MA227 (Assignment-1)

1. The `backslash` (\) is Direct Solver for linear systems in MATLAB. The command $x = A\backslash b$ returns the solution of $Ax = b$, if A is square and solution exists. On the other hand, if A is rectangular then $x = A\backslash b$ returns a best possible solution (Least square solution - we will read it in MA220 - wait till the next week). If A is square, then `backslash` find a solution by using **elimination with partial pivoting**. Write a M-file *L1Q1.m* to execute the following steps:

   - Using a `for loop`, solve $Ax = b$ for 10 square matrices with sizes increasing from 500 to 1000 in steps of 50 (May use the in-built `rand(n,n)` to generate $n \times n$ matrices for $n = 500 : 50 : 1000$.)

   - Using `tic - tok`, find the time used by the solver `backslash` to find solution of the systems in the previous step and write the data in a excel file *L1Q1.xlsx* directly from MATLAB.

   - Repeat the above steps for finding solution of the systems by `inv(A)*b`.

   - Read the data from *L1Q1.xlsx* file and plot the time taken by both of the commands and use different color and proper legends to distinguish the curves.

2. Write a function *FdSubs.m* that takes matrix L and vector b, and returns the solution of $Lx = b$. Here L is a lower triangular matrix with $L(i, i) \neq 0$.

3. Write a function *BdSubs.m* that takes matrix U and vector b, and returns the solution of $Ux = b$. Here U is an upper triangular matrix and $U(i, i) \neq 0$.

4. Write a function *luSelfnP.m* that takes an invertible matrix A, and returns L and U such that $A = LU$. Do not use any pivoting. All the notations are the same as used in MA220. Take $n = 8$, $x = [2 - 1\,zeros(1, n - 2)]$ and $A = toeplitz(x)$. Then find $A = LU$ by using *luSelfnP.m* and solve the system $Ab = b$, where $b = ones(1, 8)$, by using *FdSubs.m* and *BdSubs.m*.