In-Class Lab 1

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1. Solve Linear Systems in MATLAB:

Consider the linear system $Ax = b$ as follows Use backslash and **bslashtx.m** to solve the linear system. Compare the computational time.

```
% Using backslash
A = [1 2 3; 2 4 5; 3 5 6];
b = [2; 3; 4];
tic;% Start timer
x = A\b
elapsedTime = toc; % Stop timer and get elapsed time
disp(['Elapsed time: ', num2str(elapsedTime), ' seconds']);

% Using bslashtx.m
tic;% Start timer
x = bslashtx(A,b)
elapsedTime = toc; % Stop timer and get elapsed time
disp(['Elapsed time: ', num2str(elapsedTime), ' seconds']);
```

```
x =

    1.0000
   -1.0000
    1.0000

Elapsed time: 0.0003417 seconds

x =

    1.0000
   -1.0000
    1.0000

Elapsed time: 0.0003357 seconds
```

2. Understand partial pivoting:

Use **lutx.m** for A in Ex.1 to find $L, U,$ and P.

```
[L,U,p] = lutx(A)
```

```
L =

    1.0000         0         0
    0.6667    1.0000         0
    0.3333    0.5000    1.0000


U =

    3.0000    5.0000    6.0000
         0    0.6667    1.0000
         0         0    0.5000


p =

     3
     2
     1
```

3. Special Matrices:

I. Strictly diagonal dominant matrix: Use **lutx.m** to find $L, U,$ and P for A

```
A = [6 2 3; 2 8 5; 3 5 10];
[L,U,p] = lutx(A)

% II. Symmetric positive definite matrix:
% Use *chol* to find $R$ for $A$
R = chol(A)

% III. Banded matrix:
% a) Please use diag to generate a diagonal matrix with the diagonal
% elements from 1 to 10.
D = diag(1:10)

% b) Please generate a tri-diagonal matrix of size $10 \times 10$ with
% the diagonal elements of 2 and the super- and sub-diagonal elements of
% 1 via the following command
%       T = diag(a,-1)  + diag(b,0) + diag(c,1)
T = diag(ones(9,1),-1) + diag(2*ones(10,1),0) + diag(ones(9,1),1)

% c) Solve $TX = d$, where $d$ is a column vector whose elements are
% from 1 to 10.
% Please note $d$ is a column vector
d = (1:10)'
tic;
X = T\d % use backslash to solve it
elapsedTime = toc; % Stop timer and get elapsed time
disp(['Elapsed time: ', num2str(elapsedTime), ' seconds']);
```

```
% d) Please use *tridisolve.m*to solve the above tridiagonal linear system.
a = ones(10,1);
b = 2*ones(10,1);
c = a;
tic;
x = tridisolve(a,b,c,d)
elapsedTime = toc; % Stop timer and get elapsed time
disp(['Elapsed time: ', num2str(elapsedTime), ' seconds']);
```

```
L =

    1.0000         0         0
    0.3333    1.0000         0
    0.5000    0.5455    1.0000


U =

    6.0000    2.0000    3.0000
         0    7.3333    4.0000
         0         0    6.3182


p =

     1
     2
     3


R =

    2.4495    0.8165    1.2247
         0    2.7080    1.4771
         0         0    2.5136


D =

     1     0     0     0     0     0     0     0     0     0
     0     2     0     0     0     0     0     0     0     0
     0     0     3     0     0     0     0     0     0     0
     0     0     0     4     0     0     0     0     0     0
     0     0     0     0     5     0     0     0     0     0
     0     0     0     0     0     6     0     0     0     0
     0     0     0     0     0     0     7     0     0     0
     0     0     0     0     0     0     0     8     0     0
     0     0     0     0     0     0     0     0     9     0
     0     0     0     0     0     0     0     0     0    10


T =
```

```
     2     1     0     0     0     0     0     0     0     0
     1     2     1     0     0     0     0     0     0     0
     0     1     2     1     0     0     0     0     0     0
     0     0     1     2     1     0     0     0     0     0
     0     0     0     1     2     1     0     0     0     0
     0     0     0     0     1     2     1     0     0     0
     0     0     0     0     0     1     2     1     0     0
     0     0     0     0     0     0     1     2     1     0
     0     0     0     0     0     0     0     1     2     1
     0     0     0     0     0     0     0     0     1     2


d =

     1
     2
     3
     4
     5
     6
     7
     8
     9
    10


X =

   -0.0000
    1.0000
   -0.0000
    2.0000
   -0.0000
    3.0000
         0
    4.0000
         0
    5.0000

Elapsed time: 0.0001236 seconds

x =

   -0.0000
    1.0000
   -0.0000
    2.0000
   -0.0000
    3.0000
         0
    4.0000
         0
    5.0000
```

```
Elapsed time: 0.0001764 seconds
```

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