

Programming Exercise and Assignment: 1

This is a MATLAB/Octave programming exercise. Submit your solutions as a single zip file with the name <Roll_No>.zip on Moodle.

1. **Gauss elimination:** Write a code to take a matrix A as input, and print the following as output:
 - a. Row echelon form of matrix
 - b. Elementary matrices used in each step
 - c. Rank of the given matrix

Note that you are not to use any of the internal commands for the above steps. Then use the [*timeit*](#) function to compare the time to generate the row reduced echelon form against the builtin command [*rref*](#) for the A matrix in 2.d.

2. **Geometry of linear equations:** Graphically generate the row images and column images of the following set of linear equations. Identify and describe the nature of solutions.
 - a. $u + v + w = 2$; $u + 2v + 3w = 1$; $v + 2w = 0$
 - b. $x + y + z = 2$; $x + 2y + z = 3$; $2x + 3y + 2z = 5$
 - c. $x + y + z = 2$; $x + 2y + z = 3$; $2x + 3y + 2z = 9$
 - d. $x + y + z = 2$; $x + 2y + z = 3$; $2x + 9y + 5z = 12$

Find the row reduced echelon form of each system using the code from previous steps and correlate with the nature of solutions.

3. **Back substitution:** Take in any $n \times n$ system of equations $\mathbf{Ax}=\mathbf{b}$ as input with the last column of the input being the output $[\mathbf{A} \mid \mathbf{b}]$. Augment the code from part 1 to generate the row echelon form, with a n algorithm for back substitution to find \mathbf{x} . Using *timeit* compare the time to generate the solutions for the system in 2.d against the inbuilt solution method. You can solve the system of equations directly in Matlab using *inv(A)*b* or using the [**](#) operator.