GPH 503: Homework 3

This week's homework is computational. You should both hand in a paper version of your program and also e-mail it to me. Make sure that your code works fine by testing it with some matrices that you have already solved.

Question1 (*50 pts*): LU Factorization Code for Square Matrices without Row Exchange

I want you to write an LU decomposition program in Matlab for square matrices (n×n) where row exchange is not necessary (that is no pivot is 0). Here are some hints and requirements for your matlab code.

1. You should write comments for every procedure. Make sure that your code is well indexed (see below). Otherwise it will be hard for me to follow and bad programming practice for you.
2. This should be a Matlab Function called *slu* (don't name it *lu* because matlab already has a program called **lu**):
3. Your program should be a function in Matlab. So your filename should be slu.m (.m is standard for matlab scripts or functions). In order to be a function you should start with
   ```
   function [L,U]=slu=slu(A)
   ```
   where A is the input square matrix. Always write what a program does using matlab comment (%) so that it
4. First step is to determine the size of the matrix. Use size command to obtain the size of a matrix.
   ```
   [n,m]=size(A)
   ```
5. Then if n is not equal to m end the program. If n=m continue
6. So your code should look like this

```
function [L,U]=slu=slu(A)
%LU factorization of square matrices
%with no row exchange
[n,n]=size(A) %determine the size of A
Tol=1.e-6 %tolerance level for zero

for k=1:n  %loop over pivots of A
    if(A(k,k) < tol) %check for pivot
        disp('cannot proceed without row exchange')
    end      %cannot proceed without row exchange
    L(k,k)=1;
    for i=k+1:n   %loop over each line to determine l_{ik}
            determine l_{ik}

        for j=k:n  start from row k+1 and col. k
            remove (pivot row×Lik) from each row of A
        end

        for j=k:n
            write the pivot line to Ubecause pivot is fixed
        end
    end
end
```

Question2(*50 pts*): Solving matrix equation using LU

Next step is to solve the equation using substitution. So you will need to do the standard procedure for LU. First step is to solve Ly=b. And next is to solve Ux=y. For Ly=b you need to go from top to bottom, but for Ux=y you need to go from bottom x_n to x_1. This function will use slu function so you need to be on the same directory. Name your file "luslv.m".

Function x=luslv(A,b)
%Solve Ax=b using L&U from slu(A)
%No row exchanges

```
[L,U]=slu(A) %first decompose A to LU
```

First do a for loop from k=1:n and another for loop for j=1:k-1 and sum the contributions to b(k) from y_{k-1}, y_{k-2}...y_1.

Then y(k)=b(k)-s %forward elim. To solve Ly=b

Then solve Ux=y. You need to start from n and go to 1. In matlab you can do it

for k=n:-1:1 %go backwards from n to 1

    Sum up contributions from x_{k+1}, x_{k+2}...x_n.

  Remove the sum from y(k) and divide by the pivot