MCEN 4125/5125

Truss Topology Project

Due (Code): to Dropbox on D2L by 11:59pm on Thursday March 8th 2018.
Due (Report PDF): to Dropbox on D2L by 11:59pm on Thursday March 8th 2018.
Due (Report Hardcopy): To the box outside my office by 2pm on Friday March 9th 2018.

For this project you will be solving the Truss Topology problem via Linear Programming (LP).

- This should be a single Matlab script called "My_Truss_*Lastname*.m" (where *Lastname* is replaced by your last name)
- The possible link locations is an 11×20 (assume meters) grid shown in Figure 1
- Note the node with the red arrow, n Figure 1, is the location of the load (= 4 units of force) that your system has to support.
- We assume that the truss members have an area equal to 1 and the yield strength is equal to 8.

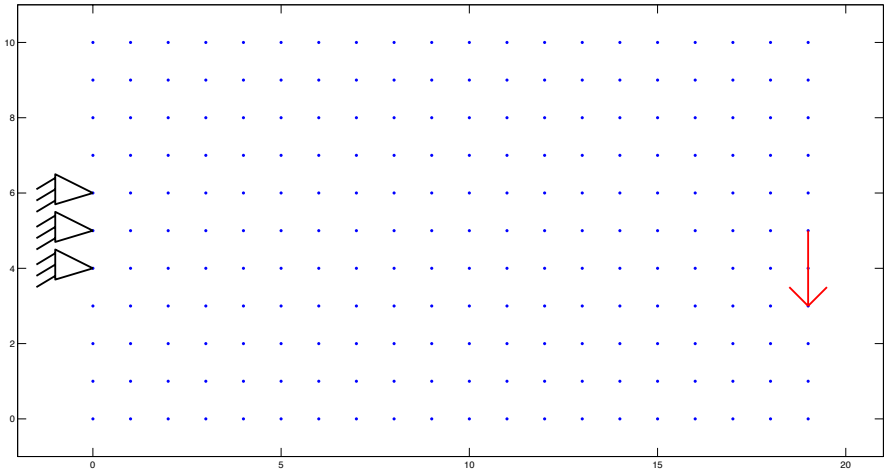

Figure 1: This figure shows the three anchors along with the grid of possible link connects (which are fixed) and the load location

- ```
  plot([19 19],[5 3],'r','Linewidth',2)
  plot([19 18.5],[3 3.5],'r','Linewidth',2)
  plot([19 19.5],[3 3.5],'r','Linewidth',2)
  plot([0 -1 -1 0],[6 5.7 6.5 6],'k','Linewidth',2)
  ```
  ```

```
plot([0 -1 -1 0],[5 4.7 5.5 5],'k','Linewidth',2)
plot([0 -1 -1 0],[4 3.7 4.5 4],'k','Linewidth',2)
plot([-1.5 -1],[3.5 3.8],'k','Linewidth',2)
plot([-1.5 -1],[3.8 4.1],'k','Linewidth',2)
plot([-1.5 -1],[4.1 4.4],'k','Linewidth',2)
plot([-1.5 -1],[4.5 4.8],'k','Linewidth',2)
plot([-1.5 -1],[4.8 5.1],'k','Linewidth',2)
plot([-1.5 -1],[5.1 5.4],'k','Linewidth',2)
plot([-1.5 -1],[5.5 5.8],'k','Linewidth',2)
plot([-1.5 -1],[5.8 6.1],'k','Linewidth',2)
plot([-1.5 -1],[6.1 6.4],'k','Linewidth',2)
axis equal
```

- Comment your code.
- A quality report is required for this project. Discuss the problem, formulation, solution, etc (see my Sample Report)
- You will be solving and comparing the two problem described in class where you are minimizing the ℓ_1-norm of the internal forces of the bars. The ℓ_1-norm problem is solved both weighted and unweighted by the lengths of the bars.
- You may only use the `linprog()`function in Matlab for this project
- When describing the formulation of the matrices in your report, it is not going to be possible to show every element of the matrix as I have done in my Sample Report. The following is an example of how to take a possibly very large matrix and describe the necessary pattern for someone to be able to recreate the matrix:

  We define the vector a (of length mN) as

$$a = \begin{bmatrix} a_1 & a_2 & \cdots & a_m & a_{m+1} & \cdots & a_{2m} & \cdots & a_{mN} \end{bmatrix}^T \tag{1}$$

  and the matrix A (of size $(m+1)N \times m$) is built from a as

$$A = \begin{bmatrix} A_0 \\ A_2 \\ \vdots \\ A_{N-1} \end{bmatrix} \tag{2}$$

  where

$$A_k = \begin{bmatrix} a_{1+m*k} & a_{2+m*k} & \cdots & a_{m+m*k} \\ -a_{1+m*k} & 0 & \cdots & 0 \\ 0 & -a_{2+m*k} & & \\ \vdots & & \ddots & \\ 0 & \cdots & 0 & -a_{m+m*k} \end{bmatrix} \tag{3}$$