**ME 489: Introduction to Finite Element Analysis**

Homework 3
Released: 02/09/2019
Due: 02/015/2019

Problem 1: What is the stress distribution in the bar shown in the Figure? The bar is made out of a single material of Young's modulus E = 30MPa, and has a varying cross sectional area. The bar is fixed to a wall at one end, and it has an applied force P = 4000N at the other end. Solve this problem by discretizing the bar with a single quadratic 3-node element.
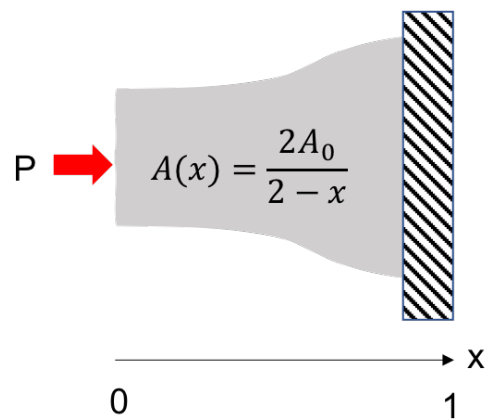
- Number the nodes and elements
- Write the shape functions for the element (you can refer to the lecture or the book for this)
- Take the derivatives of the shape functions with respect to x
- Compute the entries of the stiffness matrix for the quadratic element
- Assemble the system of equations
- Partition and solve
- Plot the solution, i.e. the function $u^h = \sum N_i(x)u_i$ where the $N_i(x)$ are the shape functions and the u_i are the values of the displacements at the nodes that you just solved for
- Plot the stress $E\ du(x)/dx$
- How does this compare to the analytical solution?