Numerical Methods
MATH 417 - 501
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First Name: _____ **Last Name:** _____

Homework 6

Exercise 1 50% (MATLAB)

Replace the symbols X in the matlab code below to solve the linear system

$$Ax = b$$

when A is tri-diagonal, i.e. the coefficients satisfy $a_{ij} = 0$ whenever $|i - j| > 1$.

```
%%%% GaussTri %%%%
%% Input:  tridiagonal square matrix A (not checked)
%%         vector b of corresponding size (not checked)
%% Output: solution to Ax=b

function  x=GaussTri(A,b)

N=size(A,1);

for i=1:N-1
        %multiply the ith row by pivot
        p=1/A(i,i);
        A(i,X) = p*A(i,X);
        b(i) = p*b(i);

        % eliminate the ith column
        A(i+1,i+1)=A(i+1,i+1)-X;
        b(i+1) = b(i+1)-A(X,X)*b(i);
end

%last step
p = 1/A(N,N);
b(N)=p*b(N);

%once the matrix is upper triangular (with one on the diagonal)
%solve (the solution is stored in b)
for i=N-1:-1:1
         b(i)=b(i)-A(i,i+1)*b(i+1);
end

x=b;
%%%% END %%%%
```

Test your routine with

```
A=gallery('tridiag',50,-1,2,-1);
b=[1:50].';
```

Exercise 2 **50% (MATLAB)**

The matlab code below is an implementation of the Gaussian elimination algorithm to solve the linear system

$$Ax = b.$$

As we shall see in class, it may happen that the algorithm find a vanishing (or small) pivot. To cope with this issue, at the begining of the first for loop, it is necessary to flip the ith row with the jth row such that $j \geqslant i$ and $|a_{ji}| = \max_{k \geqslant i} |a_{ki}|$. This is called partial pivoting. Modify the Gaussian algorithm below to invlude partial pivoting. Test your routine with

```
A=[0,1,3;5,2,3;6,8,1];
b=[1;4;1];
```

```
%%%% Gauss %%%%
%% Input:    Square matrix A (not checked)
%%           vector b of corresponding size (not checked)
%%
%% Output: solution to Ax=b
function  x=Gauss(A,b)

N=size(A,1);

for i=1:N-1
    % multiply ith row by pivot
    p=1/A(i,i);
    for j=i+1:N
        A(i,j) = p*A(i,j);
    end
    b(i) = p*b(i);

    % eliminate the ith column
    for k=i+1:N
        for j=i+1:N
            A(k,j)=A(k,j)-A(k,i)*A(i,j);
        end
        b(k) = b(k)-A(k,i)*b(i);
    end
end

% last row
p = 1/A(N,N);
b(N)=p*b(N);

% solve for x
for i=N-1:-1:1
    for j=i+1:N
      b(i) = b(i) - A(i,j)*b(j);
     end
 end

 x=b;
 %%% END %%%
```