Assignment 06: Solving system of linear equations
Assigned: 3rd December 2019
Due: 9th December 2019 at 5 PM

Note: Please upload your solution as an ipynb file to the Canvas page.

The purpose of this assignment is to introduce you to computer methods for solving systems of

simultaneous linear equations. You will perform hand calculations that solves the equations using Gauss Elimination and Gauss-Seidel iterative approach and then and write a computer program that does the same.

1. Given the system of equations $Ax = b$, as defined below:

$$\begin{bmatrix} 8 & 2 & 3 \\ 2 & 5 & 1 \\ -3 & 1 & 6 \end{bmatrix} \quad \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \quad \begin{bmatrix} 51 \\ 23 \\ 20 \end{bmatrix}$$

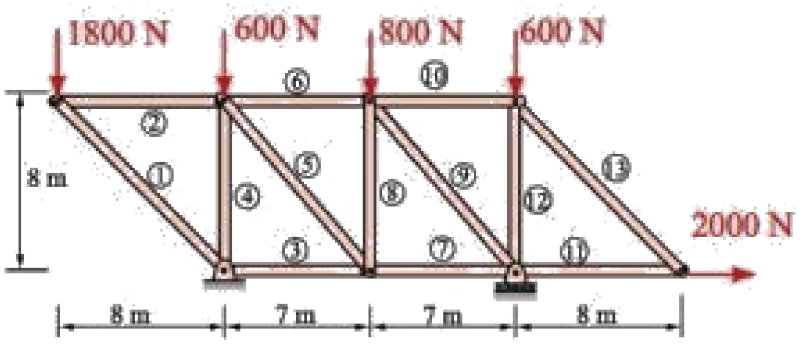
   (a) Determine the solution by hand using Gauss Elimination

   (b) Write a Python code for Gauss Elimination to solve the above equation

   (c) Use the '`numpy.linalg.solve`' library function to solve

   (d) Carry out three iterations of the Gauss-Seidel method, assuming an initial values of x equal to zero. After the third iteration, compute the error for each estimate with relative to the true values from '`numpy.linalg.solve`'

2. Solve the axial forces F_i for the following truss with pin-joints and 13 members. The resulting system of 13 equations is:



$$
\begin{aligned}
F_2 + 0.707F_1 &= 0 \\
F_3 - 0.707F_1 - 2000 &= 0 \\
0.707F_1 + F_4 + 6229 &= 0 \\
-F_2 + 0.659F_5 + F_6 &= 0 \\
-F_4 - 0.753F_5 - 600 &= 0 \\
-F_3 - 0.659F_5 + F_7 &= 0 \\
F_8 + 0.753F_5 &= 0 \\
-F_6 + 0.659F_9 + F_{10} &= 0 \\
-F_8 - 0.753F_9 - 800 &= 0 \\
-F_7 - 0.659F_9 + F_{11} &= 0 \\
F_{12} + 0.753F_9 - 2429 &= 0 \\
-F_{10} + 0.707F_{13} &= 0 \\
-F_{12} - 0.7071F_{13} - 600 &= 0
\end{aligned}
$$

(a) Solve this system of equations using the solve function in the linalg package from numpy.

(b) Solve this system of equations using your Gauss-Seidel user defined function using initial values of F equal to zero. Explain what is happening when you try to solve this problem using Gauss-Seidel.