ME 2450 Assignment 04

Name: _____

Due: February 21, 2019 before midnight

Collaborators: _____

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I declare that the assignment here submitted is original except for source material explicitly acknowledged.

I also acknowledge that I am aware of University policy and regulations on honesty in academic work, and of the disciplinary guidelines and procedures applicable to breaches of such policy and regulations, as contained in the University website.

Name	Date
Signature	Student ID

Score

Exercise Graded:	
Presentation:	/2
Technical Content:	/8
Total:	/10

Exercise 1

(3 pts.) Solve the following system of equations by LU decomposition:

$$\begin{aligned} 8x_1 + 4x_2 - x_3 &= 11 \\ -2x_1 + 5x_2 + x_3 &= 4 \\ 2x_1 - x_2 + 6x_3 &= 7 \end{aligned}$$

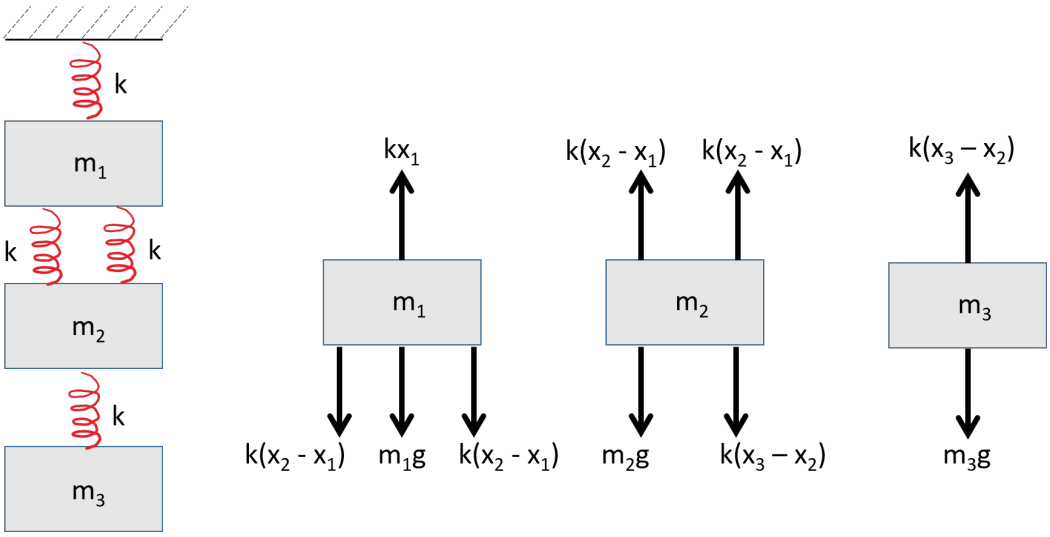
a) by hand

b) using a python or matlab script that you write.

c) Make a statement about verification based on the results of (a) and (b).

Exercise 2

(3 pts.) Use LU decomposition to solve for the displacement of each mass in the illustration. Let $k = 10\frac{kg}{s^2}$ and $g = 9.81\frac{m}{s^2}$



a) Write a system equations for the illustrated system of masses and springs. Hint: by summing forces in the vertical direction for each mass, m_i (where $i = 1...3$), a system of 3 equations (force balance) and 3 unknowns (displacement of each mass) will result. In the terms used in class, $Ax = b$, the coefficient matrix, A, will consist of the spring constants, k, and the right hand side column vector, b, will consist of the external forces, $m_i g$.

b) Use the LU decomposition script written in Exercise 1 to solve for the 3 unknown displacements. Use $m_1 = 2kg$, $m_2 = 3kg$, and $m_3 = 2.5kg$.

c) Using the same L and U matrices from part (b), solve for the displacements if the masses are changed to $m_1 = 4kg$, $m_2 = 6kg$, and $m_3 = 5kg$.

Exercise 3

(2 pts.) Use the Gauss-Seidel method to solve the following system until the approximate relative error falls below $\epsilon_A = .0005$. If necessary, rearrange the equations to achieve convergence.

$$\begin{aligned} -3x_1 + x_2 + 12x_3 &= 50 \\ 6x_1 - x_2 - x_3 &= 3 \\ 6x_1 + 9x_2 + x_3 &= 40 \end{aligned}$$

a) using a built-in function in matlab (linsolve) or python (numpy.linalg.solve)

b) using a python or matlab script that you write.