\underline{\tilde{A}}} = \left[\underline{\underline{A}} \vdots \underline{b}\right]$. Then solve for the unknown variables by back substitution.
8. Determine the inverse of the matrix in problem 4 by setting up 5 5x6 augmented matrices (concatenate A and a column of identity matrix to get each augmented matrix), applying LU decomposition on these matrices and solving for the unknown matrix. (Remember $\underline{\underline{A}}\,\underline{\underline{X}} = \underline{\underline{I}}$).