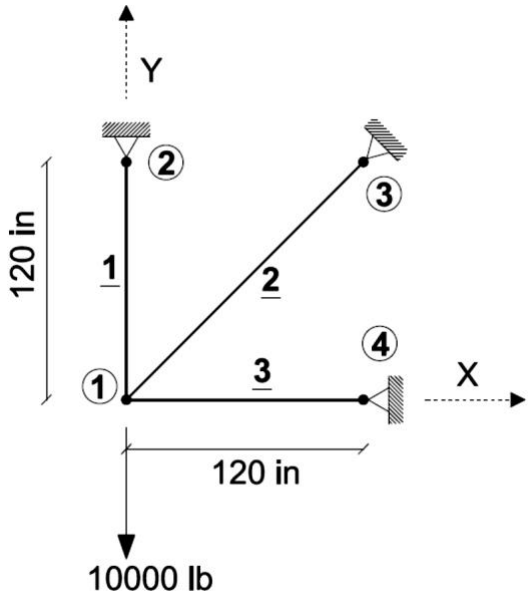
M1. (MATLAB Assignment)

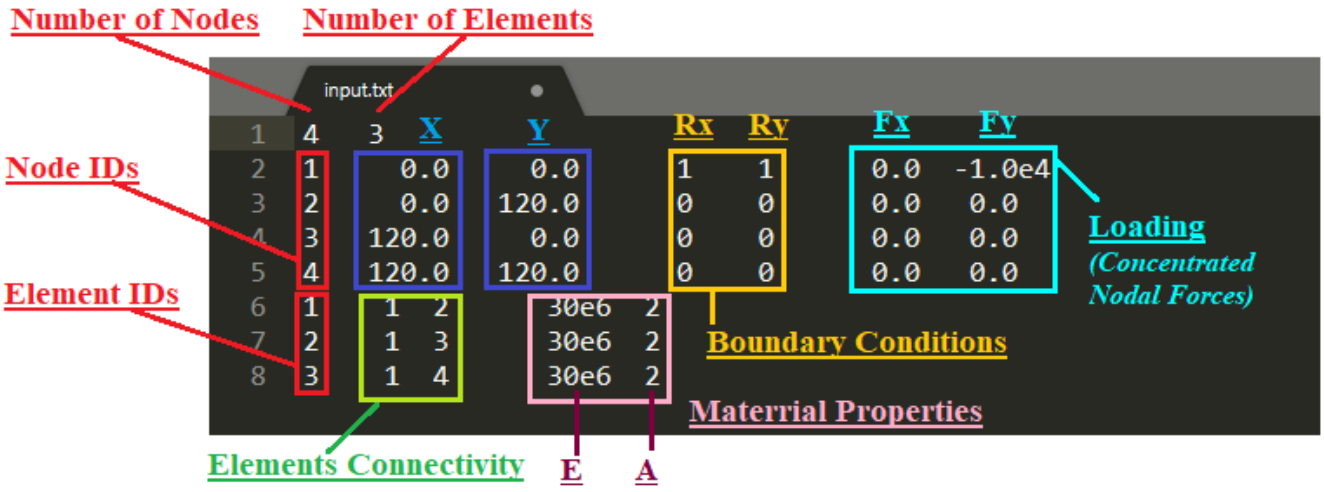
In this question, you will continue working on the simple MATLAB program you started to develop in the previous homework. In this assignment, you will

- Add boundary conditions, material properties, and loading data to the input file
- Complete the program to read data from an input file and store them to specified variables

The example problem is the same as the previous assignment with material properties $E = 30 \times 10^6\ psi$ and $A = 2\ in^2$ for all elements. A downward concentrated load is applied at node 1.



Download the skeleton file **hw2.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 given planar truss. The following figure demonstrates the format of the input file, which is the same as the input file you will be given for the MATLAB project.



In this format, Rx and Ry indicate whether a node is restrained or free. In this convention, 0 means the corresponding node is restrained and 1 means the corresponding node is free. For instance, if Rx of the second node is 0, it means that the node 2 is restrained in the x direction. Fx and Fy are the components of concentrated nodal forces applied on each node in x- and y-directions, respectively. For instance, in this problem a downward load of 10000 lb is applied at node 1; therefore, the value -1.0e4 is input in the corresponding place in the input file (we can also input it as -10000).

To accomplish this assignment, you need to complete the following simple tasks to complete reading the data from the input file and store them in specific variables to generate a simple graphical representation:

- In the homework 1, your program can read the following data:
    - `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,

  Now in this assignment, read data from the opened input file (Again, you may find MATLAB function "fscanf" useful for this part), and store them in the following variables:

    - rx: An nNode-by-1 matrix (vector) indicates whether a node is free (=1) or restrained (=0) in the x-direction, e.g. in this example:

```
rx =
     1
     0
     0
     0
```

    - ry: An nNode-by-1 matrix (vector) indicates whether a node is free (=1) or restrained (=0) in the y-direction.

    - fx: An nNode-by-1 matrix (vector) includes the nodal forces component in the x-direction, e.g. in this example:

```
fx =
     0
     0
     0
     0
```

    - fy: An nNode-by-1 matrix (vector) includes the nodal forces component in the y-direction, e.g. in this example:

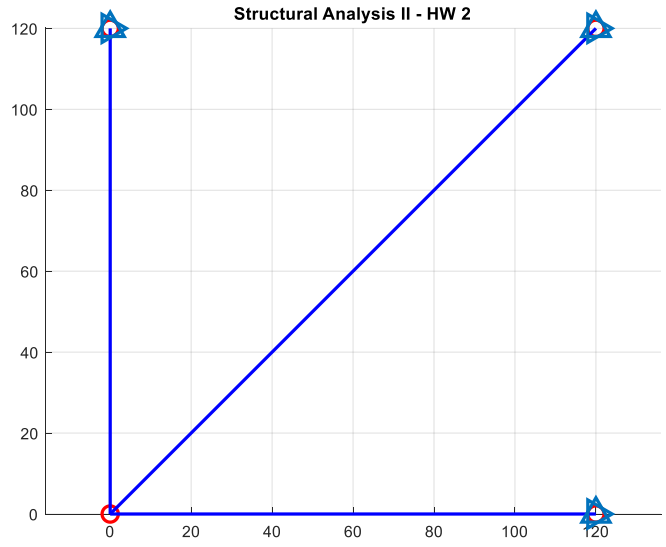
```
fy =
      -10000
           0
           0
           0
```

- 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 (truss members). For instance, in this problem:

```
E =
     30000000
     30000000
     30000000

A =
      2
      2
      2
```

Afterwards, the rest of this m-file (hw2.m) provides a simple plot, which can show that your code has read the data correctly:

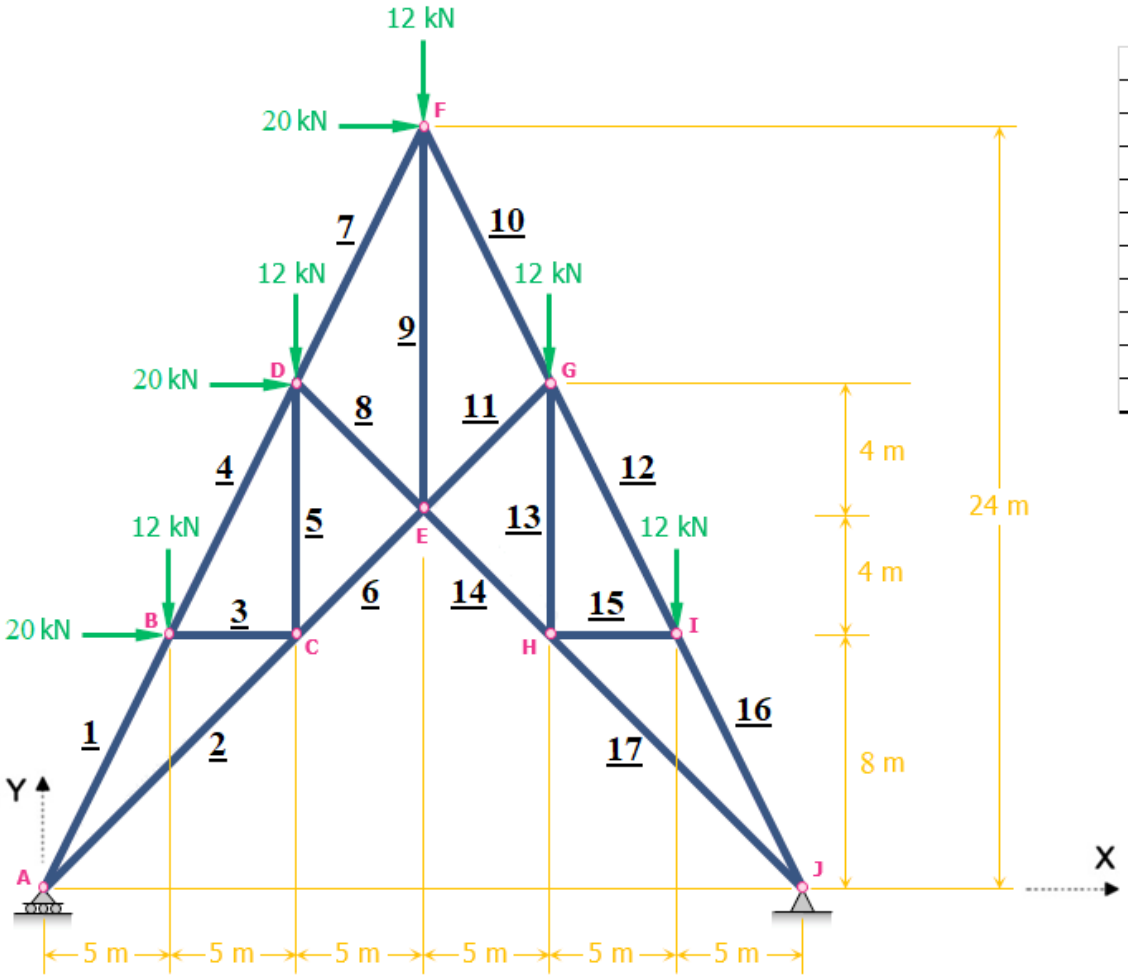


Submission:

Upload your completed version of **hw2.m** to Canvas and **attach** a **hard copy** to your submission in class

M2. (MATLAB Assignment)

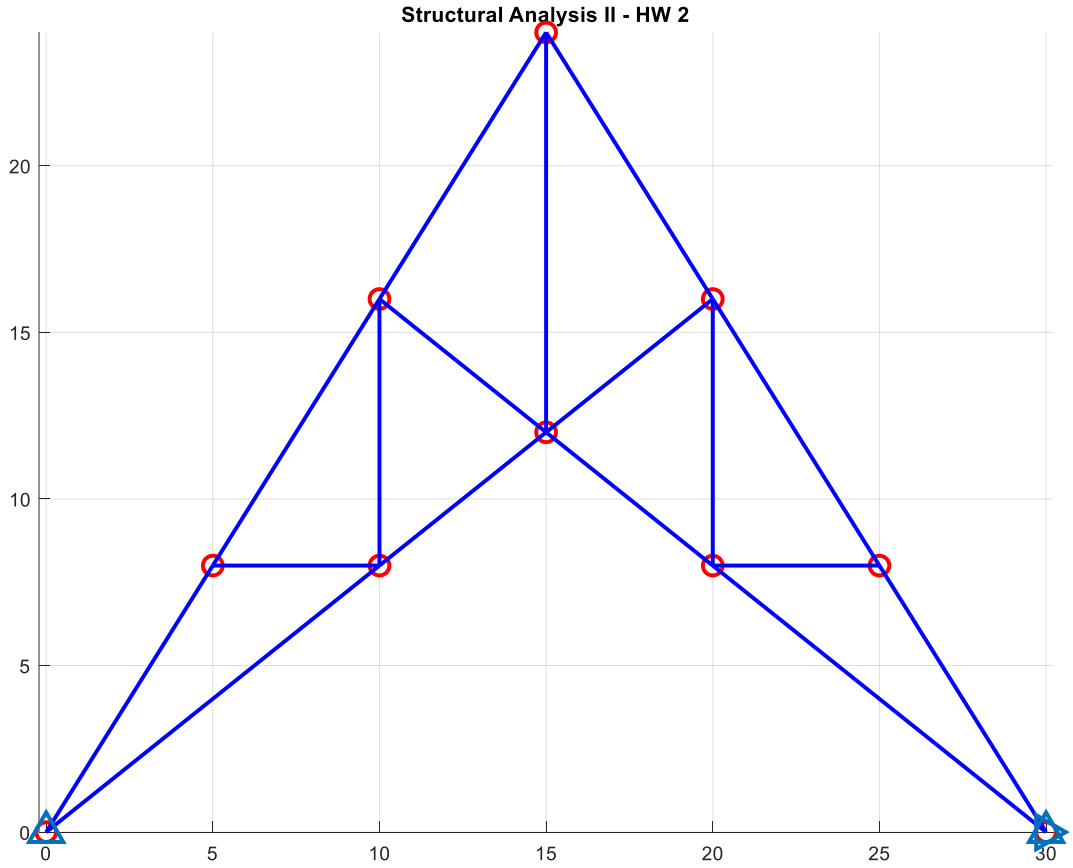
Consider the following truss:



Node IDs	
A	1
B	2
C	3
D	4
E	5
F	6
G	7
H	8
I	9
J	10

where the module of elasticity and cross-sectional area of all elements are E = 200 GPa = 200e9 N/m^2 and 100 cm^2 = 0.01 m^2, respectively. Create a new input file **"truss.txt"** to define the geometry, boundary conditions, loading, and material properties of this problem using the same format explained in the previous assignment (Input all data in SI units).

Then, use your completed **hw2.m** script to read this input file and generate the following plot. Save this figure as **"truss.png"**



Submission:

Upload (i) the new input file **“truss.txt”** and (ii) the generated figure **“truss.png”** to Canvas and **attach** a **hard copy** to your submission in class

M3. (MATLAB Assignment)

Consider the following system of linear equations:

$$\begin{cases} 2x_1 + x_2 + 3x_3 + x_5 = 3 \\ x_1 + 2x_2 + 4x_5 = 20 \\ 3x_1 - 4x_2 + 2x_3 + 8x_4 = 38 \\ 2x_1 - x_4 = -1 \\ 4x_1 + 5x_2 - 3x_3 = 19 \end{cases}$$

Convert this system of equations into the matrix form Ax = b. Download the skeleton file **hw2b.m** and complete this file by introducing A and b. Then, use MATLAB commands to solve this system and obtain the vector of unknowns x, and display the results (including A, b, and x) on the Command Window. Copy all these results into a text file **output.txt**

Submission:

Upload (i) your completed version of **hw2b.m** and (ii) the text file **output.txt** to Canvas and **attach** a **hard copy** to your submission in class.