M1. (MATLAB Assignment)

In this section, you will continue working on the simple MATLAB program you started to develop in the previous assignments. In this assignment, you are going to develop a simple program to <u>calculate truss element stiffness matrices in local and global coordinates</u>.

Download the skeleton file **hw5.m** and **input.txt** before you begin. The input file includes the data (including geometry, boundary conditions, material properties, and loading) required to define the same planar truss given in the previous assignments with material properties $E = 30 \times 10^6 \ psi$ and $A = 2 \ in^2$ for all elements, and a downward concentrated load applied at node 1.
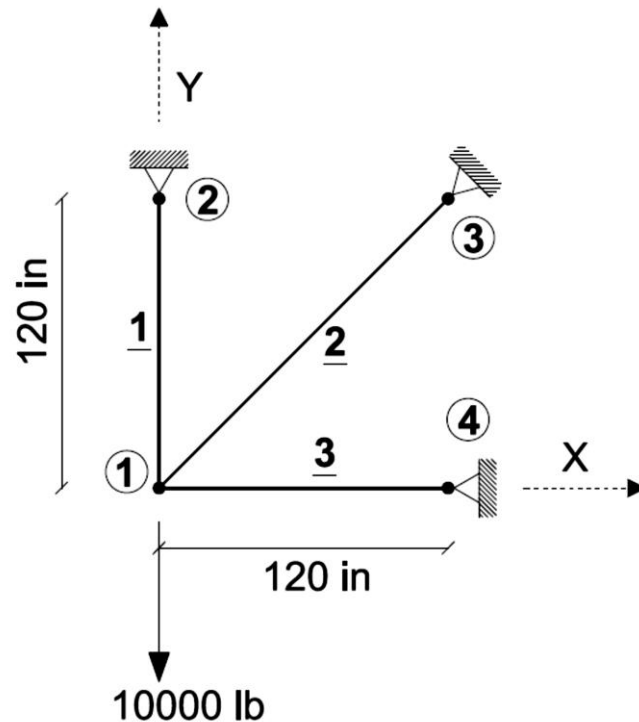
The skeleton m-file reads the input file and generates the required variables including:

- `nNode`: Number of nodes,
- `nElem`: Number of elements,
- `coordinates`: An nNode-by-2 matrix including x and y coordinates,
- `elements`: An nElem-by-2 matrix including the element connectivity data,
- E: An nNode-by-1 matrix (vector) includes the Young's modulus of elasticity values, and
- A: An nNode-by-1 matrix (vector) includes the cross-sectional area of each element

Your task:

To calculate the element stiffness matrices, you need to complete the following tasks for the i-th element in the for-loop:

    a. Calculate the length of element $(L = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2})$

    b. Form the local stiffness $\bar{k} = \begin{bmatrix} EA/L & -EA/L \\ -EA/L & EA/L \end{bmatrix}$

    c. Form the transformation matrix $T = \begin{bmatrix} c & s & 0 & 0 \\ 0 & 0 & c & s \end{bmatrix}$

    d. Calculate the element stiffness matrix in the global coordinates $k = T^T \bar{k} T$

Important Note:

You are not allowed to hardcode any values in your code. **You will not get any credit if hardcode any length, stiffness matrix, or transformation matrix**. Your program must be able to handle any other input file.

Submission:
Upload your completed version of **hw5.m** to Canvas and **attach** a **hard copy** of (1) your code and (2) Command Window outputs to your submission in class.