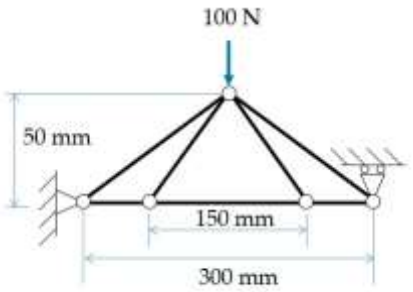
ME 260: Structural Optimization: Size, Shape, and Topology		
Assigned: Oct. 14, 2020	Homework 2	Due: Oct. 23, 2020

Problem 1 (16 points)

a) A seven-bar truss is shown in the figure on the right. Minimize the mean compliance of this truss by using the cross-section areas as the design variables with lower and upper bounds of 1 mm² and 16 mm². Use an upper bound weight constraint of 0.025 kg and steel as the material (ρ = 7800 kg/m³, E = 210 GPa).



b) Include stress constraints along with the mean compliance and re-solve the problem. Use allowable stress to be 70% of the maximum stress found in (a).

Problem 2 (10 points)

Download *TrussInteractiveDesign.zip* from the Notes page of ME 260 course website. Run *trussdesign.m* and follow the instruction by clicking on "About" button. Get the optimized truss that has the lowest strain energy for less than or equal to 40% of elements in the truss. This is to test your intuition and give you some experience with GUI in Matlab.

Problem 3 (10 points)

Consider the simple geometric problem pertaining to a cylinder. Find all KKT points and verify sufficiency conditions. Graphical visualization certainly helps.

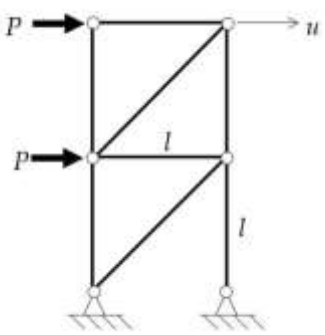
$$\underset{\substack{4.5\le D\le 12\\ 9\le H\le 18}}{\text{Min}} \; S = \pi DH + \pi D^2/2$$

Subject to

$$1500 - \pi D^2 H \le 0$$

Problem 4 (14 points)

Pose the constrained minimization problem for the design of the truss shown on the right. The objective is to minimize the weight while limiting the displacement u from above.



a) Write the necessary conditions symbolically.
b) Notice that this problem has a separable form and write the dual problem and solve it symbolically as it involves only one variable.